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MULTI-AGENCY PARTNERSHIPS IN WEST AFRICAN AGRICULTURE:

A REVIEW AND DESCRIPTION OF RICE PRODUCTION SYSTEMS IN NIGERIA

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TABLE OF CONTENTS

TABLE OF CONTENTS ..... **I**
TABLES ..... **II**
BOXES ..... **III**
ACRONYMS ..... **III**
EXECUTIVE SUMMARY ..... **IV**
1. GENERAL INTRODUCTION **1**
1.1 Overview of Nigeria Report on rice systems 1
1.2 Background on the concept of M-APs and Nigeria 2
1.3 Rice production in the world and in West Africa 2
1.4 Rice production in Nigeria 3
1.5 Rice imports 7
1.6 Summary 8
2. RICE TYPES AND SPECIES **8**
2.1 History of rice types in Nigeria 8
2.2 Summary 10
3. RICE SYSTEMS AGRONOMY AND THEIR GEOGRAPHY **10**
3.1 Introduction 10
3.2 Upland Rice 10
3.1.1 Rainfed Upland Rice 11
3.1.2 Irrigated Upland Rice 11
3.2 Hydromorphic Rice 11
3.3 Rainfed Lowland Rice 12
3.4 Irrigated Lowland Rice 13
3.5 Deep Inland Water Rice 13
3.6 Mangrove Swamp Rice 14
3.7 Geographical distribution of rice in Nigeria 14
3.8 Other rice cultivation practices by smallholder farmers 19
3.8.1 Intercropping 19
3.8.2 Fish synergy 20
3.9 Situation report on large-scale vs. small-scale production 20
3.10 Land preparation and animal traction 21
3.11 Summary 22
4. PROCESSING AND MARKETING **22**
4.1 Introduction 22
4.2 Rice milling 22
4.3 Rice marketing 23
4.4 Interplay of factors on output of processed rice 24
4.5 Summary 25
5. INSTITUTIONAL STRUCTURES **25**
5.1 Government policies 25
5.2 Research systems 26
5.3 Extension and diffusion of new technologies 27
5.3.1 Formal 27
5.3.2 Informal 28
5.4 Rice schemes 29
5.5 NGOs 31
5.6 Summary 32
6. CONSTRAINT ANALYSIS **32**
6.1 Policy inconsistency/instability 32
6.2 Fluctuations in value of Naira 33

6.3 Seed systems....34
6.3.1 Formal seed systems....34
6.3.2 Informal seed systems....37
6.4 Agronomic constraints....38
6.4.1 Diseases....38
6.4.2 Pests....38
6.4.3 Climate....38
6.4.4 Water regime....39
6.4.5 Weeds....39
6.4.6 Input supply....39
6.4.7 Farmers' responses to some constraints....40
6.5 Summary....40
7. WHAT IS TO BE DONE?....41
7.1 Government policy....41
7.2 Research focus....41
7.3 Extension....42
7.4 Private sector seed supply....42
7.5 Rice cleaning technology....42
7.6 NGOs/CBOs and the M-APs concept....43
8. CONCLUSIONS....43
REFERENCES....44
APPENDIX 1 - EXTENSION GUIDE, GROWING UPLAND RICE IN NIGERIA....48
APPENDIX 2 - GROWING SWAMP/IRRIGATED LOWLAND RICE IN NIGERIA....49
APPENDIX 3 – RESOLUTIONS OF THE M-APS' INCEPTION WORKSHOP, JOS, 21-22 MARCH 2000....50

TABLES

Table 1. Wetlands in West Africa....3
Table 2. Guide for State names in Nigeria, 1986-2001....4
Table 3. 1986/96 Estimates for actual and potential rice production*....5
Table 4. Rice imports and local production in Nigeria, 1980-1997....7
Table 5. Comparison of local and modern rice varieties of Sokoto-Rima Valley....9
Table 6. Summary of rice systems....10
Table 7. Some Characteristics of Rice Growing Environments in Nigeria....14
Table 8. Rice growing systems in the North-east zone....15
Table 9. Rice growing systems in the North-west zone....16
Table 10. Rice growing systems in the North-central zone....16
Table 11. Rice growing systems in the South-east zone....17
Table 12. Rice growing systems in the South-west zone....18
Table 13. Rice growing systems in the South-south zone....18
Table 14. River Basin Development Authorities (RBDAs)....29
Table 15. Rice Schemes in Nigeria....30
Table 16. Value of Naira to 1US$....34
Table 17. Agronomic characteristics of released rice varieties in Nigeria....34
Table 18. Varietal preference in Year 2000....36
Table 19. Certified seed production by the ADPs in 1999....37

BOXES

Box 1. Ganawuri green manure rice production system 13
Box 2. Success story of the adoption of an unofficial variety 28
Box 3. A successful NGO agricultural development project 31

ACRONYMS

ADP	Agricultural Development Programme/Project
BPG	Best Practice Guidelines
CBDD	Capacity-Building for Decentralised Development
CBO	Community-Based Organisation
DFID	Department for International Development
EDO	Eco-systems Development Organisation
FO	Farmers' Organisation
GNP	Gross National Product
GO	Government Organisation
GoN	Government of Nigeria
IBRD	International Bank for Reconstruction and Development
IFAD	International Fund for Agricultural Development
IKS	Indigenous Knowledge System
IVC	Inland Valley Consortium
M-APs	Multi-Agency Partnerships
MLAs	Multi-Lateral Agencies
NARS	National Agricultural Research System
NERICA	New Rice for Africa
NCRI	National Cereal Research Institute
NGO	Non-Governmental Organisation
NFDP	National Fadama Development Programme
ODI	Overseas Development Institute
PAP	Poverty Alleviation Programme
RNR	Renewable Natural Resources
RNRKS	Renewable Natural Resource Knowledge Strategy
RRI	Regional Research Institutions
SEM	Socio-economic methodologies (component of RNRKS)
WARDA	West African Rice Development Association
Winrock	Winrock International Institute for Agricultural Development
WNAD	West and North Africa Division

EXECUTIVE SUMMARY

- In Nigeria rice (grown on 1.77 million ha) ranks sixth after sorghum (4.0 million ha), millet (3.5 million ha), cowpea (2.0 million ha), cassava (2.0 million ha) and yam (2.0 million ha), but if placed on a social scale, it can as well be ranked first because it is no longer just a mere festival meal, but the staple of most homes in urban and rural areas.

- A worrisome phenomenon with rice production data in Nigeria is that, most of it is based on re-cycled information from ADPs rather than formal research. A true picture of the rice enterprise in Nigeria is therefore hard to come by. The ADP data are based on large-scale production. However, on the ground, there are hardly any large-scale rice farmers in Nigeria. Rice producers are smallholder farmers who are left entirely on their own to keep the sub-sector afloat against so many odds.

- Since rice can grow in every ecological zone, Nigeria has such a tremendous potential for its production. This can be easily demonstrated. Some rice growing systems like upland hill have arisen as a result of smallholder farmers searching for more land to cultivate rice. In the light of a viable rice culture (even amongst communities which have only marginal land for rice cultivation due to socio-economic factors) and availability of appropriate varieties, the crop illustrates that adoption of technologies will be faster if the key factors for each community can be identified.

- The collapse in formal extension due to lack of funding to ADPs through World Bank loans and other sources is a major constraint in bringing about technical change in agriculture. Rice cultivation will suffer most because the urban elite can easily put pressure on government to fill the gap with imports of cheap rice.

- The threat to local rice production by imported cheap rice is real, but farmers are consistent in their response that local rice with good milling characteristics actually attract better prices. The promotion of appropriate processing technology and varieties will go a long way in keeping rice farmers in business, given the huge national and sub-regional markets.

- Farmers are still growing varieties which were released several years ago because they attract good prices. However, the NARS consider such varieties as unprofitable given their low yields. It will therefore make sense for such materials to be improved and re-released, the hybridisation programme at WARDA notwithstanding.

- Many smallholder farmers are unable to part with the rice cultivation vocation even when government policies and incentives to cheaply produce the commodity are lacking. There seems to be no solution in sight concerning the neglect rice production has suffered since the days of Structural Adjustments (SAP) of 1986. In 1998 the World Bank provided a paltry loan facility of $3.0 million for a Special Rice Project as compared to the whooping sum of $300.0 million it provided in 1999 for a National Fadama Development Programme for horticultural crops.

- M-APs offers an alternative theoretical framework to proffer practical solutions to bringing the gap between research and extension to bring benefits of both rapidly to smallholder farmers. M-APs is an ideal that is attainable, provided much funds can be found for capacity building in NGOs, GOs, FOs and CBOs; re-orientation of NARS and NSS; motivating private seed companies to see the seed sub-sector as a viable enterprise; and re-defining the modes of operations of the linkages between NAERLS, ADPs, NGOs and RRIs.

- As a first step towards forging partnerships through M-APs, all its perceived components should come together to create a forum for informal exchange of ideas on rice production through activities like new rice festivals, rice planting festivals, celebration of release of new varieties and so on. This will go a long way in bringing together, people of diverse backgrounds to an informal but effective learning

environment; very different from a professional Rice Society. An NGO can co-ordinate it at the initial stages.

- As a further step, an annual National workshop can be organised for stakeholders to articulate ideas on rice cultivation. Knowledge systems must also develop to reflect new conditions. For instance, one agricultural system that has been identified as underperforming throughout Nigeria is Inland Valley Bottoms or fadamas. These are naturally flooded areas suitable for rice, cocoyams and sometimes horticultural products. Until recently, many of these were unused even in dryland areas and those in use exhibited only limited productivity. However, there are pockets of areas where that system is over exploited, given the unique socio-economic factors prevalent in communities with success stories of full exploitation. The green manuring system at Ganawuri, near Jos in central Nigeria has developed to the level of an indigenous technology which holds good prospects for adoption by other smallholder farming communities.

- A farmer demand-led extension system to be spearheaded by NGOs, CBOs, FOs, MLAs and the private sector should be designed, tested and put in place by a technical task force of stakeholders as the next logical step in building sustainable partnerships through M-APs. This should be done using true participatory mechanisms and the bottom-up approach. The rationale for a new approach to extension is the collapse of the formal system and its inability to function as a midwife between research and farmers.

1. General introduction

1.1 Overview of Nigeria Report on rice systems

This review[1] is the first part of a DFID-funded research project on how the concept of Multi-Agency Partnerships (M-APs) can be implemented in West Africa to bring about increased crop output through the rapid adoption of improved seeds and similar technologies or innovations; techniques; production, processing, storage and handling implements etc. Three countries namely Mali, Ghana and Nigeria were selected for the research. A key aim of M-APs is to effectively bridge the gap between dissemination of research findings to farmers and the feedback mechanism so that research and extension services are seen to be meeting true needs of farmers. The second part will be a Case Study Report on what farmers themselves are saying. To state that rice production in Nigeria is plagued by problems seems to be an understatement. Yields have been consistently low on farmers' fields in the face of ever increasing cost of inputs as fertilisers, tractorisation, herbicides, insecticides, manual labour and transportation of produce. It is not uncommon for adulterated chemical inputs find their way into the local market and even official farm service centres and are still sold to farmers at very high costs. A good use of inputs will make it impossible for farmers to break-even in production. WARDA is spearheading research on finding low-input varieties, even when such a technology becomes available, no formal extension system exists for its rapid dissemination to farmers. These are issues raised in this report. An increase in area under rice cultivation without a corresponding increase in yield is an indictment of the NARS and NAERLS.

The review is divided into eight chapters. A summary or conclusion is provided at the end of each chapter. However, the summaries are written in a style which seeks to blend the main point of the chapter to how M-APs may address the issues raised. The Executive Summary gives policy options which may be drawn from the Review. Chapter 1 introduces the concept of Multi-Agency Partnerships and looks at rice production realities in Nigeria. The impact of rice imports is also addressed and the fact that rice imports is never a concern to farmers themselves but only to the elite. Chapter 2 describes rice types which may be found in Nigeria. It is noted that Asian rice is more important in Nigeria than African rice. However, apart from the value of African rice to bio-technology research, the cultural practice of harvesting it from the canoe as in the Sokoto-Rima basin can be explored as an extension strategy to launch new varieties and other rice technologies. Chapter 3 is a detailed description of rice systems in Nigeria and according to geo-political zones and the contribution of each system to national rice supply. It looks also at cultivation practices by smallholder farmers which are not rice system specific. Chapter 4 discusses critical factors which must be considered in policy formulation on rice processing and marketing. Chapter 5 takes a look at the state and readiness of all institutions relevant to rice production in Nigeria. A dismal failure of both formal research and extension systems to foster dissemination of technology to farmers with rapid feedback has been noted. Chapter 6 looks at constraints which must be alleviated for a robust rice sector to become a reality in Nigeria. Chapter 7 summarises what can be done for rice production to be enhanced and how M-APs might work in Nigeria. Some conclusions for the entire Report are drawn in chapter 8. A major conclusion is that the breakdown in formal extension and seed systems actually provide an ideal for a take off of M-APs from zero level.

This Report is both a literature review and a description of the rice systems of Nigeria. Juo and Lowe (1986) is still the principal text on rice production in Nigeria. Two journal articles by Singh et al. (1997) and Imolehin & Wada (2000) are excellent recent overviews which will also be quoted extensively. This Report is the only comprehensive overview on rice production in Nigeria from a multi-faceted perspective. All those who have a stake in rice development in Nigeria should find this Report fresh, informative, thought provoking and a useful tool in policy formulation and implementation. My experience as a Plateau state Agricultural Officer who co-ordinated the Federal Department of Agriculture funded National Accelerated Food Production Project (NAFPP) and Agro-Service Systems have been brought to bear in addition to what

[1] This version was edited by Roger Blench of ODI. It should be read in conjunction with the report on the field survey.

may be found in the literature. The report has also benefited immensely from field observations during the reconnaissance survey in the course of administering farmers' questionnaires under this M-APs project. The fieldwork for the national survey and visits to agricultural libraries at Zaria, Badeggi and Ibadan were undertaken during the period September - November 2000 and February - April, 2001.

1.2 Background on the concept of M-APs and Nigeria

M-APs is conceptualised as a structure where Government organisations (GOs), Multi-lateral agencies (MLAs), Non-governmental organisations (NGOs) and Farmers' organisations (FOs) are in viable, functional and healthy relationships generating positive synergy to bring about technical change in agriculture. No single category of agency could in itself manage agricultural research and extension, if promotion of modern methods in agriculture is to be effective at the local level. In Nigeria, this realisation has led to creating an apex organisation with full autonomy to foster liaison between agricultural research and extension with the establishment of the National Agricultural Extension Research and Liaison Services (NAERLS) at Zaria. However, in practice, there has been limited liaison between the research institutes, Agricultural Development Projects (ADPs), NGOs and NAERLS.

Case studies on M-APs have been carried out in countries like Gambia, Zambia, Senegal, Mali, Kenya etc. with varying degree of success. Participation, rapid feedback, inter-dependence and true partnerships are the hallmark of an idealised M-APs. Experiences indicate that greater success in diffusing technologies and in fostering sustainable development can be achieved if farmers actively help to diagnose local problems and participate in developing and adapting new technologies. This requires participatory modes of research and development in which decisions are made in accordance with local resources and needs, as well as fora where their views can be articulated and immediate feedback received.

The economy of Nigeria has long been dominated by trade in crude oil and agriculture has been neglected by successive governments since 1966. Production had largely stagnant despite the huge injection of capital through World Bank loans and myriad of programmes now largely defunct. These include Operation Feed the Nation (OFN, 1976), National Accelerated Food Production Project (NAFPP, 1975), Green Revolution (1979), Back to Land (1984), Directorates for Food Roads and Rural Infrastructures (DFRRI, 1985), Better Life for Rural Women (1986), National Agricultural Land Development Authority (NALDA, 1992), Family Economic Advancement Programme (FEAP, 1994) and National Agricultural Research Project (NARP, 1995). The Special Rice Project (SRP, 1998) and National Fadama Development Project (NFDP, 1999) are still existing due to a huge injection of funds from the World Bank. Part of the problem may be attributed to managerial and infrastructural failure, as well as to the endemic instability in policy implementation due to frequent change in governments. In addition, agricultural inputs have continued to be very expensive and thus unavailable to farmers even in the current democratic dispensation. Part of the challenge of development is thus to deliver improved agricultural technologies to farmers, technologies that address both uncertain climatic conditions, limited extension resources and low or absent inputs.

Can M-APs bring about this perceived change? Is Nigeria at the stage where M-APs can be successfully implemented? This Report addresses some of the parameters that are crucial to fostering linkages between stakeholders in rice production. The outcome will not only contribute to the debate on technology dissemination, but a Best Practices Guideline (BPG) if need be, may be produced for policy makers and other stakeholders.

1.3 Rice production in the world and in West Africa

Rice is a major commodity in world trade. Rice has become the second most important cereal in the world after wheat in terms of production, due to a recent decline in maize production (Jones, 1995). It is widely cultivated throughout the tropics; and where flood controls are effective as in South-east Asia, production is

high. Much of the foreign rice imported into West Africa is from South-east Asia. In Sub-Saharan Africa, West Africa is the leading producer and consumer of rice (WARDA, 1996). West Africa accounts for 64.2% and 61.9% of total rice production and consumption in Sub-Saharan Africa respectively. Except for Burkina Faso and Niger, rice is a staple crop throughout West Africa, especially in Côte d'Ivoire, the Gambia, Guinea, Guinea Bissau, Liberia, Senegal and Sierra Leone. The River Niger drainage system is a major rice growing environment in the Region. Nigeria has a leading role in rice production in West Africa. Nigeria ranks highest as both the producer and consumer of rice in the Sub-region with figures slightly above 50% (WARDA, 1996). Rice is known to have been grown along the Niger for over 3000 years (Imolehin and Wada, 2000).

The trend for the Region is that the production and consumption of rice is growing faster than for other food staples. The potential for commercial production of rice in West Africa is tremendous. The ricebelts that may be developed in West Africa include wetlands as coastal plains, inland basins, floodplains and inland valley bottoms (Andriesse, 1986). The coastal wetlands as deltas, estuaries, and tidal flats are yet to be fully exploited largely due to non-availability of appropriate technology as in the Niger delta of Nigeria. The estuarine mouth of the Cross River in Nigeria is also yet to be exploited for rice cultivation. The Gambia and the Corubal of Guinea Bissau are good estuaries. Tidal flats (lagoons) occur all the way along the coast from Nigeria to Guinea Bissau. Inland basins in West Africa include the inland deltas of the Niger in Mali and the Lake Chad Basin. The floodplains occur along the Gambia River, the upper, middle, and lower Niger, the Sokoto-Rima, the Black Volta, the Cross River, the Benue and so on. The inland valley bottoms abound in West Africa. These are referred to by different names. In Northern Nigeria it is called *fadama* (Savvides, 1981) and *marigots* in francophone Africa (Kilian and Teissier, 1973); and as inland valley swamps in Sierra Leone (Millington et al., 1985). Andriesse (1986), gave wetland rice potential for West Africa as found in Table 1.

Table 1. Wetlands in West Africa

		Area	
Category	**'000s km^2**	**% of total wetlands**	**% of total area**
Coastal wetlands	165	7	1.5
Inland basins	1075	45	9.0
River floodplains	300	12	2.5
Inland valleys	850	36	7.0
Source: Andriesse (1986)			

Apart from wetlands, the potential for upland rice is huge. It is simply a matter for the farmer to switch over to its cultivation when he senses that the price of rice will be good in that cropping season, provided there is good precipitation and availability of an appropriate variety. Under such conditions the farmer will easily convert from growing conventional upland staples to growing upland rice. Maize is the first choice of an upland crop that may be substituted with rice.

1.4 Rice production in Nigeria

Rice is important in Nigeria for several reasons. It is a major contributor to internal and sub-regional trade. Rice is also the staple for most of the peoples in the Niger-Benue trough which divides Nigeria into three parts, Sokoto-Rima Basin in the north-west, Chad Depression in the north-east, Hadejia-Jamaare trough in the extreme north, and Cross River trough in the south. Farmers find rice more adaptable than a high input staple like maize when there is declining soil fertility because of the huge array of varieties they can switch over to every few years. Since it is becoming a staple crop, farmers seem to be willing to grow it all the time no matter the constraints they are facing.

Rice is one of the crops where the gap between potential and actual production in terms of hectarage is wide as shown in Table 3. Table 2 and Figure 1 clarify any confusion which may arise in using Table 3 and the rest of the Report because states names and sizes are always changing in Nigeria. Figure 1 gives the current set-up of states and their capitals. The rice area for large-scale production has increased tremendously since 1989 (Singh et al., 1997). WARDA (1996) estimated a growth rate of 7.5% to 14.2% from 1983 to 1992. Table 3 demonstrates that growth. Rice cultivation has become important in Nigeria. States like Niger, Ogun, Benue and Lagos which has remained the same since the state creation exercise in 1987, may be used for a quick use of Table 3. However, it is clear that for Lagos, there is actually a decline in rice cultivation. Table 3 reflects only the contribution to rice production by large-scale schemes that the ADPs are involved. Where the schemes have collapsed, smallholder farmers still use the fields. Therefore the figures do not even show the contribution by smallholder farmers. Statistics for that category do not exist. However, their contribution far outweighs large-scale production. No wonder the potential for each state seems to be largely untapped.

Table 2. Guide for State names in Nigeria, 1986-2001

1986	1987	1991	1997	Names and capitals in 2001
FCT	**FCT**	**FCT**	**FCT**	**FCT (Abuja)**
Anambra	Anambra	Anambra and Enugu	Anambra	Anambra (Awka)
			Enugu and Ebonyi	Enugu (Enugu)
				Ebonyi (Abakaliki)
Bauchi	Bauchi	Bauchi	Bauchi and Gombe	Bauchi (Bauchi)
				Gombe (Gombe)
Bendel	Bendel	Edo** and Delta	Edo	Edo (Benin)
			Delta	Delta (Warri)
Benue	Benue	Benue	Benue	Benue (Makurdi)
Borno	Borno	Borno and Yobe	Borno	Borno (Maiduguri)
			Yobe	Yobe (Damaturu)
Cross River	Cross River and Akwa Ibom	Cross River	Cross River	Cross River (Calabar)
		Akwa-Ibom	Akwa-Ibom	Akwa-Ibom (Uyo)
Gongola	Gongola	Adamawa** and Taraba	Adamawa	Adamawa (Yola)
			Taraba	Taraba (Jalingo)
Imo	Imo	Imo And Abia	Imo	Imo (Owerri)
			Abia	Abia (Umuahia)
Kaduna	Kaduna and Katsina	Kaduna	Kaduna	Kaduna (Kaduna)
		Katsina	Katsina	Katsina (Katsina)
Kano	Kano	Kano and Jigawa	Kano	Kano (Kano)
			Jigawa	Jigawa (Dutse)
Kwara	Kwara	Kwara and Kogi	Kwara	Kwara (Ilorin)
			Kogi	Kogi (Lokoja)
Lagos	Lagos	Lagos	Lagos	Lagos (Ijeka-Lagos)
Niger	Niger	Niger	Niger	Niger (Minna)

1986	1987	1991	1997	Names and capitals in 2001
Ogun	Ogun	Ogun	Ogun	Ogun (Abeokuta)
Ondo	Ondo	Ondo	Ondo and Ekiti	Ondo (Akure)
				Ekiti (Ado-Ekiti)
Oyo	Oyo	Oyo and Osun	Oyo	Oyo (Ibadan)
			Osun	Osun (Oshogbo)
Plateau	Plateau	Plateau	Plateau and Nasarawa	Plateau (Jos)
				Nasarawa (Lafia)
Rivers	Rivers	Rivers	Rivers and Bayelsa	Rivers (Port Harcourt)
				Bayelsa (Yenogoa)
Sokoto	Sokoto	Sokoto and Kebbi	Sokoto	
			Kebbi	Kebbi (Birnin Kebbi)
			Sokoto and Zamfara	Sokoto (Sokoto)
				Zamfara (Gusau)
Total: 20*	Total: 23*	Total: 31*	Total: 37*	Total: 37*

* Including Federal Capital Territory (FCT)
** Change in name
Alphabetical arrangement has not been followed.

Table 3. 1986/96 Estimates for actual and potential rice production*

	1986		1996		
State	**Potential Rice Area ('000s ha)**	**Actual Area ('000s ha)**	**State**	**Actual Area ('000 ha)**	**Comments**
FCT	-	2.40		5.00	Increase in production
Anambra	88.88	21.00	Anambra	12.00	Increase in production for sum total due to establishment of ADPs.
			Ebonyi	40.00	
			Enugu	65.00	
Gongola	457.47	56.50	Adamawa	35.00	Increase in production for sum total.
			Taraba	55.00	
Bauchi	332.90	32.41	Bauchi/ Gombe	50.00	Increase in production for sum total.
Benue	255.94	83.97		135.00	Increase in production.
Borno	581.03	52.00	Borno	32.00	Decrease in sum total. In 1996 there was a serious flood in Borno state.
			Yobe	5.00	
Cross River	135.19	17.39	Cross River	40.00	Quadruple increase due to establishment of ADPs.
			Akwa Ibom	40.00	
Bendel	188.44	40.00	Edo	5.00	Decline due to neglect of agricultural section due to increase in crude oil exploitation.

	1986		**1996**		
State	**Potential Rice Area ('000s ha)**	**Actual Area ('000s ha)**	**State**	**Actual Area ('000 ha)**	**Comments**
			Delta	3.00	
Imo	61.03	11.90	Imo	10.00	Only a slight increase.
			Abia	7.00	
Kano	216.34	18.00	Kano	104.00	The figure for Kano actually agrees with the situation on the ground for Jigawa which is in the rice belt. However, there is still a tremendous increase for both states due to ADPs' activities.
			Jigawa	33.00	
Kaduna	351.09	34.97	Kaduna	261.00	Tremendous increase as the sate ADP went statewide.
			Katsina	24.00	
Kwara	334.22	39.54	Kwara	29.00	Increase can be noted.
			Kogi	37.00	
Lagos	16.72	0.73		0.65	The state is far from reaching its 1986 level and its potentials.
Niger	325.06	40.40		209.00	Tremendous growth.
Ogun	83.78	7.00		12.00	Only slight increase.
Ondo	104.76	18.00	Ondo	40.00	The figure for Ondo is not realistic. It fits the situation in Ekiti state. On the whole there is increase due to ADP activities.
			Ekiti	4.50	
Oyo	188.46	10.23	Oyo	3.00	Decline due to lack of interest on the part of farmers.
			Osun	5.00	
Plateau	290.04	35.00	Plateau/ Nasarawa	87.00	Appreciable growth. However, Nasarawa is better noted for rice production than Plateau state. Increase in upland rice production on the Jos Plateau may maintain the tempo.
Rivers	96.73	2.53	Rivers/ Bayelsa	6.00	Increase may be noted.
Sokoto	512.48	26.00	Sokoto/ Zamfara	44.00	Growth is also recorded.
Total	4620.56	500.27		1,575.15	Increase for the whole country is three times but still a far cry from full exploitation.
Adapted from Chaudhary & Nanda, 1986 and WARDA, 1997; and data already corrected even for some states created in 1997.					
*Data collected from ADPs					

Recent estimates by WARDA (1996), Singh et al. (1997) and Imolehin and Wada (2000) put potential areas for rice production and actual as 4.6 - 4.9 million ha and 1.7 million ha respectively. The increase in production is due to an increase in land under rice cultivation and not increase in yield. The difference

between potential and actual yields is also very high. A yield of 4.4-7.2t/ha has been recorded on research farms. However, average rice yields are consistently low and stand at around 1.5t/ha (Ayotade *et al.*, 1986 and Singh *et al.*, 1997). It is a well known fact that most ADPs and River Basins Development Authorities (RBDAs) which were in the forefront of providing rice cultivation facilities and infrastructures are now largely ineffective due to neglect, underfunding and an inefficient bureaucracy. Farmers' yields will continue to be low as long as the agronomic constraints are not properly tackled. However, due to the resilience of smallholder farmers and the demand for rice, production has been maintained.

The Jere Rice Bowl of Borno state in north-eastern Nigeria provides a further example of how rice cultivation is still virile against all odds. This is one of the most notable rice zones in Nigeria. In 1990, the Jere Farmers Development Association - Zabarmari had cause to complain to the state Governor on the release of water thus:

> From time immemorial, rice production at this bowl is dependent on water supplied from the Jere River. The Rice Bowl encompasses some village units comprising over 150,000 hectares with a cultivated area of 37,900 ha which depend on the water from Alau Dam. We are requesting that the water should be released for three months every year from 27th August to 27th November.

During a visit to the area in October of 2000 in the course of M-APs research, farmers were seen still working hard on their rice fields, the frustration of untimely release of the water and their pleas as the one above notwithstanding.

1.5 Rice imports

The debate on rice imports is a topic that is raised at every rice forum. Table 4 gives the trend in rice imports in Nigeria.

Table 4. Rice imports and local production in Nigeria, 1980-1997

Year	Imports ('000 tonnes)	Amount (million US$)	Local production ('000 tonnes)	Comment
1980	450.00	245.0	1090	
1981	657.00	407.5	1241	
1982	539.00	290.1	1250	
1983	544.00	237.8	1280	
1984	365.00	165.0	1300	Rice ban enacted
1985	356.00	94.6	1430	
1986	320.00	80.0	1416	
1987	400.00	92.0	1780	
1988	200.00	55.0	2082	
1989	300.00	80.0	3303	
1990	220.00	60.0	2500	
1991	210.00	60.0	3185	
1992	270.00	78.0	3453	
1993	380.00	99.0	3400	
1994	411.26	109	2427	
1995	374.35	10.24	3293	
1996	2266.64	227.33	3122	Rice ban lifted
1997	6990.54	647.55	-	

Source: Imolehin & Wada, 2000

The ban on rice imports was lifted in 1997. Therefore, foreign rice is found everywhere in urban markets of Nigeria. A close look at Table 4 will reveal that the ban on rice importation or the lack of it, has no impact on local rice production. In the mid-1970s, irrigation schemes were started for local wheat production, but by 1978 most of them had become rice schemes. In 1979 a democratic regime was in place and it liberalised the importation of rice. However, it encouraged local production of rice at the same time through the establishment of more River Basins Development Authorities (RBDAs) under the Green Revolution Programme (Abalu, 1981). This policy led to clearing plenty of virgin land for rice production. In 1984, there was a change in government and rice imports was banned. Since that ban, there has not been any official lifting until 1997.

The main market for imported rice is the urban elite. They prefer it to local rice due to its good quality. It eases the housewife of some of her chores. The urban poor and villagers consume local rice. Since there was a ban on rice imports for over 15 years, smuggling is the main source of imports. There has never been a clampdown on rice smugglers. A third factor which sustains rice imports is the pressure for free trade from World Trade Organisation. Even when there was an official ban on rice imports, foreign rice has always been found in the urban markets because private investors were importing the commodity.

1.6 Summary

M-APs is conceptualised as a development model where stakeholders come together frequently for face to face interaction to enhance rapid adoption of research findings and feedback on field problems. Nigeria is ideal for M-APs to takeoff given the near complete breakdown in the formal system of extension and yet smallholder farmers are producing against all odds. The installing of a democratic government in Nigeria in 1999 is an added advantage. However, it is disturbing that a pragmatic policy to tackle the problem of low yields is yet to be formulated by government. M-APs offers some hope provided bureaucratic bottlenecks can be eliminated and farmers themselves actively participate in the research process and prescriptions. The impact of rice imports is very negligible contrary to expectation.

2. Rice types and species

It is helpful to know what types of rice the farmer is growing. A preference of one type over the other will determine the focus or direction for both formal research and extension.

2.1 History of rice types in Nigeria

Three types of rice are cultivated in Nigeria. These are the African rice, *Oryza glaberrima*; Asian rice, *O. sativa*; and only recently, WARDA's hybrid rice, NERICA available only to farmers under WARDA's PVS programme. According to Jones (1995), the African rice *O. glaberrima* originated from the wild rice *O. barthii* some 3500 years ago and its offspring, domesticated probably in the inland delta area of the Niger from where it spread through the upper Niger valley to the rest of West Africa. African rice is cultivated both as a field crop and a paddy crop. For the Niger-Benue trough, Sokoto-Rima and Chad Basin rice has been in cultivation long enough for a rice culture to have evolved going as far back as 1500 BC (Imolehin and Wada, 2000). Remarkable deepwater varieties of *O. glaberrima* exist which are specific to the unusual flood conditions that occur in the inland Niger Delta; the Sokoto-Rima Valley and other floodplains of the extreme north of Nigeria. It is also a common rice type on the floodplains of the Benue trough. The rice can be harvested, like the weedy wild rice, *O. barthii*, from canoes when the flood has risen, a technique also used by American Indians to harvest *Zizania aquatica*. *O. glaberrima* is known by different local names as *hakorin Montol* (literally, the tooth of Montol people because of its grain size) in the Plateau/Nasarawa area; and *jatau* (red) throughout Hausa land and the Chad Basin. In view of its importance, indigenous African rice is one of the least-known major cereals (Portères, 1976) until only recently when scientists

using biotechnology techniques began to unlock its great genetic potentials (WARDA, 1999a). Table 5 provides more information on the array of local names of ancestral varieties and modern varieties of deep swamp varieties grown in the Sokoto-Rima Basin to illustrate the importance of the two major rice types in Nigeria.

Table 5. Comparison of local and modern rice varieties of Sokoto-Rima Valley

Local varieties	Comments	Modern Varieties	Comments
Kaura	Very resistant to flooding.	FARO 44	Very popular and used as upland too by some farmers.
Danboto		FARO 14	Deep swamp variety, quite popular
Farin irin		FARO 7	-do-
Jan irin		DA 29	In the process of being released by NCRI.
Baki irin		Mai adda	Deep swamp variety in the process of being released. Has very good grain quality.
Yar liman		BKN	In the process of being released.
		IR 54	In the process of being released. Will be as popular as FARO 15 in spite of its shattering disadvantage. It compensates this by its very high yield.
		MAS-2401 and FARO 14	Being phased out by NCRI because of their long duration though yield is good and grain quality, very excellent.
		FARO 36, 37, 27, 29, 15	These are shallow swamp varieties. FARO 15 is an excellent material.

Source: Oral interview with Alhaji Tanko Mohammed, Station Officer, NCRI, Birnin Kebbi

The major rice type grown in Nigeria is the Asian rice *Oryza sativa*. The exact zone of its domestication remains uncertain, although it is certainly South East Asia. Recent studies have suggested that it may have been domesticated twice, once in India and once in China, corresponding to the *indica* and *japonica* races. Rice would have spread across Central Asia to the Near East, and classical sources suggest that it was being cultivated in Mesopotamia and Persia by the 2nd century BC. Unlike its African relative, *O. glaberrima*, Asian rice has a relatively short history in Africa. In the 13th and 14th centuries rice is reported on the East African coast. Its route of entry into Nigeria can be in two directions. Portuguese traders introduced Asian rice from East Africa to West Africa some 450 years ago (Jones, 1995). The Portuguese word *arroz* has been incorporated as a loanword in many languages of West Africa (Williamson, 1970). It could have also spread across the Sahara and to northern Nigeria via the oases and the Trans-Saharan trade. Udo's (1970) history of rice cultivation assigned the spread of Asian rice to 1850s at Abeokuta through missionary activities; to 1970s for the Lagos area as Epe and Okitipupa; to after the Second World for Ogoja and Abakaliki provinces; to 1945 for Shaki area of Oyo state; to early 1960s for the Niger Delta area; and to 1954 for the Oshogbo area. Western Nigeria played an important role in the introduction of Asian rice in Nigeria (Hardcastle, 1959). About a hundred years later, Asian rice has replaced the African rice in many places in Nigeria except for the deep-flooded plains of the Sokoto-Rima basin and other isolated pockets of deep swamps in the Kamodugu-Yobe drainage system and the Niger-Benue trough.

The story of rice in West Africa is becoming more interesting in view of the technological breakthrough in the development of hybrid rice by WARDA and other partners (WARDA, 1998, 1999a, Jennings et al., 1979, Ng et al., 1991). The rice interspecific hybridisation project has produced NERICA (New Rice for Africa). We are literally at the verge of a rice revolution in Africa as WARDA's Participatory Varietal Selections and Community Seed Production programmes become full-blown. NERICA is a progeny which exhibits a hybrid vigour which has the advantages of both *O. glaberrima* and *O. sativa* surpassing both in many regards (WARDA, 1999a). The revolution will be delayed unless this improved agricultural technology is delivered to farmers in a package that addresses both uncertain climatic conditions, limited extension resources and low or absent inputs.

2.2 Summary

Asian rice has replaced African rice in most rice growing environments in Nigeria. Its spread by natural means resulting into a popular variety called *kilaki* "prostitute" in the Hausa language is a pointer to the fact that the release of hybrid varieties need to be carefully planned. An uncontrolled cross on farmers' fields may result into undesirable rice types. This is an issue research has to address.

3. Rice systems agronomy and their geography

3.1 Introduction

Rice is said to rank 6th in Nigeria in terms of production in relation to crops like sorghum, millet, cowpea, cassava, and yam (Singh et al. 1997). Rice grows in all the agroecological zones (AEZ) as diverse as the Sahel of Borno state and the coastal swamps of the southwest and south-south. It is clear from Figure 2 that a classification of rice production systems according to the six vegetation zones of lowland forest, derived savannah, Southern Guinea Savannah, Northern Guinea Savannah, Sudan and Sahel in the tradition of Keay (1959), will not be realistic. Much of the natural vegetation has been altered or even destroyed by human interference and an agroclimatic classification has been adopted by some (WARDA, 1980; IRRI, 1984; Fagade and Kehinde, 1985; Ayotade and Fagade, 1986; Andriesse and Fresco, 1991; IITA, 1992; Jagtap, 1995; Singh et al., 1997; Blench, 1999). The differences in soil-water regime reflect either the topographic position of the land or the distance from the source of seepage or interflow (Moormann et al., 1986). In the rest of this section the classification system found in (Jones, 1995) is used given its practical value. Six rice growing environments (RGEs) have been identified for the purpose of this description. These are: Upland, Hydromorphic, Rainfed Lowland, Irrigated Lowland, Deep Inland Water and Mangrove Swamp. Table 6 provides a summary of each system as a guide.

Table 6. Summary of rice systems

Type	Characteristics	Geographical spread
Upland	Rainfed rice grown on free-draining fertile soils. This is also called dry uplands.	Widespread, except coasts, high rain forests and Sahel.
Hydromorphic	Rainfed rice grown on soils with shallow ground water table or an impermeable layer. This is also called wet uplands.	Very widespread at the fringes of streams and intermediate zone between upland and swamps of rivers in the Savannah.
Lowland	Rainfed or irrigated rice in aquatic conditions or medium ground water table. Water covers the soil completely at some stage during the cropping season. These are called shallow swamps or fadama	Very widespread from high rain forest to Sahel.
Deep Inland Water	Rainfed rice grown on soils with deep water tables. The rice crop floats at some stage and harvesting may be done from a canoe. These are also called deep fadamas or floodplains	Found in the Sokoto-Rima Basin and Chad Basin, floodplains of the Niger, Benue, Kaduna, Gbako, Hadejia and Komadugu-Yobe.
Mangrove Swamps	Rice grown at the coast or swamps of the high rain forest.	Coastal areas and Warri area in Delta state.

3.2 Upland Rice

Upland rice is grown on free-draining soils where the water table is permanently below the roots of the rice plant. The ecological conditions under which upland rice grows in Nigeria are diverse. However, to obtain a

successful crop, adequate and assured soil moisture reserves and fertility during key periods of plant growth are essential. The upland rice environments are defined on the basis of soils, climate, water resources, water regime at the micro level (Rashid-Noah, 1995) and topography. Two types of Upland Rice Systems (URS) are found in Nigeria. These are Rainfed Upland and Irrigated Upland. Each will be briefly described below.

3.1.1 Rainfed Upland Rice

This is the dominant URS in Nigeria. It is found in all agroecological zones. The crop depends entirely on rainfall. Heavy rainfall can lead to soil erosion, leaching of plant nutrients and possible flooding. The risk of poor grain filling due to drought is also high. In the year 2000, crop failure due to a sudden cessation of rains was noticeable in some places as far south as the Southern Guinea Savannah.

The system is found from Abeokuta, Ado-Ekiti, Abakaliki, Ogoja in the south right up to Yauri, Zamfara river, Gombe, Southern Borno and Yola. In some places the upland is a hill. Cultivation of rice on hills arise due to pressure on arable land. Hill cultivation of rice is becoming increasingly important in Ilesha of Osun state; the three local government areas on the Effun ridge of Ekiti state of South-western Nigeria (Effun-Alaya, Ekiti-West, Igbemo-Irepodun-Ifelodun Ayedere Local Government Areas (LGAs) and Obudu Hills of Cross River state of South-south Nigeria. In the Ilesha/Ekiti area, land is cleared for hill cultivation of rice in February. By March/April as soon as the rains are becoming established, the land is prepared by hoe and the seeds planted directly with an intercrop spacing of about 20cm. The plants germinate quickly and provide good soil cover before the rains become heavy to cause severe erosion. The rice crop is harvested in the month of July during the short dry spell. In this zone apart from rice other crops grown on the hills include cassava and maize. At the foothills, rice is intercropped with cocoyam and never with maize because of the unfounded belief that the pollen grain of the tassel is harmful to the rice crop.

On the Obudu plateau, hill upland rice is planted after the harvest of early yams. The heaps are spread between boulders in July/August and planted with upland rice. The variety locally called *Jango* is preferred here. The crop is harvested in October/November ahead of deep fadama rice. This timing arrangement gives farmers better price for their produce.

Appendix 1 provides further information on the upland system as prepared by NCRI.

3.1.2 Irrigated Upland Rice

In some places where the length of growing period (LGP) is short, some form of supplementary irrigation may be required to ameliorate drought conditions during critical stages of growth in the rice crop. This system is found in the southern region of Jigawa state as Birnin Kudu Local Government Area. It is also found in places where rainfall is between 150-500mm and LGP of 0 to 90 days. These abound in Borno, Jigawa, Kano and Katsina states. The growing season in the flatlands of the Sudan-Sahel is only 90 days (Dugje, 2000). The soils are generally sandy and have low water-holding capacities. Water for rice production in Borno state is supplied by government irrigation schemes as the Lau Irrigation Scheme and South Chad Irrigation Project.

3.2 Hydromorphic Rice

According to Jones (1995) hydromorphic conditions occur when water is supplied to the rice crop by a shallow ground water table, within the rooting zone of the plants. Hydromorphic rice is found either on lower slopes in the toposequence or in situations where impermeable soil layer reduces water percolation. In Tarok land of Plateau state, central Nigeria, this impermeable layer has a vernacular term *alam.* It is considered as marginal land some twenty years ago. However, today rice is cultivated even on *alam.*

Another situation which can give rise to hydromorphic conditions is the slow flow of water in a grassed waterway or even a simple ditch by a highway. It is now common to see rice in this environment all over the Northern and Southern Guinea Savannah. In Tarok land some twenty years ago such ditches were left fallow but today they are usually lush rice patches due to great demand for land.

Hydromorphic land occurs as a transition zone or fringe (Singh et al., 1997) on a continuum of the toposequence from the bottom of an inland valley to upland or a mere depression on a flat plain or topography whose soils have good water holding capacities. Fringes of streams or rivulets are areas for this system of rice production. Wet uplands will also be an appropriate terminology for this system. The area sown to hydromorphic rice fluctuates from season to season depending on the amount and distribution of rainfall. Hydromorphic rice generally gives higher and more stable yields than upland rice. Figures are not available on the size of land under this system in Nigeria.

3.3 Rainfed Lowland Rice

An estimated 25 percent of Nigeria's rice area is under rainfed lowland rice cultivation. This ecology is said to contribute between 43 and 45 percent of national rice production (Imolehin and Wada, 2000; Singh et al., 1997). However, hydromorphic rice might have been included in that category. Two sub-types are set up here for lowland ecologies: shallow fadama and deep fadama or deep inlands valleys or so called wetlands. A distinguishing feature of this system and hydromorphic rice is that the soil must be covered completely by water at some stage in the growth cycle. In deep fadamas the land is flooded all the time or during the major part of the cropping season. Farmers generally adjust their date of planting or transplanting in order to avoid flooding during the early stage of growth (Moormann et al., 1986). This is the dominant system in the floodplains of the rivers Niger, Benue, Katsina Ala, Kaduna, Yobe and their tributaries. Shallow fadamas are seldom flooded.

Excessive flooding, iron toxicity and lack of water control structures have been the bane of lowland swamp rice production in the Abakaliki area for instance. Farmers in that area have an interesting farming system. Giant mounds are made at the end of rains or onset of rain. Yam is planted at the top of the mound. With early rains, groundnuts is planted lower down the mound. By May, rice is raised in a nursery for 4 weeks. The yams and groundnuts are harvested and the mound broken down and puddled by hand and the crop residues incorporated into the soil. At this stage the fields are flooded and rice is transplanted. The giant mounds prevent the yams and groundnuts from being waterlogged. This system suffices, but in a year when the Cross river overflows its banks there can be total crop failure. Box 1 describes another rainfed lowland rice system which was evolved by the farmers themselves. That system started some 30 years ago and has become a remarkable innovation and technology.

Jigawa state has one of the highest network of wetlands for rice cultivation in the country. However, much of that will be turned into industrial sugarcane plantations as from 2001 cropping season given the policy thrust of the state government. Appendix 2 provides further information on rainfed lowland rice production as prepared by NCRI.

Box 1. Ganawuri green manure rice production system

A system similar to the Abakaliki one described in 3.3 is obtainable in Ganawuri area of Plateau state. It is a settlement located some 40 km south west of Jos, in central Nigeria. It is a fascinating and sustainable green manuring rice production system. The farmers will say "inorganic fertilisers will make our rice to grow only leaves, and so we have no need of them on our fadamas". Huge ridges are made at the end of the rains for the planting of cocoyam under residual soil moisture management. In April/May, rice seedlings are raised in nurseries near the house for 4 weeks. By June the fadama is already flooded and the farmer goes to harvest his cocoyam and in the process he turns in the green vegetation that has been allowed to grow on the ridges. He breaks up the ridges and puddles the fields and transplants the rice. He goes back to the farm only at harvest time. No herbicides, weeding, insecticides or fertilisers are needed. The same field is used year in and year out.

The success of this system is attributable to the scale of operation. The fadama is very small and the amount of land available to each family is very small. Therefore manual ridging and puddling is feasible. The implication is that the farmer does not experience much drudgery and so the fields are well prepared. Secondly, the source of flooding is a small stream and therefore no flood control structures are required.

It is even more amazing that the farmers started rice cultivation using upland varieties only in 1959. The cultivation of upland rice is on the decline because of the non-availability of inorganic fertilisers. Farmers are therefore eager to discover ways of expanding their fadama cultivation of rice. The fadama in ancient times were for the cultivation of cocoyam only. This new cropping system is now found along the entire course of the stream from Ganawuri to Attakar area of Kaduna state. The implication of the apparent scarcity of fadama lands in the area is the increase in border clashes. The question that occupies the mind of farmers each time they encounter a researcher as during M-APs visits is whether the natural fadama land can be expanded?

Today, rice is the sole cash crop of the Aten people of Ganawuri. The grains are well filled given the excellent management system. Ganawuri rice attracts a higher price than any other local rice in Jos market and competes very favourably with foreign rice.

3.4 Irrigated Lowland Rice

The establishment of River Basin Development Authorities (RBDAs) in the 1980s gave a boost to Rice Schemes and irrigated lowland rice. Irrigation is supplied from rivers, dams, wells, boreholes, washbores, and other sources to supplement rainfall for full rice crop growth (Imolehin and Wada, 2000). This system accounts for 18 percent of cultivated rice land and 10-12 percent of national rice supply. In parts of Ogoja, irrigation is by gravity. It is a system developed entirely by the farmers. They have incorporated the use of rice bran as organic fertilisers in the farming system. Apart from the Adani Scheme in Enugu state and Bida Scheme in Niger state, most of irrigated rice is in the Northern Guinea Savannah, Sudan Savannah and Sahel.

3.5 Deep Inland Water Rice

This is the floating rice system. Just before rain sets in, much of the water in the river course has receded. The land is prepared and planted with rice by direct seeding or transplanting of seedlings which had been raised in a nursery. The plants grow in not too moist conditions for 4 weeks and the water level of the river begins to rise and overflow its banks. The rice fields become flooded but the plants send down deep roots and the vegetative parts float on top of the water. The plant has the ability not to be submerged. It matures in this flooded condition and may be harvested from a canoe as may be seen in Sokoto. This system has been known there for hundreds of years. According to Imolehin and Wada (2000), it constitutes 5 to 12

percent of the national rice production area and 10 to 14 percent of the national rice output. This system is plagued by the problem of low yield because of the use of unimproved varieties of the traditional rice *Oryza glaberrima*. The average yield in deep water areas is around 1.2 t/ha, with a yield potential of up to 3 t/ha (Singh et al., 1997). The Sokoto-Rima valley is the home of floating rice in Nigeria. Can M-APs or any agency use the methodology of the popular Argungu fishing festival of the area to stage a floating rice festival that may lead to rapid dissemination of rice technology?

3.6 Mangrove Swamp Rice

This is also called Tidal Wetland rice system (Singh et al., 1997). The coastal swamp areas in Delta, Ondo, Lagos, Rivers, Bayelsa, Akwa-Ibom and Cross River states are suitable for swamp rice production. This covers a potential 1 million ha of land, but at present not up to 1000 ha is cultivated (Imolehin & Wada, 2000). This vast potential lies waste due to neglect given the cheap harvest of petrodollar in these oil producing states. Mangrove rice is produced only in Warri and on Shell Company farms in Bayelsa state. According to Moormann et al. (1986), the development of unused mangrove swamps for rice cultivation is a long-term endeavour that must be based on hydrologic, soil and socio-economic surveys and of course appropriate technology (Singh et al., 1997). Mangrove Swamp Rice is no longer a core ecosystem under WARDA's mandate its huge potentials in Nigeria notwithstanding (WARDA, 1999b). It is a challenge NCRI will have to address.

3.7 Geographical distribution of rice in Nigeria

Table 7 gives some characteristics for the distribution of the Rice Growing Environment (RGE) in Nigeria.

Table 7. Some Characteristics of Rice Growing Environments in Nigeria

Srl No.	ACZ[1]	AEZ[2]	LGP[3] (Days)	Annual Rainfall (mm)	Rainy Season	RGS[4]
1	Arid	Sahel	<75	<550	Jul-Aug	IL, DW
2	Semi-arid	Sudan Savannah	75-150	550-900	Jul-Sept	IL, RU, RL, DW
3	Sub-humid	Northern Guinea Savannah	151-180	900-1200	Jul-Oct	RU, RL, DW, H
4	Sub-humid	Southern Guinea Savannah	181-200	1200-1500	Jun-Oct	RU, RL, DW, H
5	Sub-humid	Derived Savannah	211-270	1500-2000	May-Oct	IL, RU, RL, H
6	Humid	Humid forest	>270	>2000	Mar-Nov	IL, MS, RU
7	Mid-altitude	Moist savannah	181-270	1200-1500	April-Oct	RU, RL

Source: Adapted from Singh et al. 1997

[1] Agroclimatic zone, [2] Agroecological zone, [3] Length of growing period, [4] Rice growing system, IL Irrigated Lowland, H Hydromorphic, DW Deep Inland Water, RU Rainfed Upland, RL Rainfed Lowland, MS Mangrove Swamp

Rice is cultivated throughout Nigeria, from the mangrove swamps of the Niger Delta to arid regions near Lake Chad. Traditionally, the zone of cultivation was along the Niger-Benue system, using naturally flooded valley-bottoms. Rice coming into the seacoast is cultivated either on residual moisture or in mangrove swamps. Dry-season cultivation remains relatively rare today (exceptions Ogoja and adjoining villages of Cross River and Benue states) because where farmers have access to pumps they find horticulture more profitable. The National Fadama Development Programme (NFDP) was designed with

that realisation in mind. The introduction of hardy upland varieties has allowed rice to be extended to many dry areas, especially in the 'Middle Belt' previously used for dryland cereals such as sorghum and millet.

The drainage systems of Nigeria defines the rice growing environments (RGEs). According to an FDALR report of 1990 (Federal Department of Agricultural Land Resources), these are Niger system, Benue system, Chad system, Cross system and Atlantic system. Most of the rivers of the Atlantic systems are short, north-south coastal streams which flow through more or less regular courses. These include Ogun, Oshun, Shasha, Yewa and Oluwa. The Nsukka-Okigwe Cuesta forms the major divide separating the rivers that drain into the Niger and Imo from those that drain into the Cross. In the North, the central highlands and Jos Plateau produce a radial pattern of drainage with streams draining to the Zamfara, Sokoto and the Chad Basin whose main rivers are the Yobe, Ngade, Mbudi and Goma. The Tiga, Hadejia also drain into the Basin. The Niger flows for 1,271 km in Nigeria. Figure 3 shows the six geo-political zones and Tables 8-13 give the systems found in each zone. Geo-political zones are new administrative units that group states purely on geographical terms. However, the zones now form the basis of sharing the 'national cake' as it were. Key political appointments are done on the basis of the zones. Similarly distribution of amenities and federal infrastructures are done on the same basis. The ruling political party in Nigeria is using the same formula even in filling candidates for topmost positions. It is therefore useful to look at rice growing systems from that angle if some form of mobilisation for development is to be carried out.

Table 8. Rice growing systems in the North-east zone

State	Dominant systems	Remarks
Borno	Irrigated Lowlands, Rainfed Lowlands and Rainfed Upland	Quelea birds is of the scope that not even the state government alone can handle.
Yobe	Hydromorphic and Deep Inland Swamps	Most of the wetlands have dried up due to poor management of water resources upstream.
Adamawa	Rainfed Lowlands, Rainfed Upland and Hydromorphic	Rice is in competition with sugarcane in Numan area. Perennial flooding along the Benue in the state due to release of excess water from dams in Cameroon needs to be tackled.
Gombe	Hydromorphic, Rainfed Upland	Potential for irrigated rice has not been exploited.
Bauchi	Hydromorphic, Rainfed Upland	Potentials in the northern part of the state for irrigated rice remains unexploited.
Taraba	Rainfed Lowlands, Rainfed Upland and Hydromorphic	Poor road network is a major hindrance to rice production. Problem of flooding along the Benue due to release of water upstream in Cameroon also affects rice production this state.

Table 9. Rice growing systems in the North-west zone

State	Dominant systems	Remarks
Jigawa	Irrigated Lowlands, Rainfed Lowlands, Rainfed Upland and Hydromorphic	Much of the 170 wetlands in the state were intended to revert to production of sugarcane as a state policy. Retired civil servants, *bona fide* farmers and others were mobilised and equipped in the Millennium Village Project, but Jigawa has failed to produce any industrial sugarcane.
Kano	Irrigated Lowlands, Rainfed Lowlands and Rainfed Upland	Irrigated rice has not been fully exploited given the large number of dams in the state.
Katsina	Irrigated Lowlands, Rainfed Lowlands and Rainfed Upland	Irrigated rice has not been fully exploited. The southern part of the state is the rice zone.
Kaduna	Irrigated Lowlands, Rainfed Lowlands, Rainfed Upland and Hydromorphic	Reputed to be the highest rice producing state given the floodplains in Birnin Gwari Local Governments.
Zamfara	Irrigated Lowlands, Rainfed Lowlands and Rainfed Upland	Irrigated rice has not been fully exploited.
Sokoto	Irrigated Lowlands, Rainfed Lowlands and Floating rice	Home of floating rice in Nigeria. High yielding varieties are needed.
Kebbi	Irrigated Lowlands, Rainfed Lowlands, Rainfed Upland, Floating Rice and Hydromorphic	Its potential is highest in the country given its drainage systems

Table 10. Rice growing systems in the North-central zone

State	Dominant systems	Remarks
Niger	Irrigated Lowlands, Rainfed Lowlands, Rainfed Upland and Hydromorphic	Home of rice culture in Nigeria and premier rice research institute (NCRI). Problem of flooding due to irresponsible release of excess water from dams like Kainji, Shiroro and Gbako river renders rice production in this state very vulnerable. Niger state should rank first in the production of rice in Nigeria, but in the last 4 years all that farmers know is lamentation over total crop failure. In 2000, farmers at Badeggi were transplanting the first crop of rice only in November because floods had destroyed the May/June crop. WARDA's PVS trials are also located in the state. The National Fresh-water Fish Research Institute should promote fish and rice culture in the state and the entire geo-political zone. In that way rice and fish synergy can be maximised. The development of appropriate ox-drawn technology for the Kainji area can boost rice production.
Kogi	Rainfed Lowlands and Rainfed Upland	Rice potentials is not being tapped at all. The ADP at Ayangba was the second generation ADP with a rice scheme. No trace of the ADP is seen today. Its formerly derelict structures had been taken over by Kogi State University and rice farmers along the courses of the Niger and Benue are left entirely to fend for themselves.
FCT	Rainfed Upland and Hydromorphic	Rice cultivation is vulnerable due to land use in the future. Real estate business is the main industry in the FCT. The large parcels of land acquired by absentee farmers in the Area Councils of the FCT include rice fields. As soon as housing development reaches such areas, the swamps will be provided with good drainage and housing

State	Dominant systems	Remarks
		estates will spring up.
Nasarawa	Irrigated Lowlands, Rainfed Lowlands, Rainfed Upland and Hydromorphic	The problem of excess water from the Benue flooding rice fields needs to addressed by the Federal government since the culprits are traced to dams located in the Republic of Cameroon. The huge rainfed fadama at Jangwa in Awe Local government is the most vulnerable to perennial flooding. The NALDA rice scheme at Ake in Lafia local government area is only in name.
Plateau	Irrigated Lowlands, Rainfed Lowlands, Rainfed Upland and Hydromorphic	The Ganawuri production system uses no chemical fertiliser at all. The technology appears to be spreading because similar systems are springing up in marshy fields near Liberty Dam in Jos, central Nigeria. It may be noted that Ganawuri farmers use inorganic fertilisers, but only for upland rice. Shallow fadamas are quite limited in the state, but upland rice cultivation is very extensive, especially on the Jos Plateau. The decline in maize production due to high cost of chemical fertilisers is at the root of that development, but more importantly is the fact that many upland varieties are available to farmers. They simply switch over to a new variety when they notice a decline in yield. Most of the upland farms in areas like Riyom, Vom, Rayfield, Ganawuri, Jingre, Mangu, Panyam and so on can become hydromorphic even during a single cropping season, to the advantage of the farmer. The irrigated rice fields at Longkat and the rainfed rice schemes at Kadarko and Sabon-Gida Yelwa are mere shadows of their past glories.
Benue	Irrigated Lowlands, Rainfed Lowlands, Rainfed Upland and Hydromorphic	Rice potential in this state is quite huge similar to Niger state. The ricebelt of Katsina Ala are yet to be fully developed. In Oturkpo area of the state rice bran dumps are popular mushroom growing spots.
Kwara	Rainfed Lowlands, Rainfed Upland	Sugarcane production in Bacita, Lafiagi and Pategi have reduced total area for rice production. The development of appropriate ox-drawn technology for Kaiama area can boost rice production.

Table 11. Rice growing systems in the South-east zone

State	Dominant systems	Remarks
Enugu	Irrigated Lowlands, Rainfed Lowlands and Rainfed Upland	The Adani Rice projects beg for assistance from the state government by way of repairing irrigation infrastructures. The farmers are able to grow only a rainfed crop due to the collapse of irrigation facilities.
Ebonyi	Rainfed Lowlands and Rainfed Upland	The perennial flooding of rice yields in the Ikwo area due to the increase of the level of water in the Cross River is a problem that can be solved only by capital intensive water control structures.
Imo	Rainfed Lowlands	Rice potentials remain largely untapped.
Anambra	Rainfed Lowlands and Mangrove Swamp	Rice potentials remain largely untapped.
Abia	Rainfed Lowlands	Rice potentials remain largely untapped.

Table 12. Rice growing systems in the South-west zone		
State	**Dominant systems**	**Remarks**
Oyo	Rainfed Lowlands, Rainfed Upland	The successful hybrid rice trials by WARDA at IITA and PVS will soon lead to a rice revolution in Nigeria. However, rice production has actually declined in the state in a place like Shaki.
Lagos	Mangrove Swamp	The huge potentials remain largely untapped. Rice production is actually on the decline.
Ogun	Rainfed Upland	Reputed to be the area in the South-West where Asian rice was first introduced.
Osun	Hill Upland	Found in Ilesha Hill area. Rice production in Oshogbo has been on the decline since 1957.
Ondo	Rainfed Lowlands and Rainfed Upland	Rice cultivation is restricted only to the northernmost LGA bordering Ekiti state.
Ekiti	Hill Upland and Rainfed Swamp	Hill rice cultivation is on the increase. Ado-Ekiti houses the biggest modern seed processing centre in West Africa which is currently under-utilised.

Table 13. Rice growing systems in the South-south zone		
State	**Dominant systems**	**Remarks**
Cross River	Rainfed Lowland, Rainfed Upland, Irrigated Lowland	Ogoja area is the principal rice zone. Rudimentary irrigated swamp production by gravity is practised. Farmers in Bekwarra local government area of the state attest that they had tried vegetable production, but it seems irrigated rice is more profitable to them. The potential for irrigated rice production can be increased considerably if water lifting through small pumps can be introduced. Unfortunately, the package of the World Bank assisted Special Rice Scheme has alluded the farmers in this area for inexplicable reasons. The use of rice bran as fertiliser is the practice by these farmers. They have also reported that the hill rice produced on the Obudu Plateau attracts higher price. An explanation for that is simply that the rice is harvested when paddy rice has become scarce. The government irrigation rice scheme at Ogoja has broken down completely. Unlike in places with similar problems, the farmers are waiting for the government to re-open the scheme. It has not been possible to get to the root of this phenomenon. It may appear farmers have no access to the land and they are not willing to report that.
Akwa-Ibom	Rainfed Lowland	Mangrove Swamp remains untapped.
Rivers	Mangrove Swamp	Potential not tapped.
Bayelsa	Mangrove Swamp	Only Shell Oil Company is promoting Swamp Rice cultivation in any significant way.
Delta	Mangrove Swamp	The system is practised only in the Warri area.
Edo	Rainfed Lowland, Rainfed Upland	Potentials remain largely untapped.

3.8 Other rice cultivation practices by smallholder farmers

3.8.1 Intercropping

It is a common practice for farmers in Jigawa, Kano, Bauchi, Katsina, Sokoto, Zamfara and southern part of Kebbi to intercrop rice with sorghum or maize. The advantages of intercropping besides yield need to be mentioned. Intercrops are less subject to damage from drought at times when the risk of drought is highest at the end of rains. A sole crop of sorghum at a high population which is necessary for good yields makes a great demand on soil moisture reserves. When rice is intercropped with sorghum, the risk of moisture stress for both crops is less because of the drought resistance of the latter. The choice of site is crucial. Intercropping is carried out on a site which is typically a RGE, and even when the rice crop fails, sorghum will produce a crop because of the relatively good soil moisture reserve. A sound principle of intercropping is to plant early maturing and late maturing crops together. Rice is grown on a strip of land about 1 metre wide and sorghum is planted on a 75cm ridge. Ridging improves the soil moisture status of the land because it is a kind of water conservation technique. A number of general criteria can be recognised by which increased returns are obtained from an intercropping system (Norman et al., 1970, Andrews, 1973):

1. Inter-crop competition must be less than intra-crop competition.
2. The arrangement and relative numbers of the contributing crop plants will affect the expression of the difference in competition.
3. The effect of competition between crops is greatly alleviated when their maximum demands on the environment occur at different times; this can be achieved either by selecting a crop with differing growth cycles or by planting them at different times.
4. Intercropping is more effective where the seasonal period for growth is long enough to permit the operation of principle in (3) above.
5. Legumes may be a necessary rotational component under conditions of poor soil fertility.

On this last point, Imolehin and Wada (2000) reported that NCRI is promoting the use of *Sesbania rostrata* and other organic fertilisers to boost rice production. Myers (1983) looked at the potential of 13,000 or so legumes which each year fix 35 million tons of nitrogen from the air for free. He reported that rice yields in China can be boosted by as much as 158 per cent a year. He reported similar findings at the International Rice Research Institute (IRRI) in the Philippines. The potentials of the use of organic manure in rice cultivation need to be promoted given the fragile nature of soils in the rice growing belts (Jones, 1974).

Closely related to the cultural practice of intercropping is multiple cropping of rice by some farmers. In the deep water swamps of Sokoto-Rima basin and Benue river floodplains, re-growth can result into the harvest of two or sometimes three crops. Most often, the third crop is a relay crop as cowpea grown on residual soil moisture. Ayotade et al. (1986) reported that trials at Badeggi with two crops of early maturing rice, grown in 227 days, gave a combined yield of 8.4 t/ha and a third crop of dry season cowpea.

In most regions of Nigeria, apart from Hausa land in the North, rice is hardly intercropped. In Ekiti state where pressure on land is so acute, farmers reported that they are afraid of intercropping rice with maize for example, because of a belief that pollen grains of the maize male flower can reduce fertilisation in rice plants. This is not true, but that belief can reduce the potentials of a rice field given the good moisture regimes of the area.

The Ganawuri cocoyam/rice cropping system described above, is a system that can be adopted in the wetter zones. The cocoyam is perceived by the farmers as a relay crop, but in actual fact, it is an intercrop because the crop may not be harvested when rice is being transplanted. This system is one technology M-APs can disseminate to communities that grow cocoyam as a sole crop on marshy waterlogged fields which can be utilised for the cultivation of deep swamp rice.

Intercropping is seen by some as a systems which will ultimately be replaced by the more desirable system of monocropping. Baker et al. (nd.) made bold to say that the value of an intercrop for effecient use of labour will disappear, being replaced by cattle, herbicides, or even mechanisation. We have gone a full circle in Nigeria to see that the sentiments of the philosophies of the Green Revolution have not materialised. Tyson (1971) stated that the answer to modern agriculture is the used of four technologies: mechanisation, fertilisation, the chemical control of weeds, diseases and insects, and irrigation. That ideal has not been attained to any appreciable level in Nigeria. That is why cultural practices by smallholder farmers should be the starting point for useful research.

3.8.2 Fish synergy

The deliberate cropping of fish alongside swamp rice production is common in the River Niger rice zones. Ridges and bunds are constructed to trap water for better management of rice fields. In doing so, fish is trapped along and are allowed to grow in size before the farmer harvests them just before the rice is ready for harvest. This practice is also common in Jigawa and Kebbi states. The farmer gets a higher return on his rice cultivation under this system than a sole rice culture. However, the potential of this system remains largely untapped in Nigeria.

At Konduga in Borno state, farmers consider Tilapia as a pest to rice seedlings. It is alleged that the fish destroys shoots of young seedlings. This belief underscores the need for participatory scientific research on rice-fish culture to allay the fears of farmers.

3.9 Situation report on large-scale vs. small-scale production

In the rice systems described above, the practices of the smallholder farmer has been the focus because as of today, no true large-scale farmers are growing rice. A major drawback to the cultivation of rice by large-scale producers is the high cost of inputs like seeds, fertilisers, herbicides, insecticides and tractors. The non-availability of tractors is another major constraint to large-scale rice production in Nigeria. Even when a large-scale farmer can own a tractor, the cost of fuel and maintenance is so high that he prefers to make quick returns by hiring out the tractor to small-scale farmers. The only large-scale rice farms that may be seen are former RBDAs, Green Revolution and NALDA farms. Even so, the land is parcelled out in small sizes to several farmers.

However, the rice enterprise by smallholder farmers is an active sector, production constraints notwithstanding. The efficient allocation of resources by smallholder farmers should be encouraged. Large-scale farmers were unable to control the use of inputs whose costs were subsidised, leading to excess release of chemicals into the environment due to misuse. The shortage of expertise to operate very sophisticated machinery as combine harvesters, huge ploughs and harrows, boom sprayers, seeding machines, fertiliser spreaders and so on, greatly contributed to the closing down of large-scale farms. Most of such farms were owned by government and so they are now being put into use by smallholder farmers using simple traditional tools. Apart from the logistic problems mentioned here, the World Bank has always discouraged governments from undertaking large-scale production. Such a policy is sound and should be encouraged because government projects invariably result in inefficient allocation and use of resources apart from the problem of corruption and wastefulness. True farmers as the smallholders should be the focus of any development scheme. The administration of the scheme should be local community driven and not the expensive ADP model.

3.10 Land preparation and animal traction

For deep swamps the commonest method of land preparation is deep ploughing and harrowing by tractors. In the more northern states harrowing/ridging is done by work animals for all upland crops. The advantages of animal traction in northern Nigeria is tremendous. In cases where the rains are likely to arrive late, thereby compressing the critical time of peak labour input, a plough-using farmer is far better able to cope than a hand farmer. Ridging, first and second weeding of most upland crops can be done using animal traction (Blench, 1997). Ploughing rice fields by animals is done on a very small scale only around the lake Kainji area in Niger state and Kaiama in Kwara state where the soils are light. There is a potential for the use of workbulls in northern Nigeria for rice production if plough shares can be made to be strong enough to work heavy soils of the fadama. The introduction, use and spread of animal traction implements from historical perspectives are discussed in Starkey et al., 1990; Laurent, 1968; Ransome, Sims and Jefferies, 1965; Mirchalaum, 1976; Haynes, 1965; and Maharazu, 1996. Blench (pers. com.) reported that in other African countries animal power can be increased by using 4 bulls instead of the traditional 2 in Nigeria. This will require careful introduction because the technology is unknown in the country. Nasir (1974) reported that the Ariana ox-drawn equipment has skids which can be used in puddled rice land and that the ridger which is not strong enough for heavy soils can be modified by the use of stay bars and welding of a supporting bracket. An animal-drawn plough is a basic tool for land preparation in the Philippines, Thailand and Burma unlike Nigeria (Nestor et al., 1986). The use of the camel for farming introduced to Nigeria in 1975 has not spread much (Blench, 1997). At a recent national technology review meeting of the ADPs held at Jalingo in March, 2000, the potentials for animal traction as a feasible and sustainable alternative to tractorisation for increased rice production was introduced at the meeting by EDO. That point was discussed also at the M-APs Workshop held in Jos in the same month. Appendix 3 gives the resolutions passed at that workshop.

Hand cultivation is the main method of cultivation in Nigeria. The farmer uses a hand hoe for ploughing or ridging, planting and weeding. This limits the size of farms, but it means the farmer is able to weed his field properly and have a good yield. Even the harvest is done by a hand sickle. In the mid-70s up to mid-80s tractor power was abundantly available for rice cultivation (FACU, 1988, Singh et al., 1994). However, the story is completely different today. All government owned farm machinery are broken down. The few tractors that are available are privately owned and a farmer may pay as high as N5,000.00 to plough one hectare. The cost of replacing a tractor is phenomenal. A new tractor with a set of plough and harrow costs about ₦4.5M. This is beyond the reach of many farmers. This explains the withdrawal of large-scale farmers from the rice enterprise. Through research, simple, technically feasible and economically viable planting implements for rice have been developed in recent years (Imolehin and Wada, 2000). NCRI has fabricated small and medium-scale equipment and machines for farmers, co-operative groups and Farmer Unions as rice planters, maize planters, cowpea shellers, fertiliser spreaders, rice threshers, rice parboilers, rice mill spare parts, cassava grinders, household grinders for maize, cowpea, sorghum and a complete golden brown sugar processing plant (NCRI, nd.). Most farmers are smallholders and planting is not considered as drudgery. Weeding on the other hand is the bane of rice farmers and such a technology is not yet available at an affordable price to this category of farmers. The ox-drawn farming system needs to be studied with rice production specifically in mind. It works in Jigawa and Niger states not only for sorghum, millet and groundnuts, but also for rice and it can be tried elsewhere, provided the plough share can be modified. New users will have to be convinced to grow rice on ridges so that weeding using animal traction can be employed. This may ameliorate the disadvantage of high labour cost in ridge cultivation observed by Kowal et al. 1974. At this stage of development we cannot afford to limit rice production to faith and belief in the gods, and in the efficacy of rituals to provide protective functions to rural agriculture instead of modern inputs (Ofoegbu, 1988).

Mangrove rice production require more machinery than fadama rice (De Datta, 1981). At the moment very little effort has been made for acquisition of the technology for the development of tidal swamps. Environmental pollution due to crude oil exploration and processing makes the prospect of developing mangrove rice even more slim.

3.11 Summary

Five principal rice systems are found in Nigeria. These are: upland, hydromorphic, lowland, deep inland waters and mangrove swamps. Rainfed and irrigated lowland contributes 45 and 12 per cent to national rice supply respectively. Deep inland waters about 10 per cent and mangrove swamps less than 1 per cent. The remaining is met by upland and hydromorphic systems. The establishment and growth of ADPs, RBDAs, and cheap fertilisers were responsible for increase in rice production through large-scale farming and mechanisation. However, today production is left to smallholder farmers who use manual cultivation tools. There is now a decline in the use of chemical fertilisers due to non-availability and high cost.

At Ganawuri in Plateau state of central Nigeria, the green manuring innovation is a technology worthy of in-depth study and probable promotion, dissemination and scaling up for adoption in the country and sub-region. It is a reduced tillage system similar to the ones reported by the Rice-Wheat Consortium working with farmers in the Indo-Gangetic Plains (ODI, 2001). However, more research needs to be done before any Best Practices Guide on the Ganawuri system can be prepared. Simple implements have also been designed and fabricated to reduce drudgery (Imolehin & Wada, 2000) but these are not being used by farmers due to high cost. A more feasible solution is to explore the possibility of the use of animal power as an alternative to tractorisation. Rice-Fish culture is yet to be popularised in Nigeria its tremendously economic benefits notwithstanding.

The deep water swamps of Sokoto and Kebbi states are harvested from the canoe. This spectacular sight can be a fair which can be harnessed as a means of popularising new varieties and other rice technologies. These are challenges which may be addressed through the M-APs model.

4. Processing and marketing

4.1 Introduction

Processing and marketing of rice is dictated by economic forces beyond the mere confines of the farmer. It is not uncommon for shrewd rice traders to lure a farmer into selling his produce in advance in anticipation of a good harvest. Such an arrangement provides ready cash to the farmer to buy inputs and meet cost of labour. However, the trader will always have an upper-hand because he fixes the price.

Both men and women are involved in the processing and marketing of rice. Processed rice is of two types: parboiled and non-parboiled, with the former dominating the trade. The quality of local rice is one of the factors that led the elite to put pressure on government to import the commodity. The local rice is full of stones and debris. The scare that local rice causes kidney stones is very rampant. Sometimes local rice has off smell which to some is likeable, but it is offensive to those who buy foreign rice. The quality problem begins on the field where threshing is done in dug up holes on the ground and the rice is put into bags with sand, gravel and chaff. The operation can be improved upon by threshing on tarpaulin or mats.

4.2 Rice milling

Manual processing of rice is not widespread in Nigeria. Rice mills are found all over the country. There are at least 3-5 mills in every rice producing community. Where none exists, a mill will be available within a radius of 10 km. Lafia, the capital of Nasarawa state has the highest concentration of rice mills per unit area in Nigeria. There are well over 400 mills and 5 destoners at the milling complex. The Millers Association is very strong and provides some infrastructures as boreholes, wells and security. These mills are working all year round. Abakaliki and Afikpo are other areas with high concentration of rice mills. Just on the outskirts

of Abakaliki is a rice milling complex with not less than 60 mills and 1 destoner in operation. The Millers Association is very strong and by 12 noon all milling activities must stop to provide a conducive atmosphere for trading. There are well over 50 mills at Adani, but no destoner. There is a destoner each at Wase, Langtang and Shendam all in Plateau state.

Increase in destoners reported above shows that rice business in Nigeria is driven by market forces. In 1998, even a huge rice milling complex like Lafia had no single destoner. However, with the official lifting of the ban on rice import, millers have started importing destoners to meet up with the competition. The ones at Wase and Shendam were fabricated locally in Jos by someone EDO motivated. Locally grown rice properly milled and destoned sell at the same price as imported rice. This kind of response by market forces is a clear indication that local entrepreneurs are prepared to get the best out of the share of the rice market.

Much of the paddy rice produced is parboiled before milling. This involves soaking the paddy in cold or hot water for a day or two before steaming for as long as the husks just open. This practice dextrenises the kernels and drives the vitamin thiamine and other water soluble nutrients from the testa into the starchy core. Parboiled rice has better storage and cooking quality. It is richer in food value and is devoid of unpleasant odours (provided clean water is used) and breaks less during milling (AERLS, 1977).

4.3 Rice marketing

In the last 5 years, 1kg of locally milled rice sold for N45.00-50.00 in the urban markets. Foreign rice on the other hand sold for N60.00- 65.00/kg. In 2001 due to an official devaluation of the Naira which exchanges at the rate of N112.00 to the US$, foreign rice sells at N95.00-100.00/kg in May 2001. The price of local rice stands at N85.00-90.00/kg. These figures are for the urban end-consumer. At the farmgate today, a farmer sells 1 kg of milled rice for about N50.00-55.00. Cost of local transportation due to scarcity of petroleum products contributes to the rather high price of local rice. This may seem to be a fair price given the advantage of zero cost of herbicides, insecticides and seeds. The farmer is better off not selling paddy rice because its price is as low as N20.00/kg at the peak of its scarcity, but only N8.00-10.00/kg during harvest. Milled rice attracts better prices both in the villages and urban centres.

The key players in this rather lucrative business are farmers, middlemen who buy the produce, millers and consumers. The farmer takes paddy rice to the village market and the produce is bought by a middle man who can be a trader from another community (usually Hausa or Igbo) or by a local trader (in most cases women). The rice is parboiled and milled either locally or at some sub-urban centre. This product will be sold by the trader in measures as mudu (measuring bowl) or bushel (measuring tin). The major trader puts the rice in jute sacks or nylon bags for the township market. The product is re-sold to buyers in mudus or bushels. More sophisticated packing of rice is just beginning in Nigeria with the adoption of destoning technology by marketers.

The free import policy on rice is a question we raised at all the rice mills during the research. An immediate response is the fact that foreign rice has driven the cost of local rice down. However, it is also always stated that most Nigerians prefer local rice because of its taste and sometimes even its smell. Farmers are quick to add that good processing of the local rice may make it compete favourably with imported rice. In Benue, Cross River, Kebbi, Enugu and Plateau states, millers are unanimous that highly adapted varieties like MAS-2401, DeGualle and IR 1416 sell better than foreign rice and traders prefer them to foreign rice. It was also observed that the difference in the price of foreign and local rice is only marginal. A local farmer is unable to differentiate between price stability due to reduction in inflation and a lower price as compared to previous one in a year of inflation. It is clear that the hues and cries over free importation of foreign rice is a political one. There is a huge market for local rice which is the preference of consumers and traders alike.

4.4 Interplay of factors on output of processed rice

Yields are consistently low as 1-2 tonnes/ha. The costs of items like seeds, labour (for land preparation, seeding, transplanting, weeding, harvesting and handling), inputs and processing are so variable from one community to the other. Therefore, calculations of the economics of rice production in relation to input costs can only be mere generalisation for the country. Some few years ago, economics of production was never done formally by farmers (Norman, 1970). However, the situation is changing and farmers are now quick to make rational economic decisions from year to year and it is clear that some few farmers who have the choice of earning a livelihood elsewhere have switched from rice production to petty trading as was the case in Adani Rice Scheme in Enugu state of south-east Nigeria. This sensitivity to economic realities is especially true of large-scale farmers. There was the story of 4 farmers at Adani who committed suicide because of total crop failure due to infestation by African Gall Midge. For majority of farmers, they are stacked to a vocation which has become a custom, whether they break-even or not. The cost of inputs like fertilisers, herbicides, insecticides, tractors and labour are so high that it is impossible to break-even.

Farmers easily switch from the cultivation of one crop to the other in reaction to market forces as costs of inputs, prices and government incentives. Maize was not a major crop, but when the price of fertilisers was subsidised many farmers switch from growing traditional crops as sorghum, millet and fonio to maize. Today the story is different. Local crops like fonio, sorghum, millet and cowpeas are becoming very important again. The success story of maize production is closely linked to availability of cheap or subsidised fertilisers. The current high costs of the commodity has led to a decline in maize production. This is so noticeable on the Jos Plateau of central Nigeria. The experiment with wheat production in the mid-70s in the northern states and mid-80s for Plateau and Nasarawa states is a total failure. The ban on the importation of flour of the '70s have since been lifted as from 1993. Cotton production which even led to the introduction of the ox-drawn plough into Nigeria in colonial times (Corby, 1941) has declined almost to an irredeemable level. Groundnuts production is still viable because the local demand is huge. Cocoa, rubber and oil palm production have no direct bearing on rice production. In Ekiti state, only kola nut and not cocoa plantations are giving way to swamp rice. The implication of the factors mentioned here on rice production is huge. Farmers will choose to continue to grow rice if adequate incentives as cheap land preparation, fertilisers, herbicides, insecticides, weeding and threshing are attractive.

The consumption of gari (a fermented cassava dry product) and importation of beans recently became topical issues in the national press for weeks. The beans debate was introduced by the government itself when it announced to Nigerians its intention to import beans from Burkina Faso in order to bring down the price of the commodity and to make it affordable to the poor. This policy came as a shock to many well-meaning Nigerians because they say there are stockpiles of beans in states like Borno, Yobe, Jigawa, Kano, Katsina, Zamfara, Sokoto, Kebbi, Gombe and Bauchi that can feed Africa. Even more surprising is the fact that beans is the single commodity whose price has remained stable at N55.00 per kg in the last 5 years. This point illustrates that the workings of governments are not easy to fathom and may be based of information which may not be necessarily scientific and rational.

The cassava debate is even more disturbing because its root cause can be traced to the success story of the IFAD funded cassava improvement and multiplication programme. In the last 5 years, the price of gari has never exceeded N20.0 per kg. However, today a commodity considered to be the staple of the poorest of the poor sells for N80 - N90.0 per kg. Majority of Nigerians find this inexplicable. The explanation the government has given is that more Nigerians are consuming the commodity, especially new consumers who are northerners. There is no doubt that gari has become a new diet to many Nigerians, but agriculturalists had predicted the crisis a few years ago when a gloat in cassava root production was reported all over Nigeria and that its production would drop when farmers would respond accordingly (Longmut, personal communication). The IFAD programme was quite concerned about the gloat and responded by importing cassava processing machines from India to be sold to farmers through the ADP system. The machines were too expensive and farmers could not acquire them. NALDA for instance was preparing to proffer a solution to the problem at its December 1999's technical meeting, but by January 2000 it had become defunct

courtesy of a government policy. Cheap but rapid processing and packaging of cassava has never been addressed in Nigeria and so today we have a gari crisis because farmers responded by switching over to the cultivation of other crops.

These debates raise issues which are relevant to any policy which will result in increase in rice production. The implication is that we should be thinking ahead on how to respond if M-APs and WARDA's hybridisation programme were to lead to over-production of rice. An obvious solution is for government to buy up the surplus at a good price for its strategic grain reserve programmes since rice unlike gari, can store well for a long time. That solution may not be adequate, because in the past government has been slow in such matters. That is where M-APs can come in by providing the forum for a rapid response initiated by stakeholders themselves and not by some remote technical committee or dictates of government policy or what have you.

4.5 Summary

Rice millers have independently responded to the demand for high quality rice by consumers. This may be a development that has been triggered by the lifting of the ban on rice importation. This improvement in cleaning technology can only lead to competitive pricing of local rice if the market forces can produce better but cheap packaging methods. An increase in the demand for local rice if good processing has become a culture cannot be met as long as crop yields continue at current levels of 1-2 tonnes/ha.

5. Institutional structures

Several institutions in Nigeria have a stake in rice production, processing and marketing. Government organisations, multinational corporations like the World Bank and seed companies, research institutions like WARDA, IRRI, IITA, NCRI and others, NGOs and marketers all have one role or the other to play in the rice enterprise.

5.1 Government policies

Government policies on rice production whether at the federal or state level are not well defined. Rice import or a ban has been the only policy that has occupied the attention of government over the years. Researchers are unanimous that free imports of rice would discourage local production (Imolehin and Wada, 2000). The import substitution policy of the military administration of Generals Mohammed Murtala and Olusegun Obasanjo in 1975 to 1979 was to make sure that Nigeria was self-sufficient in wheat, maize and rice. This led to the establishment of River Basins Development Authorities (RBDAs). However, in the 1980s, the civilian government of President Shehu Shagari saw the importation of cheap foreign rice as panacea to food shortages. The imports in 1980 were so high that the ports were unable to function due to innumerable ships that were offloading rice and cement. The same government had a policy to reinvigorate the RBDAs with mandates to promote local production of rice as a long term measure. Many years later it became clear that the rice imports of 1980s was only a smokescreen for rewarding political party men with import licenses so that they could have access to foreign exchange. However, credit must go to the Shagari administration more than any other government in Nigeria because though rice import was liberalised, huge fadamas were cleared in many states to open up more land for rice cultivation. No regime has replicated that feat.

Rice together with high yielding maize had been popularised under NAFPP as from 1975. Thousand hectares of rice was cultivated using cheap tractors, fertilisers and other inputs. However, as soon as subsidies were removed the large-scale farmers disappeared and rice production was to be left in the hands of smallholder farmers and at the dictates of environmental factors as rainfall, weeds, pests and diseases.

The ban on the importation of rice had been on and off until 1998 when government finally made up its mind that there should be no restriction on the importation of rice.

The only government rice policy which has been consistent over the years is constant supply of seeds through research institutes, National Seed Service (NSS) and Agricultural Development Projects (ADPs). Even when all other World Bank loans were suspended, a loan for the Special Rice Project was quickly negotiated in 1998 before NSS would totally collapse. It is the only government rice programme going on in the country now. The huge National Fadama Development Programme being implemented with a World Bank loan of about US$300 million is not crop specific. However, it is intended to boost vegetable production and not rice.

5.2 Research systems

A major government policy which has serious implication for rice production is the rationalisation of research institutes. Each research institute was given a crop mandate (i.e. a crop on which it will only conduct research). One institute in each of the 6 geo-political zone has been given an added responsibility to respond to field problems from the ADPs in the zone. National Cereals Research Institute (NCRI), Badeggi takes charge of all field problems in the North-Central zone in addition to its primary and sole mandate to conduct research on rice and sugarcane only. The Institute for Agricultural Research (IAR), Zaria, attends to field problems in the North-West zone; Lake Chad Research Institute, Maiduguri, is in-charge of the North-East zone; Institute for Agricultural Research & Training (IAR&T), Ibadan, is responsible for the South-West zone; Nigeria Root Crop Research Institute, Umudike, is responsible for the South-East zone and Nigeria Oil Palm Research Institute, Benin, is responsible for the South-South zone. This is a rather strange arrangement. For instance all farm field problems in the North-West zone will be attended to by IAR, whether it has to do with its crop mandate or not. Similarly, a field problem on cassava in the North-Central zone should be referred to NCRI by the state ADP. It is not the best arrangement, but it may be cost effective in a way. This awkward arrangement must have been informed by the philosophies of the Unified Extension System adopted by the ADPs where an extension agent is a jack of all trade. The ideal situation is for NCRI for example, to be fully equipped to attend to rice and sugarcane problems only, and in any part of the country. It may be argued that this awkward arrangement actually works because ultimately very serious field problems are referred to the relevant or specialised research institute. However, the reality is that the research, extension and farmer's link is a very weak chain. Extension will blame research for their indifference to field reports. Research on its part blames extension for lack of feedback on farmers' problems. At the moment, any assumption of a workable referral or networking system between National Agricultural Research Systems (NARS) themselves and with extension is mere wishful thinking because the ADP system has collapsed and NARS are short of funds. The radio communication between ADPs and research no longer work for flimsy excuses as the batteries need to be re-charged or operators are on sick leave and so on.

For example in the 1980s, a brand of fertiliser, muriate of potash was imported in large quantities for the cultivation of root crops. However, for a long time farmers could not adopt the technology. This was reported by the ADPs to NARS but there was no response by research. The farmers on their on soon discovered that when that brand of fertiliser is broadcast on rice, it kills all broad-leaf weeds. As may be expected, farmers soon cleared all the stocks of muriate of potash at ADP stores. Extension discovered that the increase in sales of the brand was not due to effectiveness on their part. This ingenuity on the part of farmers was again reported to NARS, and up till today no single research has been conducted on this phenomenon of the use of muriate of potash as a rice herbicide.

The mandate for research on rice and sugarcane by NCRI is not only large, but funding to the Institute has been very limited. Therefore, research work on rice is suffering badly. However, the wisdom that informed specialisation of research institutes in Nigeria has much to offer because each institute will now become a

centre of excellence in its well defined crop(s). All the institutes are only hoping that one day funds will be made available so that their activities can pick up again. NCRI has a long history. It was first established in 1899 by the British colonial administration. It became the Federal Department of Agriculture Research in 1963 and finally National Cereals Research Institute in 1975 with its headquarters at Moor Plantation, Ibadan, but was moved to Badeggi in 1984. It started as the premier institute for maize research in colonial times. NCRI only started systematic research on wetland rice in 1951 at Badeggi, which has now metamorphosed into the headquarters of the organisation. By 1985 it had sub-stations at Birnin Kebbi for deep swamp and floating rainfed rice research, Warri for tidal swamp rainfed rice research, Badeggi for shallow swamp rainfed and irrigated rice research and Bende for inland swamp rainfed rice research. Today it has sub-stations at Ibadan, Oyo state; Uyo, Akwa Ibom state; Amakama, Abia state; Mokwa and Bacita Niger state; Numan, Adamawa state; Yandev, Benue state; Birnin Kebbi, Kebbi state; and Warri, Delta state. Since its inception the institute has been in partnership with International Institute for Tropical Agriculture (IITA), Ibadan, International Rice Research Institute (IRRI), and West Africa Rice Development Association (WARDA). It has released 51 rice varieties. The success story of the release of so many varieties came about as a result close collaboration with the above mentioned partners on the Coordinated Rice Evaluation Trials (CRETs). NCRI has been on many Task Forces of WARDA as the Mangrove Swamp Research, Inland Valley Consortium (IVC) and others. Apart from lack of funding there is a shortage of staff in some departments of NCRI. This includes the breeding and soil management units.

IRRI in the Philippines, was the foremost centre for rice research. All varieties with IR nomenclature in Nigeria were bred by IRRI. NCRI collects such to test for their suitability in Nigeria and possible release. The major activities of IRRI are on rainfed lowland rice (Mackill et al., 1986). Such materials bear the IR nomenclature. Similarly varieties with ITA roots were bred by IITA and were given to NCRI for testing and subsequent release. Since the formation of WARDA in 1972, the role of both IRRI and IITA in Nigeria has reduced. However, collaborative work has continued between them especially in the exchange of germplasm and varietal evaluation. For the latter, NCRI and other NARS are involved. The main objective of research by these international organisations is to incorporate into high yielding varieties resistance to major biological and physical constraints (Masajo et al., 1986). The National Centre for Genetic Research and Biotechnology (NAGRAB) is located at IAR&T, Ibadan, where germplasm materials are conserved and genetic information can be found for routine breeding work (Imolehin and Wada, 2000). The work of both IRRI and IITA in Nigeria are now coordinated by WARDA. WARDA on its part works through NCRI in a more formal way but indirectly through ADPs and NGOs.

5.3 Extension and diffusion of new technologies

5.3.1 Formal

The formal agricultural extension research and extension set-up in Nigeria is unidirectional. NAERLS is the principal agency for agricultural extension research and extension. It collects information on new technologies from research institutes, packages them and hand them over to the ADPs for dissemination to farmers. The ADPs on their part divide their states into zonal offices. Each zone is divided into a number of Block Extension Units with officers using the same designation to oversee the activities of village extension agents. Monthly technology review workshops are organised at the state and zonal levels with scientists from the research institutes of the given geo-political zone supervising. A subject matter specialist from the state or zone solves problems reported by Block Extension officers who in turn solve the problems reported by village extension agents. This system is referred to as Training and Visit. This may best be described as a mere ideal, because the Village and Block Extension Officers are never at their duty posts. They are usually at the Head Office submitting documents for payment of bush allowance or such things.

In practice the extension system of the ADPS has completely collapsed with the expiration of World Bank loans as from 1994-1996. In some few states the ADPs are functioning commensurate with the interest and commitment of the Governor of the given state to agricultural development. These will include states like

Jigawa, Kebbi and Zamfara. In 1995, the World Bank-assisted National Agricultural Research Project (NARP) was conceived as a solution to the bottlenecks in the extension delivery system. It came up with a system called REFILS (Research Extension Farmer Input Linkage Systems). NARP has collapsed and most of the funds were wasted on buying vehicles, air-conditioners, computers and other office equipment for Project Co-ordinators. It is amazing that technocrats have to be reminded over and over that for any technology to be adopted by smallholder farmers, comments from them from inception to implementation must be taken to heart (Abasiekong, 1975, Awolola et al., 1976).

Seed technology is disseminated through NCRI, National Seed Service (NSS) and ADPs. NCRI produces breeder and foundation seeds on behalf of NSS. The foundation seeds are given to ADPs to multiply through the outgrowers programme or community seed programmes. At the end of each season NSS buys up all the certified seeds from the farmers for processing and packaging. At the beginning of each cropping season NSS releases the seeds to the ADPs for distribution to farmers. A weak link in this chain is the inability of NSS to maintain rigorous standards for the production and packaging of certified seeds. Stories abound on farmers seeing up to three layers of crops from seeds bought at an ADP farm centre. Some outgrowers simply go to the market and buy paddy rice which is supplied to NSS as certified seeds.

The system is plagued by seed quality problems as adulteration of seeds and low germination rates. World Bank loans to NSS for seed production had long expired. NSS is now completely unable to enforce seed production standards. Seed companies which should be in the forefront of promoting new seeds are making very negligible contribution. They are too few and have limited scope. Farmers have to depend on the informal system for spread of technology.

5.3.2 Informal

A major channel of extension is farmer-to-farmer. It is a cost effective method of extension because the farmer acquires a technology that has been proven to be successful by another farmer. Some cultural practices have been passed from one generation to the other for a long time. In Sokoto and Kebbi states the varieties of floating rice which farmers cultivate are from ancestors. At Bekwara in Cross River, dry season rice cultivation rice by gravity irrigation is said to have been started by a lad some few years back. Now it has been adopted by many farmers in the area. Large-scale farms are common places where other farmers learn new technologies. A good field will always attract farmers. I had a personal experience with the spread of improved cassava to my village of Zamko, in Langtang, south east of Jos in central Nigeria. I planted some cuttings which I collected from the ADP in 1987. The variety was new and most farmers were literally

Box 2. Success story of the adoption of an unofficial variety

The rice variety called ‘yar China' in the northern Nigeria or ex-China in the southern Nigeria is popular with farmers all over the country. However, this is a material that has not been released formally. It has even been rejected as unsuitable by NCRI scientists. How this variety came to Nigeria can be used to illustrate three points. In the first place, the farmer-to-farmer extension channel is very effective. In the second place, the role of a master farmer in the extension strategy should not be swept away by sentiments of the ideals of participatory models. 'Yar China' was a variety brought into Nigeria by late Governor Kangiwa of Sokoto state. He was on an official visit to the Republic of China and came across the rice variety he liked very much. He collected some seeds and distributed it to high ranking officials in his state to propagate and distribute. The seeds got into the hands of farmers very soon and from 1983 to date 'yar China' is seen in every RGE as upland rice, swamp rice and what have you. In the third place the danger of importing seeds without due quarantine is a real problem, but the mistake can be rectified and the material dully tested for formal release. Ex-china has started appearing in publications by respectable scientists as being very popular, but susceptible to leaf blast (Singh et al., 1997). That may be a good sign that this unofficial variety which we have seen as far south as Cross River and Ebonyi states may soon be a candidate for some research work.

sympathising with me that my dwarf cassava would produce a poor crop. They were aware that I had transported the cuttings at a huge cost from a farm service centre located 200 kilometres away. However, at the time of harvest when they saw the size of the cassava roots, they all had a change of heart and everybody wanted some cuttings. That variety was introduced without any formal extension message. Box 2 provides another example of the informal extension system at work in Nigeria.

5.4 Rice schemes

Rice schemes were initially conceived as model farms to propagate and popularise rice production as at Shaki in Western Nigeria in 1945 (Udo, 1970). The aim of massive production of rice was a policy that has been adopted for irrigated rice schemes under the Green Revolution programme. This led to the establishment of 11 River Basins Development Authorities (RBDAs) to provide irrigation infrastructures. Table 14 provides a list of RBDAs which the present Federal government see as a viable policy option for increased agricultural production and are being resuscitated.

Table 14. River Basin Development Authorities (RBDAs)

Name	States covered	Date of establishment
Upper Benue	Adamawa, Gombe, Bauchi, Yobe	1978
Lower Benue	Plateau, Nasarawa, Benue	1978
Lower Niger	Kaduna, Katsina, Kogi	1978
Upper Niger	Kwara, Niger	1978
Sokoto-Rima	Sokoto, Zamfara, Kebbi	1975
Hadejia-Jamaare	Kano, Jigawa, Bauchi	1975
Chad Basin	Borno, Yobe	1975
Ogun-Osun	Ogun, Osun, Oyo, Edo, Delta, Lagos	1978
Imo	Imo, Abia, Rivers, Bayelsa	1978
Anambra	Anambra, Enugu, Ebonyi,	1978
Cross-River	Cross-River, Akwa-Ibom	1978

A major drawback with the RBDAs is that they have little or no formal extension components. Dams are constructed free, land prepared and sometimes planted and parcelled out to farmers in small plots to maintain and at the time of harvest cost of inputs, including water, are paid for by the farmer. RBDAs do not engage in direct production, the huge capital investment notwithstanding. They are like faceless task forces.

However, before the RBDAs, there were rice schemes under irrigation or rainfed floodplains. The only ongoing Rice Scheme with substantial government input is the World Bank assisted Special Rice Programme. Some 20-30 farmers are selected per state and they are provided with a package including seeds, herbicides, insecticides, fertilisers and small money to grow rice. The cost of inputs and credit are paid for at harvest. This programme is nation-wide. It will fail like the ones reported in Chaudhary & Nanda (1986) at Bida, Lafia, Gusau, Ayangba and Ilorin funded by World Bank loans but are now completely extant. They failed because of inadequate funding, untimely supply of funds and inputs, and lack of firm commitment by officials and staff. Table 15 is a list of such schemes which may actually be extant, but smallholder farmers are actively growing rice on them.

Table 15. Rice Schemes in Nigeria			
Name of Scheme	**Year**	**State**	**Status/comment**
Jere Bowl Rice	1948	Borno	Government now supplies only water for supplementary irrigation.
Sokoto Mechanised Rice	1948	Sokoto	Now incorporated under S-RBDA.
Shaki Experimental Station/Rice	1945/53	Oyo	By 1960 it has declined, now extant.
Oshogbo Rice	1954	Osun	Abandoned by farmers since 1957.
Abakaliki Experimental Station	1942	Ebonyi	Rice production is now adopted by smallholder farmers as a vibrant private sector business.
Uzo-Uwani Farm Settlement/Adani Rice	1962/78	Enugu	Only one crop of rice is grown because the irrigation facilities are all broken down. The 1978 component was a provision of funds from the World Bank to reactivate about 5,000 ha. This too has collapsed many years ago but two managers are left as rent collectors for land farmers are cultivating.
Lau Irrigation	1959	Borno	Government now supplies only water.
Abadam Irrigation	1957	Borno	Government now supplies only water.
Zauro Folder Project	1975	Kebbi	Operational through small pumps.
Sokoto-Rima Rice	1975	Kebbi	Operated now by smallholder farmers.
Goronyo Irrigation	1975	Sokoto	Dam is a menace responsible for perennial flooding in the entire Basin due to irresponsible release of excess water.
Bakalori Irrigation	1975	Zamfara	-do-
Saba Irrigation	?	Zamfara	No infrastructural support to resident farmers.
Talata Mafara Irrigation	1975	Zamfara	-do-
Kadawa Irrigation	1975	Kano	Initially for wheat cultivation. Vegetable production have overshadowed rice cultivation.
Hadejia Valley Project	1981	Jigawa	Sugarcane will soon replace swamp rice throughout the state.
Jekarade Irrigation	?	Jigawa	-do-
Dambo Irrigation	?	Jigawa	-do-
Duku/Lade Irrigation	1985	Kwara	No infrastructural support to resident farmers.
Magura Irrigation	1978	Yobe	-do-
Boloram Irrigation	1982	Yobe	-do-
Balle Irrigation	1992	Yobe	-do-
Longkat Rice	1978	Plateau*	Taken over by Lower Benue Development Authority.

* Some rice schemes were taken over by NALDA throughout Nigeria. However, NALDA is now defunct and it is expected that farmers will continue to cultivate rice on the land without support from government until the Department which took over NALDA is able to have a programme.

The reality at Adani Rice scheme (also called ADARICE) today in Enugu state is representative of the other schemes. The dam is silted and all the main channels are blocked. The farmers no longer grow rice in the dry season. The rainfed crop is cultivated without any technical or extension information from the ADP. There are 2 managers at the scheme whose only role is to lease out the land to farmers at the rate of N1000-1200/ha/annum. The farmer makes arrangement for his seeds, other inputs, ploughing and so on.

The failure of these schemes is easy to account for. Instability in government policies is the bane of agricultural development in Nigeria. Both officials and staff lack commitment to the objectives of the projects. Farmers on their part have been mesmerised by the subsidy syndrome which the World Bank has been opposing but tacitly supporting because the loan facilities seemed to be there for the asking. Poor co-

ordination of government activities in relation to the schemes is another factor which has led to their demise. Ministries are always being created and effective handing over or taking over of the parastatals or units are never completed before a new government is put in place with different policy emphasis.

Last year, the Governing Boards of the RBDAs were inaugurated with the mandate to reactivate them. Given adequate funding we should be witnessing some activity which will bring relief to the farmers who have been growing rice on the schemes without any support from the government. We hope silted dams will now be cleared and water channels reconstructed for dry season cultivation of rice to be possible again.

A disturbing phenomenon which has arisen due to the inactivity of the authorities in-charge of some of the irrigation dams has been irresponsible release of water without regard to downstream consequences. In Kebbi state, farmers harvested a rice crop for the first time in four years only due to an agreement brokered by the Federal Ministry of Water Resource between Sokoto, Zamfara and Kebbi states on the release of water from the Bakalori dam. Water was released at the beginning of the rains when all dry season activities were over, instead of the practice of releasing it in September when rice would be heading.

Farmers along the Benue drainage system have been experiencing flooding when water is released from a dam in the Cameroons in the month of September with massive destruction of maturing rice in Adamawa, Taraba, Plateau, Nasarawa, and Benue states. An international agreement between Cameroon and Nigeria to be mediated directly by officials of the two countries or European Union will be helpful.

5.5 NGOs

There are only a handful of NGOs that are directly involved in the dissemination of rice technologies. Church based NGOs have been known to be in the forefront of disseminating information on crops as maize, vegetables, trees, cassava, palm tree, but not so much on rice. The few NGOs promoting rice cultivation are the Catholic Agricultural Training Centre, Abwa, (near Gboko, Benue state), Sudan United Mission/NRC, Abakaliki, Development Exchange Centre (DEC), Bauchi and Women Farmers Advancement Network (WOFAN), Kano. The last two are involved with women groups in only the processing and marketing of rice at Dass and Garko respectively. The Abwa centre provides tractor hiring services, distributes farm inputs, trains farmers in the use of inputs and runs a credit/loan scheme with 100% re-payment rate (Box 3). As a result of this current M-APs project in Nigeria, EDO has started providing a rice network between GOs, NGOs and Research Institutes. Even so, the Network is still low-keyed.

Box 3. A successful NGO agricultural development project

The Catholic Rural Agriculture Training Institute at Abwa, near Gboko in Benue State is a success story on how an NGO has an effective Agricultural Development Project. The Centre is run by an expatriate priest and a Nigerian assistant. It has been offering courses in basic modern farming techniques for a long time. Students are also taught basic hygiene, health and water sanitation. The Institute was established in 1964 and became fully operational in 1968. Graduates from the institute are given farm inputs to start their own farms. In addition they are instructed to mobilise farmers into co-operative societies called Catholic Agricultural Services Unions so that they can have access to more expensive inputs as improved seeds, tractors and fertilisers. The Institute has about 12-15 tractors for its 16 Unions which had to be reduced from 30 in order that promise of services can be met in the face of the scarcity of fertilisers. There are about 70 members per Group. Each society raises money to pay for the inputs and the Institute faithfully meets their obligations on time. The Unions have constructed 'grain banks' to collectively store their produce under good management and are sold when prices are good. This system works because of the commitment on the part of the workers of the Church and the farmers' willingness to pay for services, even when they are not subsidised. In the year 2000 BNARDA(Benue State Agricultural and Rural Development Authority) hires out its tractors at N450.00/acre only, but the service is never available to smallholder farmers. The Institute hires its tractors at the rate of N1000.00/acre and yet farmers are willing to pay for the service.

Seedlings of mangoes and citrus are sold at a rate lower than that of government (N15.00 vs. N30.00) in order to encourage farmers to re-stock their orchards after a serious outbreak of mealybug infestation in the last 5 years.

5.6 Summary

Institutions that have a major role to play in meeting the needs of farmers include Government Organisations (GOs) as Regional Research Institutes (RRIs), National Research Institutes (NRIs) and ADPs; NGOs and the private sector. The formal extension system has collapsed with the expiration of World Bank loans for the ADPs. Can a commercial service-led extension system be put in place by M-APs? Huge funding through loans for extension may never be available in Nigeria again. The only option left is how the informal system can be modified to be semi-formal. NGOs may provide initial take off platforms with the understanding that when grants from donor agencies dry up, the extension system should be able to sustain itself. Some NGO health programmes have been known to is self-supporting and agricultural extension can be ran using similar principles. In 1988-1992, I was involved in making policies for a veterinary extension service by an NGO (COCIN RDP) to cattle breeders. The scheme paid itself and such philosophies can be explored for other forms of agricultural extension. The cattle breeders needed reliable services and were prepared to pay for them.

A further consideration is that there must be face to face discussion and planning by all the institutions which will make M-APs to work.

6. Constraint analysis

The environment under which a farmer produces rice since the expiration of World Bank loans as from 1994 is not encouraging. Biophysical and climatic conditions are not easily predictable. However, several farmers are enthusiastically producing rice against all odds. We have come across only one community where rice cultivation constitutes very minimal drudgery. That is at Ganawuri of Plateau State of central Nigeria.

6.1 Policy inconsistency/instability

Change is a familiar feature of policy in Nigeria without cause other than political consideration and some intangible reasons. Every government has its interest and resources are allocated to meet them. These may not necessarily be for the common good, but they are considered national interests all the same. A recourse to easy World Bank loans has compounded matters. Since 1960, there are not less than ten major change of government and the attendant change in policy formulators and implementors. Each new government wishes to surpass the previous one in zeal of putting aside well articulated policies and programmes. There has been continuity in government in Nigeria given its 40 years of chequered political history. However, the same can never be said for policy.

The issue of fertiliser subsidy best illustrates the point. In the colonial era, there were a number of Agricultural Schemes. These were basically experimental stations/extension outposts and strategy to improve the income of farmers. Rice was introduced to the Abakaliki area in 1942 because unlike other provinces, the area had no cash crop like rubber, cocoa, cotton or groundnuts. There were abundant swamps that were not suitable for cultivation of yams. With the Scheme came job opportunities as parboiling rice, fabrication of parboiling drums, milling jobs etc. An interesting aspect of the Scheme was that though rice was a new crop, farmers had to pay for all the inputs including fertilisers. The Abakaliki Scheme was a success story. A similar Scheme at Kontagora (now in (Niger state) in 1948 failed because farmers wanted

all inputs subsidised. That seemed to set the stage for a heavy subsidy policy on agricultural inputs especially fertiliser from independence up to the mid-eighties in Northern Nigeria. By 1977-78 government had realised that fertiliser had been a major drain on the foreign reserve and a phosphate blending plant was established at Kaduna. This was followed by a nitrogen plant at Onne, Port Harcourt. Both plants were meant to conserve scarce foreign exchange. However, government continued to import and subsidise fertiliser to date because the plants are not functioning properly.

From 1990, the commodity had become scarce and out of the reach of farmers. It was only in 1995 that subsidy on fertiliser was removed and a farmer could have it at the right time and in the quantity he required. That coincided with the expiration of funding for most World Bank assisted projects. However, in 1999, the government imposed a 25% subsidy on fertiliser with the attendant result of a scarcity of the commodity again. Government is right that agriculture is subsidised the world over, but it needs to acknowledge that the subsidy usually goes to *bona fide* large-scale farmers and not smallholders whose operations and needs cannot be easily assessed and evaluated. Nothing is as worrisome to a farmer as uncertainties over the availability and procurement of essential inputs, tractors and credits. In many areas, rice production depends on fertiliser (FAO, 1984, Tanaka et al., 1964).

Policy inconsistency is not only at the Federal level. In the democratic setting, states are autonomous and their policies can even be at variance with the Federal government. Thus during the 2000 cropping season in Jigawa state alone, about 250 tonnes of rice seeds were planted. Jigawa happens to have over 170 wetlands and 60% of the floodplains of the former Kano State are in Jigawa. However, much of the wetlands will soon be turned into sugarcane plantations as a state policy. The situation in Kebbi State is more cheering as far as rice production is concerned. The Sokoto-Rima system which is about 300 km long is almost equally divided between Sokoto and Kebbi states. Over 200 km of River Niger flows through Kebbi. The potential of these watercourses is yet to be fully tapped. With the cessation of World Bank loan facilities in the last 4 years one would expect a decline in rice activities. However, that is not the case in Kebbi (Gollifer, 1995). The fadama projects were well executed when the funds were available. Over 7578 tubewells and washbores for irrigation are physically in place. Under the special rice programme seeds, sickles and other inputs are still being made available to farmers on loan.

6.2 Fluctuations in value of Naira

Another key constraint to producers is variable supply and pricing of inputs. The value of the Naira has suffered much fluctuation; hence the pricing of imported inputs as fertiliser and other agricultural chemicals. In the days of the oil boom, Nigeria had an artificial exchange rate of 40 US cents to N1.00. Its effect on agricultural production could not be felt because of subsidies and huge foreign reserves. By the early days of the Structural Adjustment Programme of 1986, farmers started feeling the impact of the fluctuation. Five Naira exchanged for the US dollar. Now N112.00 officially exchanges for a dollar under a single tier exchange market. However, currency speculators exchange the dollar for N140.00. This has serious implications for rice production. Imported inputs will continue to be beyond the reach of smallholder farmers because production costs will rise considerably. This is even worst for large-scale farmers who are more sensitive to input pricing. Table 16 provides the trend in the fluctuation of the value of the Naira.

Table 16. Value of Naira to 1US$		
Year	**Naira value Autonomous rate**	**Official rate**
1985	1	1
1986	5	2
1987	5	2
1988	7	2
1989	7	3
1990	10	5
1995	40	20
1997	90	22
1999	100	22
2000/2001	112	112

6.3 Seed systems

The development, production and distribution of quality seeds are crucial to successful cultivation of rice. In Nigeria all three critical activities are done formally and informally. The formal system is in the hands of GOs, International Research Institutes (IRRs), Multilateral Agencies (MLAs), NARS and seed companies. The informal system on the other hand is carried out by farmer-to-farmer and local market forces. The seed systems in Nigeria are full of problems.

6.3.1 Formal seed systems

Table 17 gives the array of as much as 51 rice varieties (with 4 additional ones in the pipeline, Tanko Mohammed, per. com.) that have been released to farmers. NCRI is preparing a manual on the characteristics of all the varieties covering diagnostic features a field worker can use in order to proffer solutions to farmer's field problems. This should improve tracking down varieties and information delivery service to farmers.

Table 17. Agronomic characteristics of released rice varieties in Nigeria

Variety	Cultivar source	Ecology*	Year of release	Growth duration	Grain type*	Reaction to blast*
FARO 1	BG-79	SS	1955	135-174	B	S
FARO 2	D-114	SS	1958	135-176	B	S
FARO 3	Agbede	Upland	1958	95-120	B	S
FARO 4	KAV-12	DS	1959	189-220	B	MR
FARO 5	Makalioka 823	SS	1960	135-154	B	S
FARO 6	I.C.B.	DS	1961	176-198	B	MR
FARO 7	Maliong	DS	1962	160-217	A	MR
FARO 8	MAS-2401	SS	1963	155-60	A	S
FARO 9	SIAM-29	SS	1963	189-220	A	S
FARO 10	SINDANO	SS	1963	115-145	A	MR
FARO 11	OS-6	Upland	1966	115-120	B	R
FARO 12	SML-140/10	SS	1969	145-155	A	MR
FARO 13	IR-8	SS	1970	135-140	B	S
FARO 14	FRRS-43	DS	1971	170-198	B	MR
FARO 15	FRRS-162-B	SS	1974	145-160	B	MR
FARO 16	FRRS-168-11-2-B	SS	1974	140-160	B	MR
FARO 17	FRRS-148	SS	1974	145-160	B	MR
FARO 18	Tjina	SS	1974	167-179	B	R

Variety	Cultivar source	Ecology*	Year of release	Growth duration	Grain type*	Reaction to blast*
FARO 19	IR-20	SS	1974	135-140	B	MR
FARO 20	BPA-76 (BICOL)	SS	1974	125-130	B	MR
FARO 21	Taichung Native 1	SS	1974	90-110	C	R
FARO 22	IR 627-131-3-37	IS&SS	1974	145-150	B	MR
FARO 23	IR 5-47-2	IS&SS	1974	145-150	B	MR
FARO 24	DeGaulle	IS&SS	1974	135-145	A	S
FARO 25	FAROX 56/30	Upland	1976	115-120	B	MR
FARO 26	TOS-78	IS&SS	1982	130-135	B	MR
FARO 27	TOS 103	IS&SS	1982	110-115	A	MR
FARO 28	FAROX-118A	IS&SS	1982	135-140	A	MR
FARO 29	BG90-2	IS&SS	1984	125-135	B	S
FARO 30	FAROX 228-2-1-1	IS	1986	110-115	B	R
FARO 31	FAROX 228-3-1-1	IS	1986	110-115	B	R
FARO 32	FAROX 228-4-1-1	IS	1986	110-115	B	R
FARO 33	FAROX 228-1-1-1	IS	1986	110-115	A	MR
FARO 34	FAROX 228-2-1-1	IS&SS	1986	105-115	B	MR
FARO 35	ITA 212	IS	1986	105-115	B	R
FARO 36	ITA 222	IS	1986	120-135	B	R
FARO 37	ITA 306	IS	1986	120-135	A	R
FARO 38	IRAT 133	Upland	1986	125-140	C	R
FARO 39	IRAT 144	Upland	1986	100-105	C	R
FARO 40	IRAT 299	Upland	1986	100-105	B	R
FARO 41	IRAT 170	Upland	1986	115-120	B	R
FARO 42	ART 12	Upland	1986	115-120	B	R
FARO 43	ITA 128	Upland	1986	115-120	B	R
FARO 44	SIPI 692033	IS	1992	100-105	A	R
FARO 45	ITA 257	Upland	1992	90-100	B	R
FARO 46	ITA 150	Upland	1992	100-105	B	R
FARO 47	ITA 117	Upland	1992	110-115	A	R
FARO 48	ITA 301	Upland	1992	110-115	B	R
FARO 49	ITA 315	Upland	1992	115-120	B	R
FARO 50	ITA 230	SS	1992	130-135	B	R
FARO 51	CISADANE	IS&SS	1998	145-150	B	MR

* SS = Shallow Swamp A = Long grain type R = Resistant
DS = Deep Swamp B = Medium grain type MR= Moderately Resistant
IS = Irrigated Swamp C = Short grain type S = Susceptible

Source: NCRI, 2000

Farmers who get their seeds through GOs as NSS/ADPs and seed companies consistently complain of poor quality. Seeds are commonly mixed and a field may have up to three tiers or storeys of rice plants. Another common complaint is poor germination rate. These complaints will continue as long as NSS cannot strengthen its field monitoring system. This is how the idealised formal seed system works. NSS mandates NCRI/ADPs to multiply breeders' seeds. NSS then requests the ADPs/seed companies to multiply foundation seeds. The ADP in collaboration with NSS supervise a seed outgrower scheme to produce certified seeds; NSS buys up all the certified seeds and stores them; at the beginning of the cropping season, NSS requests the ADPs to collect certified seeds for re-sell to farmers. That system does not work efficiently. In the first place NSS lacks the logistic support to enforce rigorous field standards as site selection, removal of volunteer crops, timely and effective weeding and so on. It is also not uncommon to hear that an outgrower who had collected rice seeds and other inputs from the ADP would not plant the seeds at all. However, at the time of harvest he would go to the market and buy grains to be re-sold to NSS

as certified seeds and at a much higher price for that matter. He makes more money than the outgrower who actually grows the crop. He would not be caught because field monitoring by NSS is not effective. The calibre of field staff is another major complaint. NSS would just post National Youth Service Corps (NYSC) members serving with it to monitor field operations that are completely new to them.

There are very few rice seed companies in Nigeria. Some are UTC Farms, UAC Farms, A.G. Leventis Farms and Pioneer Seeds. These companies find the sales of vegetable seeds more lucrative than rice seeds. So when they are drafted by NSS to distribute rice seeds, they do so reluctantly on a sales on return basis. That means NSS will uses them only as sales outlets. They are paid a commission on true sales. Unsold stocks will be collected back by NSS. This partly explains the source of the complaints of poor germination rate by farmers on some NSS stocks. This low private sector participation is not good for increased rice production. However, WARDA's Community Seed Production programme under the auspices of NSS/NCRI/Seed companies offers much hope.

NSS and NCRI have gone a step further to identify varieties preferred by farmers. However, the scope of the research is limited since it concerns only rice produced under the Special Rice Programme. Table 18 and Table 19 provide the data.

Table 18. Varietal preference in Year 2000

				RICE	**VARIETIES**				
STATE	**FARO 44**	**CISADANE**	**FARO 15**	**FARO 27**	**ITA 212**	**FARO 46**	**ITA 315**	**FARO 43**	**ITA 306**
Abia		X			ITA 301		X		
Adamawa									
Akwa-Ibom	X								
Anambra	X					X			
Bauchi	X							X	
Bayelsa									
Benue	X				X	X			
Borno									
Cross-River	X				X	X			
Delta	X								
Ebonyi	X	X							
Edo									
Ekiti	X					X			
Enugu	X						X		
FCT	X					X			
Gombe	X					X			X
Imo	X								
Jigawa	X					X			
Kaduna	X		X				X		
Kano	X								
Katsina						X			
Kebbi	X					X			
Kogi	X					X	X		
Kwara	X							X	FARO 29
Lagos	X								
Nasarawa	X								
Niger	X							X	FARO 48
Ondo	X					X			
Ogun						X			
Osun						X			

Oyo	X					X			
Plateau	X			X					
Rivers	X								
Sokoto	X								
Taraba	X					X			
Yobe	X					X			
Zamfara	X					X			
Source: Shobowale (2000)									

Table 19 illustrates the scope of seed distribution in the formal system through ADPs. This is not comparable to the seeds distributed under the informal system.

Table 19. Certified seed production by the ADPs in 1999

			RICE	VARIETIES			
ADP	**FARO 46**	**FARO 44**	**ITA 315**	**FARO 35/37**	**FARO 29**	**FARO 43**	**TOTAL (Metric ton)**
Abia		4.0					4.0
Adamawa		10.5		10.0			20.5
Akwa Ibom		2.0					2.0
Anambra	2.5	4.5					7.0
Bauchi		10.0					10.0
Benue		5.0					5.0
Borno		17.0	22.4				39.4
Ebonyi		15.0	0.5	1.5*			17.0
Enugu			3.0				3.0
Imo		1.5					1.5
Jigawa	30	100		70			200
Kaduna		1.1	3.8		1.97*(15)		6.87
Kano		160			1.0	0.97	161.97
Katsina	7.0						7.0
Kebbi		30		20		4.0 (50)	54.0
Kogi		2.4					2.4
Lagos		4.8			1.0	1.0	6.8
Nasarawa		5.0					5.0
Niger		6.0	1.7		5.0		12.7
Ogun	3.0*						3.0
Total	**42.5**	**380.8**	**31.4**	**101.5**	**8.97**	**5.97**	**571.14**

Source: Shobowale (2000) * Low viability

6.3.2 Informal seed systems

Much of rice cultivated in Nigeria is from the informal seeds system. It is a system where seeds are distributed from farmer to farmer without an agricultural extension agent telling the farmer that such and such seed is good and should be planted by him or her. The 'yar china' story in 5.3.2 is an example that shows the strength of the informal system. The farmer is able to observe the field and crop of another farmer during the cropping season. According to the judgement of the observing farmer, the rice farmer may be approached for seeds. This may be given out on a reciprocal basis or simply as a dash, but in small quantities. Seeds perceived by farmers of a given community to be good will not be taken to the market but will be exchanged with "bad" seeds which will be sold in the market. Farmers adopt seeds in the informal system according to what the farmer has seen performing on the field of another farmer and according to needs and not something forced down their throat.

The farmers growing African rice use seeds which have been passed from one generation to the other. It is like seeds from ancestors themselves. However, no community in Nigeria seems to be growing ancient varieties just because of some traditional sanctions. Rice is grown according to choices the farmer makes which are considered best for every cropping season.

Seeds can also be bought on the open market under the informal system, especially in southern Nigeria. However, the quality of such planting materials cannot be guaranteed especially in terms of viability. In the northern Nigeria, farmers may exchange seeds or give out as dash. That is a constraint in a way because only small quantities can be given out free. An activity that M-APs may undertake to improve the informal seed system is to appoint farmers who will be quality control officials of a sort to provide on the spot seed grading services free of charge. That will go a long way in improving the informal system.

6.4 Agronomic constraints

6.4.1 Diseases

This section draws heavily from Singh et al., (1997), Ukwungwu et al. (1989), and Ukwungwu et al. (1992), which treat agronomic constraints which affect rice production in Nigeria. The major rice diseases in Nigeria have been identified as leaf and panicle blast, rice yellow mottle virus (RYMV) and leaf scald. Others are sheath blight, grain discoloration, bakanae, false smut, sheath rot and brown spot.

Leaf and panicle blast is caused by the fungus *Pyricularia oryzae* and is very common in upland and rainfed lowland environments. It is also a common disease of plants under irrigated conditions. In areas prone to drought conditions, blast can be severe. Asian rice varieties are more susceptible to blast than the African rice (WARDA, 1999b).

RYMV occurs in scattered spots throughout the country, but it is more prevalent in localised irrigated lowlands of the Sudan Savannah. Leaf scald is widespread in the humid zones on rainfed uplands and irrigated lowlands of the north. Sheath blight has been observed in upland varieties in the humid zones. Sheath rot is widespread in every RGE and if rainfall occurs at the reproductive stage, it can be severe.

6.4.2 Pests

The African Rice Gall Midge (ARGM) is a major insect problem (Awoderu 1974, Alam, 1991). The midge *Orseolia oryzivora* is more common in the south. There was an outbreak in 1988 from Benue River floodplains through Anambra, Cross River, Imo and Ebonyi states. Abakaliki and Adani are hot spots for ARGM. African rice is more tolerant to ARGM and so are some Cisadane varieties. These are available for farmers to use due to the breeding of blast and ARGM resistant varieties (Akinsola, 1985, Anon. 1997b).

Stemborers have been reported in all RGEs. In upland rice, nematodes, termites and army-worms can be serious. Vertebrate pests as rodents and birds are major problems in all the rice growing environments. The common bird pests are weavers and quelea especially in the Sudan Sahel zone.

6.4.3 Climate

Drought is a major problem of upland and rainfed lowland rice in the northern part of Nigeria. In some places like the Jere Rice Bowl, supplementary irrigation is mandatory. Low temperatures in the dry season that may be ideal for a wheat crop for which most of the irrigation projects were started in the first place can slow down rice growth and poor grain filling. Submergence of the crop and waterlogging in deep water environment and flood prone areas can be a real source of worry to farmers.

Iron toxicity due to soils with high ferrous ion is common in inland valleys and irrigation sites throughout Nigeria (Masajo et al., 1986, Winslow et al. 1989). This can be easily corrected by manipulating the soil pH.

6.4.4 Water regime

The management of water is crucial in profitable production of rice. The River Basin Development Authorities were established to harness the natural water resources for irrigation. Unfortunately, most of the dams overflow at the peak of the rains in July/August. This happens to be a crucial stage in the growth of the rice plant. Due to poor water management, the water released from these dams cause incalculable damage to rice fields downstream. Farmers in Kebbi states are always at risk if the Bakalori dam in Sokoto State is released in July/August. Farmers at Badeggi are at risk of total crop failure when River Gbako overflows. Similarly for many years running, farmers still in Niger State have suffered total crop failure due to untimely discharge of excess water from Kainji Lake and Shiroro Lake.

In the year 2000, farmers in Kebbi could harvest a crop in four years because the Federal Ministry of Water Resources brokered an agreement between the states in the Sokoto-Rima River system and the water from the dams were released in April/May before the rains became established. With proper management the dams will never fill to the point of causing flooding, but still it will hold sufficient quantities for planned water activities.

Farmers on the Benue drainage system are also at risk of total crop failure when excess water is discharged from a dam in Cameroon in the month of September/October. The Benue has caused serious flooding in recent times in Adamawa, Taraba, Nasarawa and Benue states. An international agreement on the release of excess water from dams in Cameroon needs to be brokered for the sake of smallholder rice farmers.

6.4.5 Weeds

Weeds have the potential of causing total crop failure. Yield losses caused by uncontrolled weeds in rice has been estimated for Nigeria as 80-100% for upland ecologies and 46-84% for lowland ecologies (Akobundu et al., 1986). The major weeds of inland valley bottoms and floodplains are *Cyperus spp., Commelina spp., Paspalum spp., Cynodon dactylon, Ischaerum rugosum, Echinochloa spp., Sacciolepsis spp.* and so on. Weeds of deep water ecologies include *Oryza barthii, O. longistaminata, Ipomoea aquatica* and *Eleocharis plantaginaea.* Competition with weeds in most rice growing ecologies implies that the farmers spend much time weeding. Moreover, social change makes it increasingly difficult for farmers to mobilise labour, and they are thus unable to increase production. Akobundu et al. (1998) describes aquatic weeds very accurately. The high cost of herbicides and their residual effects are major hindrances to the use of the technology. The most important method of weed control remains, and is likely to remain, through cultivation and efficient water control (Bullen, 1971).

6.4.6 Input supply

Input supplies are not only erratic, but sometimes adulterated and yet very expensive. Under the current Special Rice Programme, inputs are always received late by the ADPs. Fertilisers are sometimes of the wrong formulation and there is always need for top dressing. This increases the cost of labour. Herbicides and insecticides are usually expired. Given the low price rice attracts, the farmer finds these inputs dispensable and so his production is very low. Some old stocks of chemicals are from Petroleum Tax Fund (PTF) days of 1993 - May, 1999 when excess money from the removal of subsidy on petroleum products was channelled to actual development. These are still available, but the farmer is awaiting government subsidy.

6.4.7 Farmers' responses to some constraints

Smallholder rice farmers have evolved ingenious ways of tackling some of their field problems. These are reported here not as recommendations on indigenous knowledge system (IKS) techniques for adoption, but rather as mere field observations. Throughout the Plateau and Nasarawa states, farmers use the powder of old dry-cell batteries as a kind of seed dressing before planting rice by broadcasting. This is not only hazardous to the farmer, but to the soil also. The benefits reported by farmers are that birds will not see the seeds and therefore the risk of replanting is reduced considerably.

Another cultural practice worthy of reporting is found in the deep swamps of Katsina Ala river of Benue state. Damage to rice by rodents, especially rats is quite high. Just before harvest when the problem is more acute, farmers make trenches around the fields and filled them with water. Bait prepared from ground fish bones mixed with palm oil is smeared in the trenches. The rats are drowned in the process of eating up the bait and in that way a good rice harvest is more assured. Farmers in Birnin Kebbi of Kebbi State have reported that the year they experience flooding, they never have problems with rats. Unfortunately, they will have no crop either. Using water to control rats is a sound cultural practice.

The use of ash from rice straw or bran as manure is a widespread practice with rice farmers from the far stretching from the North right down to Ogoja, Abakaliki and Adani rice zones in the South. It is a scientific practice as confirmed by Dr. Olu Asiname, WARDA Co-ordinator at Ibadan. The ash corrects soil pH and therefore iron toxicity will be greatly ameliorated (Stockinger et al., nd.). The green manuring system of Ganawuri in Plateau State is such a relief to farmers because they have no need of expensive chemical fertilisers. The use of crop residues in Ebonyi State is a system that improves soil fertility. Farmers all over Nigeria incorporate organic manure in one form or the other into the soil during land preparation for rice cultivation, but the two systems highlighted here are technological innovations in a way. On the other hand heaps of mud and vegetative residues which add no nutrient to soil are common sights in some rice fields.

6.5 Summary

Some of the responses by farmers mentioned above underscore the need for a systematic and realistic policy option in helping farmers to produce rice under favourable conditions. A free market economy is the model in practice in Nigeria. However, government lacks the expertise and ability to monitor compliance to minimum standards. A complete removal of subsidy on all inputs (herbicides, fertilisers, pesticides etc.) may be recommended but are importers honest enough to procure high quality goods? Will such inputs be at prices that a farmer will find affordable to make him break-even? Have there been cases of adulterated goods finding their ways to the market, which are cheap enough to attract a naive farmer? Yes, of course. That is the strongest argument of those not in favour of the removal of subsidies on agricultural inputs.

Organic manuring and other practices by farmers themselves should dictate the lines for future research and technology dissemination. In that way the farmer will be able to cope with the constraints at minimal cost.

7. What is to be done?

Several problems associated with rice production have been identified and discussed above. Can anything be done to alleviate some? Given the huge potential for rice production in Nigeria, something ought to be done to make the sector to take centre stage in food production. It is not good that it remains largely untapped and that its cultivation is only in the hands of smallholders. They are known to be better at allocating resources than a parastatal of government. That notwithstanding the best option is to augment their efforts with that of private sector investment.

7.1 Government policy

Government must make up its mind on how low agricultural productivity must be addressed. Good and sound policies are not in short supply, but their professional implementation. Subsidies will work only for large-scale producers. Most of the World Bank assisted programmes have been dismal failure because farmers made no input in their conception, planning and implementation. It is time for government to go the way of professional advice or face the grim reality of squandered hope of a better future under a democratic dispensation. The time for lip service and adhoc policies on agricultural development should be over with the end of transition programmes under military rule. Any import substitution policy when Nigeria is a signatory to the World Trade Treaty will amount to deception. The era for comparative advantage in production is over. We are in the age of competitive advantage. Government must come up with smallholder producer friendly policies that will make him produce good quality local rice to compete with foreign rice.

The institutional support for agricultural development as credit facilities, cooperative organisations and insurance leave much room for improvement. Any institution that is not commodity and community based will amount to wastage of public funds. The Poverty Alleviation Programme (PAP) is a good example. However, why should money be paid to people who are sweepers instead of ploughing the money into a viable economic sector by way of improving infrastructures and giving credits to farmers? That initial faulty step has been corrected and PAP Co-ordinators with powers of the President of Nigeria's ambassadors were recently appointed to manage the programme with a holistic agenda. The merger of the Nigeria Agricultural and Co-operative Bank (NACB), People's Bank of Nigeria and Family Economic Advancement Programme (FEAP) into one organisation called Nigeria Agricultural and Rural Development Bank will only compound bureaucratic bottlenecks that farmers have been facing. Most often than not, the genuine farmer cannot obtain the credit easily and quickly or none at all. To end these outmoded conditions for extending credit, the usual financial collateral conditionality should be stopped. The Guaranteed Agricultural Credit Scheme where the Central Bank guarantees loans to be collected by farmers from commercial banks has never worked efficiently. The Nigeria Agricultural Insurance Corporation has not rendered effective service to farmers because of sheer inefficiency.

7.2 Research focus

Research efforts must be needs orientated and not just to add to human knowledge. The private sector needs to see the relevance of research and funding should come from there and not government. Research has always been modelled according to western agenda and methods. These have to change in favour of collaborative research with farmers, NGOs and the private sector. Research must provide answers to problems to agricultural production. NCRI can boast of the fabrication of many implements, but farmers are not adopting them to reduce drudgery in weeding, harvesting, threshing etc. Destoners are now being made locally and millers are buying them. Why is it so? Research should provide the answers.

Research on sources of energy as windmills, solar energy etc. should be intensified. The frustrations associated with the purchase of poorly distributed petroleum products can be eliminated.

Research should also be intensified on how data can be made accessible to researchers. Some data are from the colonial times and must be updated. The UNDP assisted Agricultural Databank established at Abuja with zonal offices at Enugu and Ibadan cannot work when the telecommunication system cannot be modernised to satellite systems.

A useful contribution of government to research should be in the area of training. A situation where NCRI has only 2 rice breeders and no soil scientist is ridiculous. Government sponsorship for overseas staff development for NARS should be a priority.

7.3 Extension

The collapse of the formal extension system is not due to a shortage of sound methodologies and expertise. Rather it is largely due to problems of logistics, poor and inadequate funding, lack of commitment on the part of technocrats and field staff and the lack of an understanding that agricultural development is not the only answer to reduction in rural poverty and impoverished livelihood. A new direction should be charted for a demand-led extension system whereby professional extensionists may be contracted by governments to deliver such services to farmers on a competitive but timely basis. Rural people are prepared to pay for healthcare services and the same can easily go for technical advice on agricultural production and marketing problems.

7.4 Private sector seed supply

The private sector has found the seed business unattractive because the true cultivators of rice are the smallholder farmers who use saved seeds. These farmers are excellent risk aversion strategists. So a field planted with mixed seeds will be maintained until the time of harvest when the farmer selectively harvests the different storey of rice. He has the time to do all that hard work and so he does not see the advantage of buying seeds from good sources. A way out is for the private seed companies to be in the forefront of promoting WARDA's NERICA. This can be done through participatory or community seed production that private seed companies should be actively involved from the planning stage right to the implementation stage. Government can encourage them by guaranteeing seed prices before the planting season. Government must set seed standards and vigorously implement policies on seed production, certification and inspection. This is more easily done through seed companies than ADPs.

7.5 Rice cleaning technology

Destoners have started appearing in many rice mills all over the country. That is a welcome development. However, the parboiling industry has much room for improvement especially in the area of hygiene and water sources. Once the rice cleaning technology can be perfected, the rice production revolution through breeding will rapidly lead to a rice marketing revolution. Government can train and equip sanitary inspectors to work at these mills. However, the Miller Associations should select, appoint and remunerate such personnel and not government.

7.6 NGOs/CBOs and the M-APs concept

Most of the CBOs have no link with government. Rather NGOs are their foster parents. However, NGOs and even GOs have low capacity to carry out the objectives or policies they set out for themselves. The total collapse in the formal extension system, low level of activities on the part of NARS, low participation by NGOs in rice production activities are ingredients which may be needful for a true testing of the M-APs model.

8. Conclusions

Everywhere we went in the course of conducting the national rice survey, farmers and ADP officials see M-APs as a practical solution in re-vitalising extension, research, input delivery and adoption of technology. For M-APs to work in Nigeria the following things must take place:-

- Much consultation and communication between GOs, FOs, CBOs, NGOs and MLAs must take place as a prelude to a successful M-APs.

- Capacity building and much training in resource management for GOs, FOs, CBOs, and NGOs is a *sine qua non* for a workable M-APs in Nigeria. The country has been under military rule for such a long time that a culture of undertaking projects without wide consultation was the order of the day. That psyche must be changed across the entire country for M-APs to be a possibility. DFID has considerable expertise and advantage in helping the smallholder farmer who is always neglected in government programmes by sponsoring more participatory researches into their needs; workshops and seminars. Overseas training may be required by NGOs, FOs and some GOs as NCRI and a select ADPs.

- A national rice stakeholder workshop to discuss the way forward for both small, medium and large-scale rice producers and marketers is needed. DFID and other donor agencies as USAID, EZE, ICCO and so on can sponsor the workshop. At the end of such a workshop, a rice network rather than a professional rice society should be started.

- Some forms of direct funding to NGOs like the Catholic Centre at Abwa, SUM Abakaliki and WOFAN. Others are Country Women Association of Nigeria (COWAN), Catholic Mission Abakaliki, Oyo/Oshogbo Dioscean Agricultural Programme, Leventis Agricultural Training Centre, Ife and Development Exchange Centre (DEC) Bauchi, will go a long way in restructuring the dissemination of rice technologies to a wide spectrum of the Nigerian society.

- The advances in WARDA's hybrid releases is setting a stage that will be right for GOs and NGOs to be resource persons in the wide testing of varieties. The ADP system has collapsed almost entirely. Enabled NGOs can fill the gap in the short-run. Straight participatory models cannot handle the much documentation needed.

- Given the promises these hybrid lines hold, the private sector should classify them as true technologies that they are. M-APs will therefore provide a model of the 'Technology Triangle' adopted by developed countries for concretising the linkage between researchers and industry. GOs/NGOs/Extension/FOs form one leg of the tripod, WARDA/NCRI form the second leg and private seed companies/marketers/processors form the third leg. The objective is to get technology out of the scientists' laboratories into the hands of industry and farmers where it will be used to create new products, generate new companies and opportunities and provide in the process, unlimited new jobs (Adegoke, 1989). The way this triangle may work in the long run is for private seed companies to sponsor farmer-based technology researches. The outcome of the research is taken up by the GOs/NGO/FOs/Extension leg within the context of some form of partnership with the private sector. That sector provides the impetus and resources for growth in both research and extension. Whatever

form the tripod may take in the end, its underlying philosophy must be that all three legs interact to meet true needs of the farmer.

- GOs/NGO/CBOs/seed companies and other stakeholders should create avenues for informal interaction as new rice variety festivals and such social functions, which have much potential for dissemination of technology information and ultimately bringing rapid change in West African agriculture. Festivals are engines of change that western research models have neglected. However, they have good prospects for enhancing technology dissemination. This concept is different from Agricultural Shows or Fairs which have no bearing to the culture of the people. Festivals are core values of the cultures of the peoples and therefore have some form of reality. For example new yam festivals are not only well known, but they attract crowds from communities of organisers and well wishers. A new rice variety festival to be organised by an M-APs body on behalf of WARDA, IVC or DFID for that matter is realistic. Fishing festivals similar to the annual Argungu Fishing Festival in Kebbi state in northwest Nigeria is spreading to other states. This model shows that a new rice variety or technology festival is realistic. The harvesting of rice from canoes in Sokoto can be organised into a festival for the immediate takeoff of such a programme. This will be under the auspices of DFID.

- M-APs as an organ can be established for each of the 6 geo-political zones under the co-ordination of an expatriate DFID project officer in close collaboration with a local NGO. At each ADP, a M-APs unit can be established within the extension/research department. The focus of extension will be farmers, but M-APs will focus on networking with all stakeholders as government institutions, rice marketers, rice producers, FOs, input distributors, NGOs, the press etc.

In conclusion it can be stated again that the basic ingredients for the take-off of M-APs exists in Nigeria. This will depend on the availability of some initial funding by a donor agency. The conditions include low government participation in agricultural extension and research. Others are availability of many rice varieties some that are worth celebrating through annual cultural festivals. The high participation in rice production by smallholder farmers in the face of mitigating constraints is yet another factor. A responsive milling and packaging sector willing to invest in procurement of processing technology without an intervention on the part of government is a positive factor. The use of green manuring technology discovered by farmers themselves is concept worthy of promotion. The willingness of government officials and researchers to participate in M-APs should be utilised to promote rice production. Furthermore the installation of democratic governance after several years of military dictatorship and a growing NGO sector with focus on rice will go a long way in promoting technical change in West African agriculture.

The second part of this project is a Case Study that will pursue in greater detail constraint analyses highlighted here. It will serve as an update on issues raised in this Review. The Report will also provide fresh field data on rice systems and recommendations on how M-APs may be introduced and implemented to lead to rapid change in technical change in agriculture in Nigeria.

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Appendices

Appendix 1 - Extension Guide, Growing Upland Rice in Nigeria

Varieties	FARO 46 (ITA 150) in dry and moist savannah region; FARO 43 (ITA 128), FARO 47 (ITA 117), FARO 48 (ITA 301), humid and sub-humid region.
Seed rate	80-100kg per ha
Sowing time	June (Savannah zone); March-April (Humid and sub-humid)
Land preparation	Plough once and harrow twice to make good till. Apply basal fertiliser before final harrowing.
Fertiliser dose	60:30:30 kg NPK/ha
Basal fertiliser	30:30:30 kg NPK/ha. Apply 200kg/ha four bags 15:15:15 or 100kg of 27:13:13 (two bags) mixed fertiliser at final harrowing by drilling method.
Seeding method	Direct seeding in row to row distance of 20-25cm apart and plant to plant continuous by drilling method.
Gap filling	Uproot the plants from thickly germinated area and transplant it to other spaced area, a week after seeding on a rainy day.
Weed Control	Use Grammoxone Preforan 4 litre/ha immediately or a day after seeding. Do not use after the germination of paddy seeds. Apply Basagram PL2 at 5 litres/ha as post emergence, 14-21 days after seeding. Hand weed the field twice 20 and 40 days after seeding.
Top Dressing	Twice at 50kg/ha Urea, immediately after weeding. Incorporate the Urea in soil by hoeing after top dressing.
Insect Control	Apply Decis to control rice bugs which suck the sap after flowering.
Bird Control	**B**irds are problems after seeding and during grain maturity. It should be controlled manually by bird scaring.
Grain Yield	2.5 to 3 t/ha.
Harvesting	The crop is ready for harvest when 80% of the grains have turned to straw colour. Thresh immediately, winnow and sun-dry 3 to 4 days for safe storage.
Cropping System	Grow legume crop like cowpea after rice harvest to enrich soil fertility.

Source: NCRI, Badeggi, Rice Research Programme

Appendix 2 - Growing Swamp/Irrigated Lowland rice in Nigeria

Varieties	(a) For shallow swamp or irrigated lowland areas: Early maturing varieties : FARO 44 (SIPI 692033) Medium maturing varieties: FARO 29 (BG 90 - 2) FARO 35 (ITA 212), FARO 37 (ITA 306), FARO 50 (ITA 230) Late maturing varieties: FARO 8 (MAS 2401), FARO 12 (SML 140/10), FARO 15 (FRRS/162 - B 111 - 1) (b) For medium deep swamp: FARO 15 (c) Deep swamp: FARO 7 (MALIONG), FARO 14 (FRRS 43/3) (d) Gall midge endemic areas: FARO 51 (Cisadane)
Seed Rate	50kg/ha (transplanting) 60 kg/ha (dibbling) 80-100kg/ha (broadcasting)
Sowing Time	May-August, early planting in flood prone waterlogged and gall midge affected areas.
Direct Seeding	Direct Seeding by broadcasting or dibbling could be practised in hydromorphic areas. Divide the field into plots of 50 or 100 m^2 and construct small bunds. Spacing in dibbling should be 20-25cm between rows and 15-20 cm between plants. Direct seeding could be carried out with pregerminated seeds in wet soils.
Nursery Raising	Soak the seeds in 12% salt solution for two minutes. Those that sink to the bottom of the solution are the healthy seeds. Separate the seeds and wash them thoroughly free of salt. They should be dried before sowing in the nursery. For one ha transplanting, raise nursery in 500m^2 (1/20 area).
Seeding	Spread the seed uniformly on a puddled nursery field. Drain the excess water for a week from the field. Raise seed beds in high rainfall areas. Avoid bed damage during germination.
Field Preparation	Construct bunds around field to store rain water, plough the field up weeds have grown, rotovate (sic) a day before planting. With hand puddling, construct heaps in the field at the on-set of the first rains for weed control. Transplanting Uproot 21-28 days old seedlings and transplant 2-3 seedlings per hill.
Spacing	20cm row to row and 15-20cm plant to plant.
Fertilizer Dose	90:30:30 kg NPK/ha.
Basal Fertilizer	30:30:30 kg N:K/ha. Apply 200kg/ha (4 bags) 0f 15-15-15 0r two bags (100kg) of 27:13:13 mixed fertilizer before transplanting.
Gap Filling	Gap fill the spaced hill 7-10 days after transplanting of remnant seedlings.
Weed Control	Spread Tamarice or Risane at 3kg ai/ha, two weeks after transplanting or two hand weeding 20 and 40 after transplanting.
Water Control	Maintain water in field up to 5cm, one week after transplanting till grain maturity. Drain water a week before harvesting, cracks should not be visible in field.
Top Dressing	Apply 50kg/ha Urea per ha immediately each weeding, incorporate fertilizer in field by using hand hoe.
Insect Control	Apply Decis to control rice bugs which suck the sap after flowering.
Bird Control	Birds are problems during grain maturity. Control them by bird scaring.
Harvesting	The crop is ready for harvest when 80% of the grain has turned to straw colour. Thresh immediately, winnow and sun-dry for 3-4 for safe storage.
Grain Yield	5-6 t/ha.

Source: NCRI, Badeggi, Rice Research Programme

Appendix 3 – Resolutions of the M-APs' Inception Workshop, Jos, 21-22 March 2000

- Government should be encouraged to either reconsider its policy on importation of rice *or* make producer friendly policies on local rice production and related issues.

- Government is encouraged to decentralise input supply systems and research dissemination.

- A national network should be established to bring together all stakeholders in the rice industry to articulate ideas on common interest.

- The workshop recognises the need for a national rice survey and the need to put in place a continuous monitoring system to ensure sustainability on basic data collection and analysis. M-APs should be institutionalised and co-ordinated by an NGO for that purpose.

- Increase effort should be put in alerting WARDA on the developments in rice production with the view of building a closer relationship.

Source: M-APs Workshop Report Prepared by EDO for ODI