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TOWARDS AN INNOVATION SYSTEM IN THE TRADITIONAL SECTOR: THE CASE OF THE NIGERIAN COCOA INDUSTRY

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ABSTRACT

In recent years the revitalization of the Nigerian cocoa industry through a cocoa re-birth initiative has been a major focus of the Nigerian government. By applying the analytical framework of the agricultural system of innovation this paper traces the process of value-addition in the cocoa agro-industrial system, examines the impact of the Nigerian cocoa re-birth initiative and makes suggestions that are critical for strengthening the innovation system in a traditional sector. The study demonstrated that though an innovation system in the cocoa industry is far from being realized, the policy intervention of the cocoa re-birth initiative can be potent as an instrument of innovation. Towards this end, the findings suggest that policy emphasis should aim at organizing the cocoa re-birth initiative as an innovation focused programme that enables interactive learning among actors in cocoa research, production and industrial processing.

Keywords: innovation, research and development, cocoa industry, Nigeria

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1. Introduction

In spite of the overwhelming importance of the oil sector in Nigeria's economy, agriculture remains the mainstay of the economy. In recent years agriculture contributes at least one-third of Nigeria's GDP (average of 35% of GDP from 2001 to 2004). (CBN, 2004). Cocoa production is a major agricultural activity in Nigeria; and R&D aimed at improving cocoa production and value-addition has long existed at Cocoa Research Institute of Nigeria (CRIN) and notable Faculties of Agriculture in Nigerian Universities and Colleges of Agriculture. However, while the export of raw cocoa beans has continued to thrive, innovation in cocoa production and the industrial processing of cocoa into intermediate and consumer products have been limited (Idumajogwu, 2005). This is in contrast to some other cocoa producers (e.g. Indonesia and Brazil), which have attained considerable value-addition and innovative activities in cocoa production and industrial processing (Panlibuton and Lusby, 2006). This paper is drawn from the report of a study that investigated the state of the innovation system in Nigeria's cocoa production and cocoa processing industry. The study examined the cocoa industry as a traditional sector that can play a major role in structural transformation of a late industrializer such as Nigeria. Understanding the network relationships and institutional mechanisms that affect the generation and use of innovation in the traditional sector is critical for pro-poor growth and the overall economic development. Nigeria's development policy emphasizes making agriculture and industrial production the engine of growth. In recent years the revitalization of the cocoa industry through the cocoa re-birth initiative has been a major focus of government. By applying the analytical framework of the agricultural system of innovation this paper traces the process of value-addition in the cocoa agro-industrial

system, examined the impact of the cocoa re-birth initiative and identified the actors critical for strengthening the innovation system.

The scope of this study covers cocoa development activities in Southwest Nigeria which is traditionally the hub of cocoa production and industrial processing in Nigeria. The research methodology consists of review of documentary evidence on the development of cocoa agro-industrial system in Nigeria; mapping of the linkages between the key actors; and interviews of some of the important stakeholders that form nodes in the cocoa agro-industrial network in Nigeria. The Cocoa Research Institute of Nigeria (CRIN), Cocoa Association of Nigeria (CAN), Central Bank of Nigeria Statistical Bulletin, International Cocoa Association Bulletin, and UNCTAD[4] data on commodities are the main sources of relevant secondary data. The backward and forward linkages of the cocoa processing firms and the constraints and opportunities for technological innovation in the industry were examined by means of in-depth questionnaire-guided case study of three of the five existing cocoa processing firms in Nigeria. CAN provided the institutional position of cocoa farmers on current reforms in the sector, while six farmers were selected for in-depth questionnaire guided interviews on their innovative processes at the farm level and linkages with the cocoa processing firms. The selection of these six farmers took cognizance of the enterprise sizes, two from small scale (less than one hectare), two from medium scale (less than five hectares), and two from large scale (more than five hectares).

[4] United Nations Conference on Trade and Development, Geneva, Switzerland.

Technological innovation is widely acknowledged as the engine of growth in every sector of the economy. The rate of agricultural development in Nigeria is accordingly hinged on the rate of development of the country's agricultural technology. Nigeria, like most sub-Saharan African countries, lost out in the green revolution (Ikpi, 2002; FAO, 2004). In Nigeria there was a significant shift in emphasis from commercial agriculture in food crop production (for domestic consumption) and tree crop production (for export) during the early 1960s to food importation starting from late 1970s (Idachaba, 2000; Thoburn, 2000; Ikpi, 2002). The inability to exploit technological opportunities in the agricultural sector and subsequent resort to large-scale food importation apparently account for the low pace of the development of the local agro-food industrial system in Nigeria. Consequently, there has been limited agricultural production's link with the industrial system in the local and international contexts. It is however heartening to note that the current economic reform in Nigeria has a major focus on promoting value addition to agricultural commodities, integrated development of the primary agriculture and agro-food processing, and export of semi-processed agricultural products rather than raw commodities (NPC, 2004). For the case of cocoa agro industrial system, the Federal Government has set up a specialized committee (National Cocoa Development Committee-NCDC) to promote the revival of cocoa production, and stimulate value-addition through processing for export and local consumption. While there are other studies that have examined the economic policy impacts on cocoa industry (e.g. Philip, 1990; Akanji, 1992a, 2000; Titilola, 1997; Idachaba, 2000), there has so far been no empirical investigation of the technological constraints and opportunities that may affect current efforts to revive the cocoa industry in Nigeria. This study is aimed at bridging this

knowledge gap by applying the national system of innovation (NSI) framework to analyze the linkages (or lack of linkages) between the institutions and other economic agents that determine innovative activities in Nigeria's cocoa agro industrial system. We propose that if the integrated approach envisaged by the cocoa re-birth initiative should succeed for the cocoa industry, the cocoa agro industrial system in Nigeria should be powered by technological innovation. Within the NSI framework technological innovation involves the invention, introduction, improvement and diffusion of new products and production processes emanating within a nation's borders or the adaptation, absorption and assimilation of imported technologies (Adeoti, 2002). Innovation in this respect does not occur simply by carrying out research activities. Rather, innovation occurs in a systemic interaction among agents linked in a complex network that provides opportunities for technological learning (Freeman, 2002; Lundvall, 2005; Nelson, 2007). Thus, the study reported in this paper identifies the features of the innovation system in cocoa production and industrial processing in Nigeria, provides explanations for its current limitations, and makes suggestions for its further development.

The rest of the paper is organized as follows: the next section provides an overview of the agricultural system of innovation framework; section three presents the research methodology; section four discusses the main findings; while the final section presents measures necessary to promote an innovation system for effective cocoa re-birth and sustainable growth of the cocoa industry in Nigeria.

2. Literature Review and Theoretical Framework

2.1. The national system of innovation in perspective

The theoretical framework for this study draws from the concept of the national system of innovation (NSI) and evolutionary perspectives on economic change as applied to the agricultural economy (Freeman, 1987, 1992; Lundvall, 1992; Nelson, 1993; Nelson and Winter, 1982). Before presenting the analytical framework on the agricultural innovation system for the cocoa industry, it is necessary to examine the literature on the perspectives of the NSI especially as applicable to developing countries.

The drive for innovation is a major success factor among competing agents. Innovation as a driver of economic development is known to occur as a result of interactions among institutions that can be identified within a national state. The firm as the centre of innovative activities does not act in isolation and lack capacity to innovate without the benefit of knowledge resources accessible from other agents. Research and development activities and the institutional arrangements for policy intervention to ensure that knowledge generation and use provides structural transformation and economic change are crucial to the national system of innovation. Research and development activities in the public and private sectors are considered major sources of economically productive knowledge or technological knowledge. In this context, the mainstream neo-classical assumption of technological change as a shift in the production function (Jones, 1974) gives way to actual identification of technological change as endogenous to the production system. The NSI is both a productive system and a system that enables the generation and use of innovation in every sector of the economy. As different from most

economic frameworks which stress the importance of maximizing output from scarce resources, the NSI focuses on innovation processes. It distinguishes innovation from research as measured by scientific and technical outputs. The emphasis of the NSI is that, innovation is neither research nor science and technology, but rather the application of knowledge (of all types) to achieve desired social and/or economic outcomes. This knowledge may be acquired through learning, research or experience, but until applied for social and/or economic gains it cannot be considered innovation. These processes of learning and acquiring knowledge are interactive, often requiring extensive links among different sources of knowledge. (Hall and Sulaiman, 2007).

As earlier indicated, the main objective of the NSI is to generate and employ innovation for economic development. Thus the NSI may be viewed as an integrated system of economic and institutional agents directly promoting the generation and use of innovation in a national economy. Generally speaking, the elements of the NSI have been identified to include the following (Adeoti, 2002):

- Internal organization of firms;
- Inter-firm relationships;
- Role of the public sector;
- Institutional set-up of the financial sector;
- R&D intensity and R&D organization; and
- Education and training.

These elements suggest that institutional settings are very important in shaping the processes (e.g. interacting, learning, knowledge sharing) critical for innovation. In this

respect the NSI framework does not limit institutions to include only bodies such as enterprises, research institutes, government and non-governmental organizations; but also embraces the new institutional economics definition of institutions as sets of common habits or norms, routines, practices, rules or laws that regulate the relationships and interactions between individual agents and groups (Edquist, 1997; North, 1997; Parto, 2005). When the elements of the NSI are well developed, the firm which is regarded as the core or centre of the NSI becomes more innovative, and the impact of innovation as the engine of economic growth and technological progress is widespread. The structural transformation becomes evident and international competitiveness of national or local firms begins to thrive. (Kim, 1997; Mytelka, 1998; Lall, 2001).

In recent years, the NSI framework has continued to gain prominence in the analyses of the determinants of technological innovation (Goel *et al*, 2004). On one hand, it has been extended to analyze regional systems of innovation (Freeman, 1995; Edquist, 1997), while on the other hand, it has been reduced to analyze sectoral systems of innovation (Malerba, 2002; Hall et al, 2005). Of interest to this study is the application of the NSI to sectors that are considered crucial for growth and poverty reduction. In this respect, the agricultural sector and its linkage with industry is very important for countries where agriculture is the main economic activity of the vast majority of the population. For Nigeria, the economy has been known to be largely agrarian in spite of the oil economy. As shown in table 1, the agricultural sector is known to account for at least 40% of the GDP from 1999 to 2005. The manufacturing sector's contribution to GDP has remained relatively small, contributing less than 4% of the GDP. Except for the telecommunication

sector which has emerged as a growth pole there has been no significant change in other sectors' contribution to GDP. Thus, structural change has been very limited in the Nigerian economy. In particular, the continual dominance of the agricultural sector and the absence of significant growth in the manufacturing sector suggest an examination of the sectoral innovation system might be worthwhile to the identification of needed interventions that can provide stimulus for structural change.

Table 1. Nigeria: Sectoral contribution to GDP, 1999-2005

Sector	Percent contribution to GDP						
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Agriculture	43.45	42.65	42.3	42.14	41.01	40.98	41.21
Petroleum	24.45	25.91	26.04	23.46	26.53	25.72	24.33
Solid Minerals	0.25	0.25	0.25	0.26	0.25	0.26	0.27
Telecommunications	0.45	0.46	0.55	0.78	0.99	1.2	1.45
Manufacturing	3.49	3.44	3.52	3.7	3.57	3.68	3.79
Financial Institutions	4.05	4.03	4.02	4.97	4.12	3.96	3.82
Wholesale and Retail Trade	13.46	13.04	12.76	12.99	12.54	12.9	13.64
Others	10.25	10.1	10.42	11.54	10.87	11.18	11.36
Total	99.85	99.88	99.86	99.84	99.88	99.88	99.87

Source: NPC (2007, p.34) based on data from various issues of Statistical Bulletin of the Central Bank of Nigeria, Abuja.

2.2. Agricultural system of innovation

This study focuses on a sectoral innovation system, viz., the agricultural innovation system in Nigeria's cocoa industry. The agricultural system of innovation can be conceived not only as ensuing from, but also as an integral part of the NSI. Temel *et al* (2002), quoted by Dalohoun (2005), defined the agricultural system of innovation as:

> *"a set of agents (farmers or farm organizations, input supply, processing and marketing enterprises, research and educational institutions, credit institutions, extension and information units, private consultancy firms, international development agencies, and the government) that contribute, jointly and/or individually, to the development, diffusion, and use of new agricultural technologies, and that influence, directly and/or indirectly, the process of technological change in agriculture and agro-processing"*.

The Agricultural system of innovation maps out the key actors and their interactions that enable farmers obtain access to technologies. The 'farm firm' is at the centre of the agricultural innovation system framework, and the farmer as the innovator could be made less vulnerable to poverty when the system enables him to appropriate returns to his innovative efforts. The agricultural innovation system framework presents a demand-driven approach to agricultural R&D. This transcends the perception of the role of public research institutions as technology producers and farmers as passive users by viewing the public laboratory-farmer relationships as an interactive process governed by several

institutional actors that determine the generation and use of agricultural innovation. There is opportunity for a participatory and multi-stakeholders approach to identifying issues for agricultural R&D, and agricultural technology could thus be developed with active farmers' participation and understanding of the application of new technologies. The agricultural innovation system approach as an institutional framework can be stimulated and/or self-organizing depending on the institutional circumstances and historical background of the national agricultural development strategies.

Hall and Yoganand (2003) identified five main features of an agricultural system of innovation to include:

i) The agricultural system of innovation (ASI) focuses on innovation (rather than research) as its organizing principle. The concept of innovation is used in its broad sense, i.e. the activities and processes associated with the generation, production, distribution, adaptation, and use of new technical, institutional, organizational, or managerial knowledge.

ii) By conceptualizing research as part of the wider process of innovation, the ASI helps identify the scope of the actors involved and the wider set of relationships in which research is embedded.

iii) By recognizing the importance of both technology producers and technology users, and by acknowledging that their roles are both context specific and dynamic, the ASI escapes the polarized debate between the proponents of the theories of technology "push" versus demand "pull".

iv) The ASI recognizes that the institutional context of the organizations involved (and particularly the wider environment that governs the nature of the relationships) promotes dominant interests and determines the outcome of the system as a whole.

v) The ASI recognizes that innovation systems are social systems, that is, it focuses not only on the degree of connectivity between the different elements, but also on the learning and adaptive processes that make such system dynamic and evolutionary.

These features apparently conceived ASI as focusing mainly on primary agriculture. However, in the context of this study the theoretical framework is applied to the agro-industrial sector covering the primary agriculture and industrial processing of the agricultural output. In a less developed economy where the agricultural sector is predominant, the strengthening of the linkages between the agricultural and the industrial sectors become very important for structural change to be realized. While agricultural growth stimulates demand for consumer goods and for industrial inputs into agriculture; industrial growth stimulates demand for food and for agricultural inputs into agro-allied processing industries (Siazon, 1992). The pace, scope and direction of this transformation process are determined by the technological capabilities in the agricultural and industrial sectors. It is unlikely that an agricultural production system that is reluctant to modernize by adopting new production techniques and/or improved seeds will be able to meet the challenges of increased food demands and increasingly stringent requirements of agricultural raw materials for industry. Similarly, firms that are not technologically

innovative are unlikely to be able to compete as processors of agricultural outputs into consumer or intermediate goods. Thus, ASI is not limited to the dynamics of primary agriculture but rather involves the intricate network of institutions that interact across the production and processing of primary commodities.

2.3. A framework for the analysis of cocoa innovation system in Nigeria

From the discourse on the agricultural system of innovation (ASI) above it is apparent that the cocoa innovation system as an ASI should draw from the elements of the national system of innovation (NSI). In this section, we accordingly identify some of the elements of the cocoa innovation system and there interactive linkages. A guiding hypothesis for the study is that current sectoral system of innovation in Nigeria's cocoa industry is weak but its intrinsic features can be stimulated for growth. The interactive links between some of the elements that may characterize the innovation system for the cocoa industry can be depicted as shown in Figure 1.

R&D intensity and R&D organization

The intensity of R&D and its organization in the context of the cocoa innovation system may be indicated by the number and extent of the commercialized products of the R&D institutions in the cocoa industry. The diffusion of such innovation (i.e. commercialized products) would be determined by the system of agricultural extension at various levels, programmes and projects for agricultural and rural development, and where applicable,

international projects and programmes in support of the cocoa industry.[5] In the context of Nigeria, the main R&D institution that is devoted to cocoa R&D is the Cocoa Research Institute of Nigeria. The study therefore explored the extent of the commercialization of identifiable R&D outputs of CRIN and the constraints on and/or opportunities for their diffusion.

Internal organization of firms and inter firm relationships

There two categories of firms interacting in the cocoa economy, viz.:

i) the 'farm-firms', which are various types of farms, mostly peasant farms of holdings not more than two hectares in the case of Nigeria (Ojo, 2005); and
ii) cocoa processing firms, which are firms manufacturing either intermediate products or cocoa consumer products.

In the cocoa innovation system these firms have their individual internal organization that facilitates or constrains ability of the firm to innovate. Added to this, their interactive behaviours determine the capability of the innovation system to serve as an agent of renewal of the cocoa industry.

Role of the public sector and the institutional set-up of the financial sector

[5] An example of such international programme is the the Sustainable Tree Crops Program (STCP) hosted by the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. The STCP has been working to reverse the decline in the Nigerian cocoa production through a pilot project focused on four key areas: farmers' organizations, technology transfer, marketing, and social issues including child labor. Science in Africa (2004).

Considering the fact that the agricultural sector is a relatively highly subsidized sector it is difficult to decouple the role of the public sector from the institutional set-up of the financial sector in an agricultural system of innovation. In reality the financial agencies that provide significant support to the agricultural economy are embedded in the public sector. For example, in Nigeria the private sector financial institutions are known to be very reluctant in providing loans for projects in agriculture and agro-allied industries. We therefore examine the role of the public sector as encompassing the activities of the main public sector agencies (financial and non-financial) and how their interactions with other identified agents in the cocoa innovation system affect the generation and diffusion of innovation in the cocoa industry.

Education and training

Education and training are important sources of knowledge that sustains the dynamism of an innovation system. The pace of the evolution of the innovation system is determined by the knowledge resources available to the system and the capacity of the system to assimilate new knowledge. In the cocoa innovation system we propose that educational and training institutions are important agents of knowledge generation and their interactions with other agents determine the extent of the constraints on and opportunity for learning within the cocoa innovation system. However, other sources of knowledge may be equally important especially when the tacit elements of knowledge required for productive activities are considered.

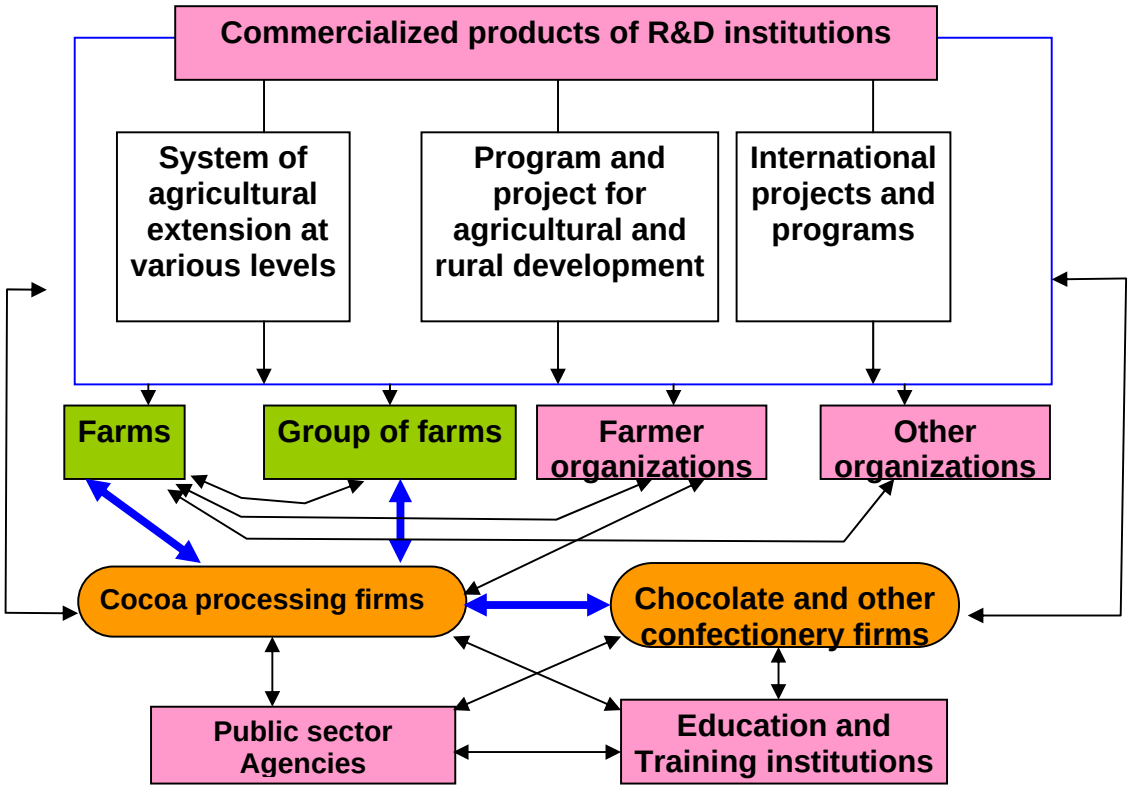

Figure 1. Elements of the agricultural system of innovation for the cocoa industry

Source: Adapted from Adeoti *et al* (2006)

3. The Cocoa Economy and Cocoa Re-birth Initiative in Nigeria

Agricultural R&D in Nigeria started in 1893 with the establishment of a botanical garden in Lagos by the colonial administration (Idachaba, 2000).[6] Ikpi (2002) indicated that this garden was part of a network of gardens established in colonies under British rule,

[6] Presently, there are at least 81 government and higher-education agencies engaged in agricultural research in Nigeria (Beintema, 2004).

focusing on the introduction of new crops, which were apparently sources of raw materials for industries in the United Kingdom. Cocoa was introduced to Nigeria from Fernando Po in 1874, and the initial development of the cocoa industry was entirely due to the initiative and entrepreneurship of peasant farmers. The colonial government later became interested in cocoa cultivation and seedlings were supplied from the botanical garden for field trial up country (Opeke, 1982; FRN, 2005). Commercial production of cocoa in Nigeria started in the first decade of the 19th century and Nigeria rose to become one of the world major producers by her independence in 1960.[7] The 1950s and 1960s were decades of glory for cocoa as it was the most important foreign exchange earner for Nigeria. Production peaked at 400,000 metric tons in 1970. However, the oil boom of the 1970s resulted in the 'dutch disease' expressed in the neglect of the agricultural economy while focusing on oil which became almost the sole foreign exchange earner. The economic recession that followed became acute by mid-1980s and necessitated the introduction of the economic structural adjustment programme (SAP) in 1986. The SAP achieved some measure of success in raising cocoa production. Akanji (1992b) reported that cocoa production increased from 100,000 metric tons in 1986 to 256,000 metric tons in 1989; while Titilola (1997) indicated that Nigeria recovered to become the fourth largest producer (after Cote D'Ivoire, Brazil, and Ghana) by 1993. Subsequently, cocoa production declined again to as low as 170,000 metric tons in 2000 (CBN, 2004).

The urge to revive the cocoa industry prompted the Federal Government to establish the National Cocoa Development Committee (NCDC) in 1999; and thereafter, cocoa

[7] Cocoa entered its first phase of commercial cultivation in Nigeria in 1902 around Ibadan. The first export of cocoa beans from Nigeria into the international market was an export of 3,000 tonnes in 1910. (FGN, 2005).

production gradually improved to 202,000 tons in 2004. The Minister of Agriculture and Water Resources is the Chairman of NCDC and the Committee has representatives from the private sector stakeholders, government agencies relevant to cocoa industry, and Nigeria's fourteen cocoa producing states[8] comprising Ondo, Osun, Ekiti, Oyo, Ogun, Edo, Delta, Abia, Akwa Ibom, Cross River, Kwara, Kogi, Adamawa and Taraba. Specific members of the NCDC include the Deputy Governors of the 14 cocoa growing states, the Executive Director of CRIN, and the representatives of the Cocoa Farmers Associations. The NCDC has sub-committees on cocoa production, cocoa processing and value-addition, increased consumption of cocoa products, and cocoa marketing.

Cocoa production is currently done by mainly smallholder farmers in Nigeria. These smallholders, whose average farmstead is 2ha, account for about 60% of Nigeria's total output.[9] In 2005 the fourteen cocoa producing states raised a total of 5,976,854 seedlings, which can plant 5,454 ha of new cocoa farm, and distributed the seedlings free of charge to farmers. In order to sustain and improve on these performances, the President of Nigeria launched a special programme tagged "Cocoa Re-birth" in February 2005.[10] The programme essentially aimed at creating awareness of the wealth creation potentials of cocoa, promote increase in production and industrial processing, attract youth into cocoa cultivation, and help raise funds for the development of the industry (FGN, 2006). Box 1 presents the main elements in the blue-print for the cocoa re-birth initiative.

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[8] Nigeria is a Federation of 36 states and a Federal Capital Territory.

[9] Web posted report on Nigerian Economic Summit Group (NESG) Consultative Forum with Cocoa Farmers in Southwest Nigeria, 30 march 2004.
http://www.pak-nigeria.org/pdfs/6_Cocoa_Farmers_Consultative_Forum.pdf

[10] This event took place in Ibadan, the capital city of the Old Western Region which was the bastion of the Nigerian cocoa economy.

It is important to point out that Nigeria has some capacity for industrial processing of cocoa especially into intermediate products. There are presently five cocoa processing firms in operation in Nigeria.[11] Table 2 presents the installed capacity and current capacity utilization of these firms. The total installed cocoa processing capacity of Nigerian firms is at least 105,000 tons per annum while at least 45,000 tons is processed into intermediate products for local beverage industries or export. It is noteworthy that one of the firms (i.e. Cocoa Industries Ltd.) not only process cocoa beans into intermediate products but also thereafter manufactures a popular cocoa beverage.

Box.1. Elements of the cocoa re-birth blue print

- Increased local consumption of cocoa to reduce the quantity going into the international market and thereby bring about a concomitant increase in the price of cocoa.
- Value addition which involves alternative utilization of the cocoa bean and of cocoa by-products.
- Sensitization and training of cocoa farmers to bring out the best in varieties planted, tree management, good quality formation, drying, soil management, etc.
- Rehabilitation and regeneration of old moribund cocoa trees/plantations to arrest dwindling harvests/outputs.
- Soil rejuvenation research to help bring exhausted/marginal cocoa soils back to life.
- Youth attraction into cocoa farming to ensure adequate replacement of the current ageing generation of farmers.
- National cocoa survey to give state of plantations, production figures, variety grown, fermentation systems, etc on state by state basis.
- An aggressive cocoa breeding programme to generate clones which are disease-resistant.

Source: FGN (2005)

[11] Two other cocoa processing factories that exist have stopped production. These are Cocoa Products Industry Ltd., Ede, Osun State and Owena Mills in Ondo State.

Table 2. Capacity of cocoa processing firms in Nigeria

Firm	Year production started	Current installed capacity (tons/annum)	Current production level (tons/annum)	Capacity utilization, June 2007 (%)
1. Cocoa Products Ltd., Ile-Oluji, Ondo State	1984	30,000	12,000	40
2. Cooperative Cocoa Products Ltd., Akure	1992	18,000	14,000	78
3. Stanmark Ltd., Ondo	1992	15,000	10,000	67
4. Cocoa Industries Ltd., Ikeja	1964	30,000	n.a.	n.a.
5. Multi-Trex Ltd., Warawa Village, Ogun State	March 2006	12,000	9,600	80
Total		**105,000**	**45,600**	

n.a = not available

Source: Field data and Cocoa Mirror Magazine 2007, Vol.1, No.2, p.20.

There was an attempt by the Nigerian government to ban export of cocoa beans in 1990. The ban was to take effect at the beginning of 1991 and was aimed at developing the cocoa industry to promote local industrialization, create employment, increase foreign exchange earnings, and facilitate technology transfer. However, the ban was short-lived because of policy failure and pressure from stakeholders, especially Cocoa Association of Nigeria (CAN), which stressed that local industrial processing capacity was inadequate for handling the national cocoa beans output (Olomola *et al*, 1993; Ojo, 2005). This notwithstanding, it appears that a positive outcome of the ban was the establishment of two additional cocoa processing firms in 1992. One of the firms (Stanmark Ltd) was established by the subsidiary of a multinational company (i.e. Cadbury Nigeria PLC) while the other (Cooperative Cocoa Products Ltd) was established by the Cocoa Association of Nigeria with the support of the Ondo State Government.

The NCDC subcommittee on alternative uses of cocoa has articulated a report on the various consumer products derivable from cocoa and has succeeded in securing government approval for the following strategies aimed at reviving local cocoa processing firms and encouraging new entrants into local manufacture of cocoa based products (FGN, 2005).

- Serving of free cocoa beverages daily to all primary school children in order to increase cocoa consumption as well as acquiring the taste for cocoa;
- Serving of cocoa based beverages in government offices and official functions; and
- Ban on the importation of cocoa powder, butter and cake.

However, only the ban on the importation of cocoa powder, butter and cake has been implemented.

4. The Cocoa Agro-industrial System

Before proceeding to examine the specific elements of the cocoa innovation system as a major instrument of cocoa re-birth in Nigeria it is important to present an overview of the global cocoa agro-industrial system which has a dominant influence on the national cocoa economy of many cocoa producing countries.

4.1. Production and consumption pattern

Cocoa is an international crop,[12] and trade in cocoa products is very important for developing countries that depend on cocoa as major source of foreign exchange,[13] and for developed countries whose industries depend on cocoa products as critical inputs for the manufacture of essential consumer and intermediate goods. The production, use and industrial application of cocoa have developed into a bourgeoning global agro-industrial system. Cocoa is cultivated mainly in the tropical belt spanning between latitudes 20^{o} North and South of the equator.[14] Cocoa is mostly produced in developing countries but mostly consumed in Europe, North America, Japan and Singapore. Latin American countries have as their main export destination the United States, while Africa sells most of its cocoa to Europe. Asia mostly imports from Indonesia or Malaysia or from Ecuador and other South American countries. While some developing countries such as Brazil and Malaysia[15] have developed significant capacity for industrial processing of cocoa, the bulk of industrial processing of cocoa beans and products are currently carried out in industrial countries. The world current cocoa production is estimated to be about 3.5 million tonnes. (UNCTAD, 2007). Figure 2 shows the share of the eight main cocoa producing countries in total forecasts for cocoa beans production in 2005/2006 crop year;

[12] Cocoa is grown in more than thirty-five countries, and the cultivated area covers between 3.5 and 4.5 million hectares. The cocoa tree is thought to have originated in the Amazon basin of South America, spreading to Central America, particularly Mexico. (UNCTAD, 2007)
Cocoa is now grown principally in West Africa, Central and South America and Asia. In order of annual production size, the eight largest cocoa-producing countries at present are Côte d'Ivoire, Ghana, Indonesia, Nigeria, Cameroon, Brazil, Ecuador and Malaysia. These countries represent about 90% of world production (see figure 2).

[13] Cocoa bean prices experienced an important increase in the 1970s, which encouraged production expansion in traditional cocoa growing countries and production in countries such as Malaysia and Indonesia. However, since the beginning of the 1980s prices have declined. In spite of a modest recovery in the mid 1990s, international cocoa prices are still low compared to those prevailing in the 1970s. (ECA, 2007).

[14] The bulk of world cocoa is actually cultivated in the regions between latitudes 10^{o} N and 10^{o} S.

[15] Though countries like Brazil and Malaysia are main producers of cocoa beans, they are not necessarily large exporters due to the size of their processing industry. In fact, Haque (2004) reported that Brazil and Malaysia sometimes import cocoa beans to meet the demands of their local processing capacity.

while figure 3 shows the share of main consuming countries[16] in 2004/2005 crop year. It has also been reported that though African countries account for about 80% of the world cocoa export, at the regional level African consumption of cocoa products has been estimated to be only 2% of world's total consumption (Falusi, 2006).

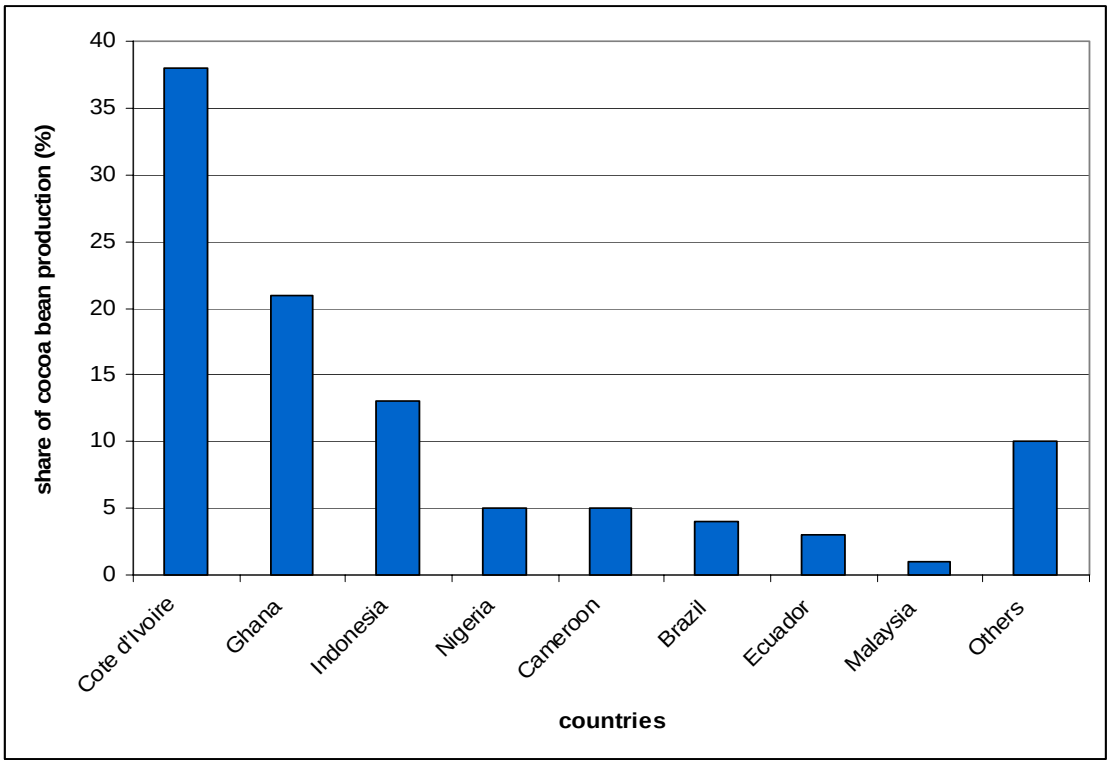

Figure 2. Share of countries in total cocoa beans production (2005/2006 crop year forecasts)

Source: Based on data obtained from ICCO[17] quarterly bulletin of cocoa statistics as presented on the UNCTAD website (www.unctad.org)

[16] The apparent domestic cocoa consumption is calculated as grindings of cocoa beans plus net imports of cocoa products and of chocolate products in beans equivalent.
[17] International Cocoa Organization.

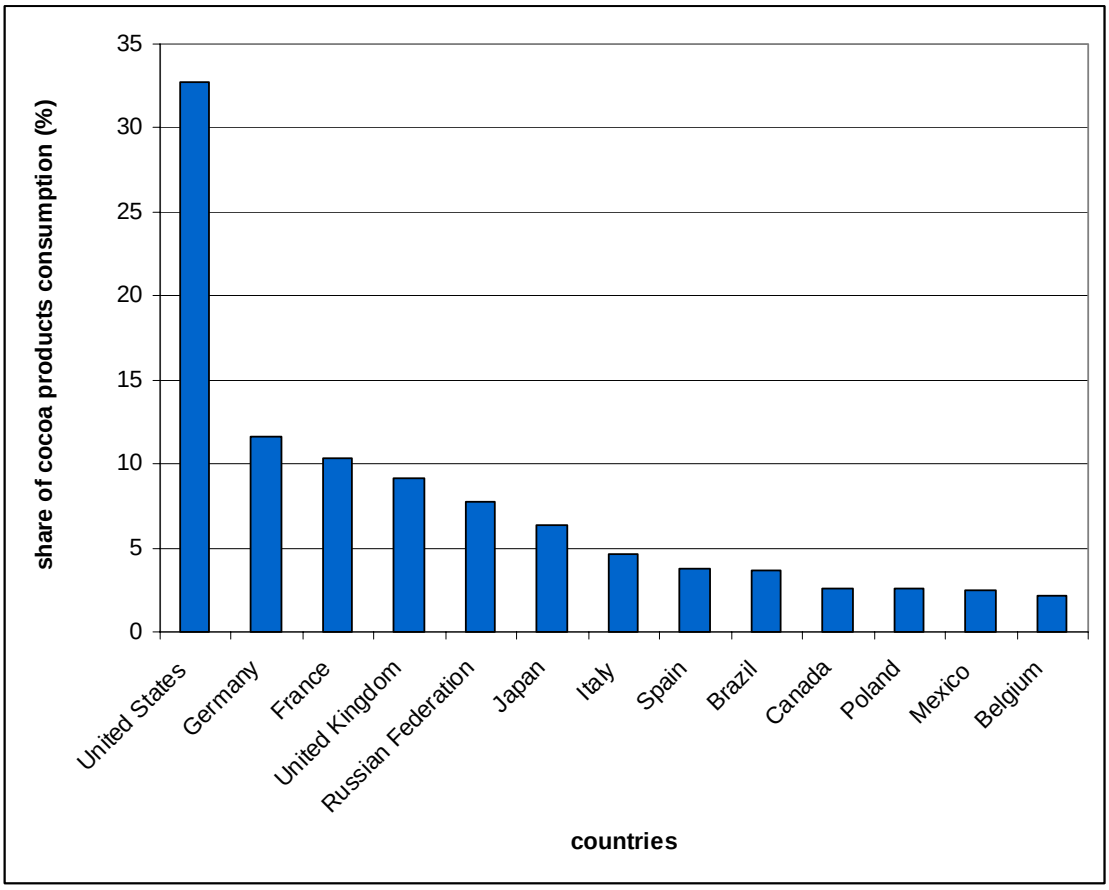

Figure 3. Share of countries in total cocoa products consumption in 2004/2005 crop year

Source: Based on data obtained from ICCO[18] quarterly bulletin of cocoa statistics as presented on the UNCTAD website (www.unctad.org)

The most important cocoa products are made from cocoa beans, the kernels of the cocoa fruit. The most popular cocoa product is chocolate,[19] which is made from cocoa mass (or

[18] International Cocoa Organization.

[19] In 1828 Coenraad Johannes van Houten of Amsterdam developed the cocoa press, allowing the extraction of cocoa butter by pressing most of the fat out of the cocoa mass. This process actually yields cocoa powder and cocoa butter. Subsequently, John Fry invented pure chocolate in England in 1847. In a short time chocolate conquered the world and made cocoa important as an industrial raw material. In 1875 the Swiss chemist Henri Nestlé invented milk chocolate and solid chocolate. This further boosted the widespread of chocolate as an important nutrition product. (UNCTAD, 2007).

"cocoa liquor"), cocoa butter and a sweetening agent, usually sugar. Chocolate is a product that remains solid at room temperature but has a melting point below body temperature. It also has a richer taste and is milder than drinkable cocoa made from cocoa cakes.

4.2. Industrial technology and value addition

Cocoa processing and chocolate manufacturing are dominated by a few multinational companies. However, developing capacity for industrial processing of cocoa into intermediate products either by domestic firms or subsidiaries of MNCs are main concerns in cocoa producing countries (Haque, 2004; Obasanjo, 2006). Though cocoa mass is best known as the principal ingredient in chocolate manufacture, there are actually four intermediate cocoa products that may be derived from cocoa beans.[20] These are cocoa liquor, cocoa butter, cocoa cake and cocoa powder. The starting point in the cocoa industrial technology is the processing of raw cocoa beans into cocoa mass. Prior to the factory level processes, the raw cocoa beans must be fermented and dried to specified industrial standards. At the processing factory the beans are further subjected to thorough inspection, and thereafter cleaned, mixed into the desired blend, fragmented and stripped of their husks. What remains is the inner part of the kernel, called 'nib'. The nibs are heat-treated to eliminate possible bacteria, and subsequently roasted and ground into a liquid cocoa mass. The cocoa mass is an intermediate product, which is supplied to the

[20] UNCTAD (2007) pointed out that cocoa processing and chocolate manufacturing are two different processes that, although linked, require different procedures to obtain the products wanted. Cocoa processing means basically converting the beans into nib, liquor, butter, cake and powder; while chocolate manufacturing covers the blending and refining of cocoa liquor, cocoa butter and other ingredients such as milk and sugar.

chocolate industry. It is also the basis for the production of cocoa butter and cocoa powder. Figure 4 presents a graphical illustration of the processes of value addition in the cocoa agro-industrial system.

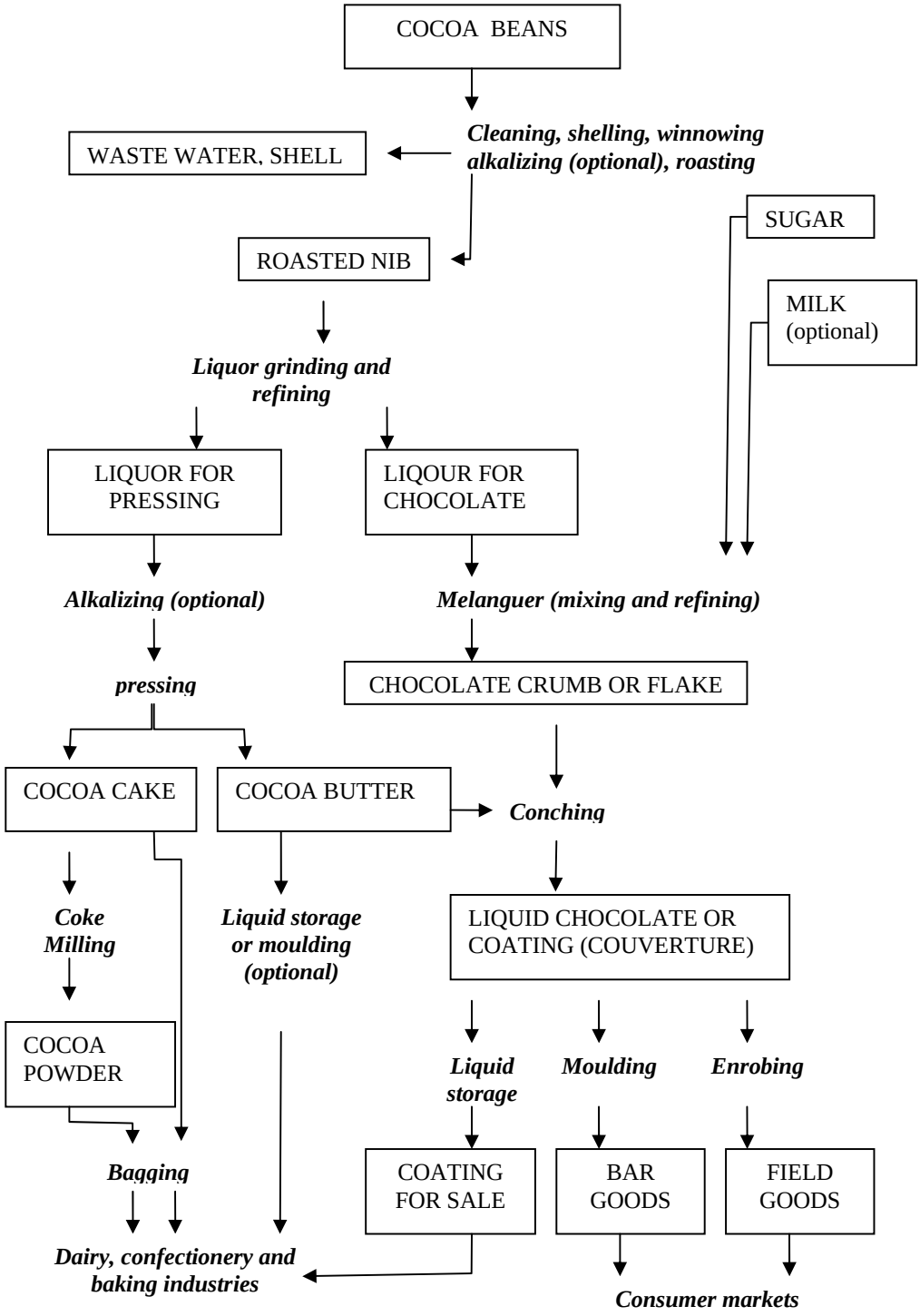

Figure 4. Flow chart of value addition in the cocoa agro-industrial system

Source: UNCTAD (2007)

5. Empirical Results

5.1. Elements of the cocoa innovation system in Nigeria

Applying the analytical framework enunciated in subsection 2.3 to the field data, in this subsection we discuss the main feature of the cocoa innovation system in Nigeria.

5.1.1. R&D intensity and R&D organization

The cocoa re-birth initiative has made the Cocoa Research Institute of Nigeria (CRIN) the focal point of all R&D related to the revival and renewal of the cocoa industry in Nigeria. CRIN is an active participant in the cocoa re-birth activities and interacts closely with the National Cocoa Development Committee (NCDC). CRIN was established in 1964[21] and has accumulated considerable knowledge in research into cocoa production and industrial processes aimed at adding value to cocoa beans. Box 2 presents the main findings of the interview conducted with a top management staff of CRIN on the current status and intensity of R&D activities at CRIN, while table 3 provides the list and commercialization status of cocoa product inventions that have industrial relevance.

[21] CRIN was established in Ibadan on 1st December 1964 as a successor research institute to the Nigerian substation of the defunct West African Cocoa Research Institute (WACRI) established at Tafo, Ghana in 1944. The Nigerian substation of WACRI was established in 1947. WACRI has the responsibility to conduct research to facilitate improved production of disease-free or disease-resistant cocoa. Though cocoa research is the main concern at CRIN, its R&D activities are organized around five major tree crops that are grown in Nigeria. These tree crops include cocoa, kola, coffee, cashew and tea. (FGN, 2005).

Box 2. Status of R&D activities at CRIN, March 2007

- CRIN has newly developed genetically improved high yielding cocoa seedlings capable of exceeding 1800kg/ha/year yield. These seedlings have been and are being produced and distributed to farmers under the cocoa re-birth initiative.
- CRIN has many products of R&D that have industrial relevance. The list of these inventions is provided in table 4. The inventions are all patented in Nigeria.
- The R&D activities are at best demonstration pilot projects.
- Most of the R&D outputs are not cost effective when compared with market realities. For example, the cocoa bread is produced by CRIN but not at a competitive price and hence could not go to the market beyond CRIN.
- The milk chocolate patent* has recently been sold to a Nigerian entrepreneur who is expected to produce it in commercial quantities. CRIN's board recently approved its commercial production by the entrepreneur. The entrepreneur paid N2m for the proprietary right to use the patent. The CRIN equipment is imported from Malaysia and can produce 45kg/day. If the market trial is successful, the entrepreneur will import equipment with a larger capacity.
- Most end-use invention by CRIN is post 1970. Before 1970 CRIN focused mainly on breeding and plant protection. The original mandate of CRIN at its inception in 1964 was limited to conducting research to facilitate improved production of disease-free or disease-resistant cocoa.
- Many of the inventions are in 2002-2005 because there was an unwritten norm (before 2002) that research is only for demonstration and not for commercial purposes. Since 2002 government has been promoting commercialization of inventions.

* This patent is for milk chocolate that remains solid at relatively high temperature.

Source: Field interview report 2007

Table 3. Industrial relevant R&D outputs at CRIN and their commercialization status, March 2007

Name of invention	Description	Commercialization status
1. Cocoa bread	A recipe of bread with cocoa powder supplementation in dough. Taste, appearance and storage assessment were rated higher for this recipe than for normal bread.	Limited in-house pilot scheme commercialization.
2. Cocoa juice	Pasteurized cocoa sweetened drink; a highly relishing drink, sold frozen.	Pilot scheme demonstration. Yet to be commercialized.
3. Cocoa Cola	A 50:50 beverage incorporating cocoa and kola powder; retains the stimulating effect of kola.	Pilot scheme demonstration. Yet to be commercialized.
4. Cocoa toffee	A candy-like (sweet) product containing cocoa. It is highly relished by young and old.	Pilot scheme demonstration. Yet to be commercialized.
5. Cocoa wine	Wine brewed through fermentation of cocoa juice.	Pilot scheme demonstration. Yet to be commercialized.
6. Cocoa custard	A custard recipe incorporating cocoa powder.	Pilot scheme demonstration. Yet to be commercialized.
7. Cocoa cake	A cake recipe incorporating cocoa powder.	Pilot scheme demonstration. Yet to be commercialized.
8. Milk chocolate	Normal chocolate recipe with special formulation to maintain its solid state at higher temperatures.	Pilot scheme demonstration. Yet to be commercialized.
9. Cocoa biscuit	A special biscuit formulation with cocoa powder inclusion	Pilot scheme demonstration. Yet to be commercialized.
10. Cola chocolate	A chocolate formulation with mild substitution of the cocoa powder base for kola powder.	Pilot scheme demonstration. Yet to be commercialized.
11. Coffee Chocolate	A chocolate formulation with mild substitution of the cocoa powder base for coffee powder.	Pilot scheme demonstration. Yet to be commercialized.
12. Cashew chocolate	A chocolate formulation with mild substitution of the cocoa powder base for cashew powder.	Pilot scheme demonstration. Yet to be commercialized.
13. CRIN Vita	A special cocoa beverage formulation.	Pilot scheme demonstration. Yet to be commercialized.
14. Cocoa liquid detergent	A liquid detergent made from potash sourced from the ash of the cocoa pod husk, which is an erstwhile cocoa farm waste product.	Pilot scheme demonstration. Yet to be commercialized.
15. Cocoa body cream	A novel recipe of body cream incorporating cocoa butter.	Pilot scheme demonstration. Yet to be commercialized.
16. Cocoa hair cream	A novel hair cream formulation with cocoa butter base.	Pilot scheme demonstration. Yet to be commercialized.
17. Soychoco	A soya flour and cocoa powder blend served in liquid form cold or hot.	Pilot scheme demonstration. Yet to be commercialized.
18. Black soap	A new formulation of black soap sourced from cocoa pod husk. An improved version of similar traditional products already in the market.	Pilot scheme demonstration. Yet to be commercialized.
19. Choco-Gari	A special gari formulation with the introduction of cocoa powder into the mash. Very nutritious for children.	Pilot scheme demonstration. Yet to be commercialized.
20. Cocoa feeds	A cocoa husk based livestock feeds. A good formulation for broiler starters and finishers, growers and cockerels, layers, pigs, and rabbits.	Pilot scheme demonstration. Yet to be commercialized.

Source: Based on data in FGN (2005).

From the NSI framework, for these inventions to become innovations there should be interactive learning processes that are characterized by exchange of knowledge among the agents associated with the cocoa economy in Nigeria. We explore this by identifying three distinct stakeholders that are critical in this respect. These are the cocoa processing firms, farmers, and the Cocoa Association of Nigeria (CAN) which is the umbrella organization representing diverse private sector interests in the Nigerian cocoa industry. We identified five levels of relationship to measure the strength of linkages and interactions among agents in the Nigeria cocoa innovation system. Table 4 shows these linkages and the assigned values representing the magnitudes of the strength of the linkage. If the NCDC would harness the research capacity and output at CRIN for achieving the objectives of the cocoa re-birth initiative it is important to understand the current state of the interactions between the identified critical agents, CRIN and the NCDC. Table 5 present the results of questionnaire-aided interview on the type and strength of the interactive linkages among these important agents of cocoa re-birth.

Table 4. Type of interactive linkages and assigned points

Type of linkage	Assigned points
Joint research project development involving cost and benefit sharing	5
Close interaction and exchange of knowledge	4
Arms length seller-buyer relationship	3
Indirect linkage through an intermediary agent	2
No interaction or linkage, though potential exist	1

Table 5. Matrix of strength of interactions among critical agents of cocoa re-birth

	CRIN	NCDC
CAN	5	5
Cocoa processing firms*	2.3	2
Farmers**	1.7	2.5

* points are the average of three firms interviewed

** points are the average of six farmers interviewed

Source: computed from field data

From table 5, it is apparent that the linkages between CAN, CRIN and the NCDC are strong involving joint project development enabling significant exchange of knowledge that are mutually beneficial. However, it appears that the cocoa processing firms and farmers have no close interactions with CRIN and the NCDC. The result demonstrates that their relationships are at best an arms length affair in which intermediary agents might play significant roles. In this case a useful intermediary agent would most likely be CAN. Our interview with CAN showed that the organization has played this role over the years to a limited extent. The constraints of inadequate physical and human infrastructure have made adequate and timely diffusion of technical knowledge by CAN difficult.

5.1.2. Internal organization of firms and inter firm relationships

The two category of firms interacting in the Nigerian cocoa economy are ‘farm firms’ (simply represented by farmers and farmers’ organizations) and firms in the Nigerian manufacturing sector. The farmers interviewed indicated that there has been no

significant difference in their farm practices and the way agricultural production is organized before and after the introduction of the cocoa re-birth initiative. Though some of them have benefited from the input subsidy programme (especially the supply of improved varieties of cocoa seedling), the emphasis has been on farm renewal and increase in the acreage cultivated, and on improved quality of cocoa beans through effective management and control of the supply chain from farm to the factory gate.

The manufacturing firms involved are those processing cocoa beans into its intermediate products and those manufacturing cocoa based confectioneries and beverages. These firms have their individual internal organization that facilitates or constrains the capability of the firm to innovate. For the three firms interviewed for this study table 6 provides the basic information on the firms while table 7 presents our findings on the current state of their skills' structure and production technology as indicators of their internal organization with respect to capacity for technological innovation.

Table 6. Basic information of the case study firms

Firm*	Age (years)	Ownership	Turnover in 2006 (₦ million)	Installed capacity (tons/annum)	Capacity utilization in 2006 (%)
A	15	98.8% foreign + 0.2% local private	3,000	15,000	89.6
B	15	100% local private	2,200	18,000	70
C	23	90% local private + 10% govt.	127	30,000	41.2

* The products of the firms are identical comprising cocoa butter, powder, cake and liquor.

Source: Field data, 2007

The three firms are active and produce identical range of intermediate cocoa products comprising cocoa butter, powder, cake and liquor. The oldest of the firms has the largest installed capacity but lowest capacity utilization. It is one of the two remaining firms that were initially established by government but later sold to private investors with government retaining only 10% ownership in 2006.[22] As shown in figure 5 the capacity utilization improved considerably from 30% in 2005 to 41% in 2006. The two other case study firms are completely private sector initiatives. Though they are each smaller than firm C, they are apparently more efficient. As shown in figure 5, they have maintained relatively higher levels of capacity utilization with firms A and B achieving 90% and 70% capacity utilization respectively in 2006.

With respect to capacity for innovation, the internal organization of firms can be indicated by the skills structure and the characteristics of the production technology employed by the firm. The firms A, B and C employ 151, 350 and 250 persons respectively. As shown in table 8, Firm A is the most skill intensive firm as indicated by the skill intensity ratio of 0.5. The firm also has the highest proportion of persons with higher education (60% of employees has higher educational qualification as compared with 25% and 20% in firms B and C respectively). For the three firms, the features of the production technology are remarkably similar. Though firm A claimed to have some components of its production technology sourced from local fabricators, the main technology is foreign like in the other two firms. It is however noteworthy that firm B which has the oldest production equipment claimed to have made major modification in the bid to cope with the local competition among the firms. The process flow line was

[22] See Cocoa Mirror (Vol.1, No.2, 2007, pp.19-20) for the details of the current ownership of the firm.

modified to enable the introduction of additional equipment to improve efficiency and production level. The production equipment employed by firm C is not as old as the other two firms. However, firm C appears to be the least efficient by capacity utilization. This suggests that the combination of low skill intensity ratio (0.1) and relatively new machine/equipment is incapable of matching the performance of the combination of high skills intensity ratio (0.5) and older machine/equipment of firm A. Similarly, though the skills intensity ratio of firm B is only twice of firm C, the capacity to adapt and modify old equipment put firm B in better performance mode than firm C.

At this juncture, it is important to point out that we found no evidence of significant inter firm relationship among the three case study firms. Firm A interacts with its parent company, while firm B also interacts with the parent company[23] that currently manages the firm in behalf of the local private owners.

[23] This parent company is Olam Nigeria Limited. Olam Nigeria Ltd is an affiliate of Olam International which has its headquarters in Singapore. Olam International is a global supply chain manager of agricultural products and food ingredients. The company actually has its roots in Nigeria where it was established in 1989 before it later grew into a multinational company. Olam is involved in the production and marketing of agricultural commodities such as cocoa, cashew, coffee, sheanuts, sesame, beans and rice. (Cocoa Mirror, Vol.1, No.1, December 2006; www.olamonline.com). Olam is currently engaged in contractual management and operation of firm B.

Table 7. Skills structure and production technology of case study firms

Firm	No. of persons employed	Percent of staff with higher education	No. of technical staff*	Skills intensity ratio**	Source of production equipment	Age of production equipment	Reason for process technology	Major changes to process?
A	151	60%	75	0.5	Local + foreign	15 years	To produce premium quality products	No
B	350	25%	60	0.2	Foreign	17 years	Best available for the production equipment	Yes
C	250	20%	22	0.1	Foreign	10 years	Best suited for the production equipment	No

* technical staff comprise of engineers, scientists and technicians

** Skills intensity ratio is calculated as the proportion of technical staff in total number of persons employed (see Adeoti, 2001 and Lal, 2004)

Source: Field data, 2007

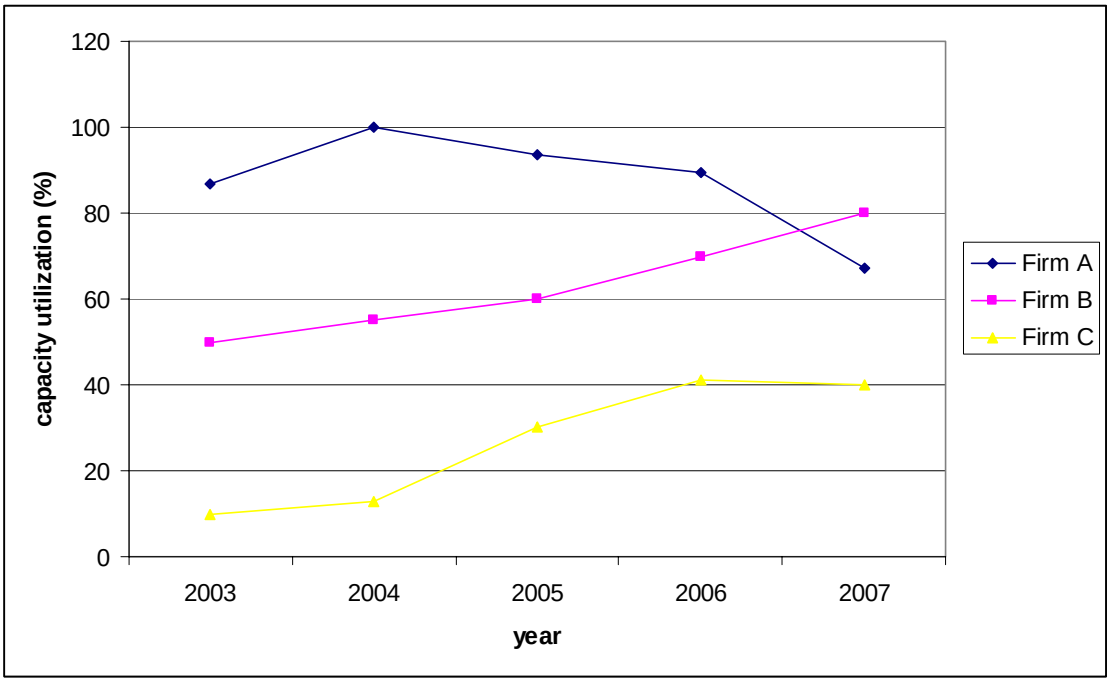

Figure 5. Trends in capacity utilization of case study firms, 2003-2007

5.1.3. Role of the public sector and the institutional set-up of the financial sector

As pointed out in the theoretical framework for the study, the Nigerian agricultural sector is relatively highly subsidized, and hence, it is difficult to decouple the role of the public sector from the institutional set-up of the financial sector in the analysis of the cocoa innovation system. We discovered that except for firm B which has benefited from financial support from a commercial bank,[24] none of the other two firms indicated significant financial support from the private sector. Similarly, the farmers interviewed

[24] Cocoa Mirror Magazine (Vol.1, No.2, 2007) reported that Skye Bank PLC acquired 90% of firm B for ₦400 million in February 2006 from the Ondo State Government, which retained 10% ownership. A turn-around programme commenced immediately after the acquisition. This involved substantial renovations, refurbishment of some equipment, and importation of several spare parts for replacement of decayed parts.

are unanimous in stressing that financial support, mostly in kind, has been from the public sector.

Table 8 presents the indicative strengths of the linkages between the case study firms and the public sector actors that may be involved in the cocoa innovation system. Table 8 also indicates the strength of the linkage of the firms with two other important actors, which though not public sector agents, but determine the firms' capacity to innovate and improve performance. These agents are the industrial users of the firms' products, and the parent companies in the cases of firms A and B.

As shown in table 4, a score of not more than three points is indicative of relatively weak linkage, suggesting that the linkage is not interactive and at best limited to an arm length seller-buyer relationship that may or may not provide essential feedbacks. From the results in table 8, the average scores of the three case study firms show that the public sector agents that have relatively strong and interactive linkage with the cocoa processing firms are the Nigerian Export Promotion Council (NEPC) (4.3 points), the State Ministry of Agriculture (4.0 points), the Federal Ministry of Environment (3.7 points), and the State Environmental Protection Agency (3.7 points). These linkages are reasonably at the level of close interactions involving exchange of knowledge that may result in innovation and improved firm performance. The NEPC appeared so important apparently because all the three firms are actively involved in the export of their products. The state ministry of agriculture (Ondo State) considers cocoa production as a major source of income and pride itself as the largest cocoa producing state in Nigeria. Moreover, there has been

upsurge in the advocacy for economic diversification and the cocoa industry in the state is regarded as presenting a major opportunity in this respect.[25]

Table 8. Indicative strength of linkages between firms and actors in the cocoa innovation system

Economic actor	Indicative strength of linkage as perceived by firms*			
	Firm A	Firm B	Firm C	Average score for all firms
National Cocoa Development Committee	2	4	1	2.3
Individual cocoa farmers	4	5	2	3.7
Cocoa farmers' associations and cooperatives	4	3	2	3.0
Cocoa Research Institute of Nigeria	4	2	1	2.3
Federal Ministry of Commerce and Industry	2	3	4	3.0
State Ministry of Commerce and Industry	2	3	4	3.0
Federal Ministry of Agriculture	2	4	4	3.3
State Ministry of Agriculture	4	4	4	4.0
Federal Ministry of Science and Technology	1	1	2	1.3
Universities	2	2	2	2.0
Federal Institute of Industrial Research (FIIRO)	2	1	2	1.7
Raw Material Research and Development Council (RMRDC)	2	1	2	1.7
Nigerian Export Promotion Council	4	4	5	4.3
NAFDAC	4	1	2	2.3
Standard Organization of Nigeria	4	1	4	3.0
Universities	2	2	2	2.0
Federal Ministry of Environment	4	3	4	3.7
State environmental protection agency	4	3	4	3.7
Industrial users of your firm's outputs	4	4	4	4.0
Parent company	5	4	n.a.	n.a.

* the scores are assigned as indicated in table 5

n.a.= not applicable

Source: Field data, 2007

[25] See Ondo State Economic Empowerment and Development Strategy (ODSEEDS, 2005) for the strategic role of cocoa in the Ondo State economy.

The result also shows that individual cocoa farmers have significant interactions involving exchange of knowledge with the firms. In fact, firm A claimed to hold interactive sessions with the farmers in order to get close to the farmers. Some of the benefits of these interactions include getting to know the farmers' problems and helping to solve them. Such help rendered by the firm included supplying improved seedlings to farmers free of charge, giving them good prices for cocoa beans, assisting and sharing knowledge on handling cocoa to improve the quality of cocoa beans produced. The significance of the firms' linkages and interactions with the Federal Ministry of Environment and the State Environmental Protection Agency may be anchored on the increased awareness of the need for environmentally sustainable industrialization in Nigeria. The challenge of mitigating the external diseconomies of production may have brought the case study firms and the environmental regulators into close interactions and exchange of knowledge. Adeoti (2001) presented a detailed analysis of this in the broader context of Nigeria's industrial development.

Other public sector actors that scored up to an average of three points include the Federal Ministry of Agriculture (3.3 points), cocoa farmers' associations and cooperatives (3.0 points), Federal Ministry of Commerce and Industry (3.0 points), and Standard Organization of Nigeria (SON) (3.0 points). The interactions of the firms with these agents are largely arms length in nature, and thus may not involve significant exchange of knowledge leading to innovation. It is however noteworthy that while the farmers are individually closer to the firms, the farmers' associations are perceived as having only arms length relationship with the firms. It appears that the firms prefer to relate directly

with individual farmers, perhaps to make it difficult for farmers to develop oligopolistic market and cartel practices.

As earlier mentioned, other important actors with which the firms interact closely include the industrial users of the firms' products and the parent company of firms A and B. Though these are non-public sector agents, they to a large extent determine the firms' ability to remain in business, and the feedbacks they provide can be an important determinant of the firms' capacity to innovate.

5.1.4. Education and training

For both cocoa farmers and cocoa processing firms the Nigerian educational institutions are not considered as important sources of knowledge. Most of the farmers interviewed for this study identified individual fellow farmers as the most important source of knowledge that have helped improved their farm practices. The second most important source of knowledge is farmers' cooperative societies and associations. Some of the farmers attest to the fact that the cocoa processing firms also provide them with useful information especially on quality requirements. We found no evidence of formal education and training programme that may enhance the innovation capacity of the farmers. It appears that most of them depend largely on accumulated knowledge gained from several years of cocoa cultivation, and there is no deliberate effort aimed at acquiring new skills or knowledge that may improve farm performance.

Table 9 presents the sources of knowledge for the three case study firms. Foreign technical partners and other manufacturing firms in the cocoa industry are sources of

technological knowledge to all the three case study firms. This may be an indication that though these firms interact among themselves and to some extent share technological knowledge; they still depend on their respective foreign technical partners for important technology solutions. As earlier stated in section 5.1.2, strong inter-firm relationships are absent among the firms, and hence knowledge sharing would expectedly be to a limited extent. Besides, the firms are competitors in the same market.

Table 9. Sources of knowledge for innovation

Sources of knowledge	Firm A	Firm B	Firm C
Other manufacturing firms in cocoa industry	x	x	x
Your firm's foreign technical partners	x	x	x
Your firm's in-house R&D	x	-	x
Supplier(s) of the main production technology	x	-	x
Supplier(s) of raw cocoa beans	x	-	-
Local research institute(s) in Nigeria	x	-	-
Nigerian universities	x	-	-
Your firm's parent company	x	-	-

Source: Field data, 2007

While firm A claimed several sources of technological knowledge, firm C identified suppliers of the main production technology and its in-house R&D as additional sources of knowledge. It appears from these results that while firms A and C recognized the internal mechanism for learning and innovation through in-house R&D, firm B's attention is rather on the external sources of technological learning. Moreover, for firms A and C, the suppliers of the main production equipment were identified as the most important source of knowledge. This suggests that firms A and C keep relatively close relationships with their technology suppliers.

5.2. Factors that constrain value-addition in the Nigerian cocoa industry

Table 10 presents the factors identified by firms as constraints on firm's capacity to add value to cocoa beans. Prominent among these factors are high cost of machinery and equipment; poor industrial policy; inadequate power supply from Power Holding Company of Nigeria (PHCN); and poor government policy on cocoa production. High cost of production equipment ranked highest among these factors, followed by poor government industrial policy. Other factors mentioned as constraints by the firms include international competition in cocoa processing, and lack of skills to operate critical machines and equipment. Firm A specifically stressed that it has been difficult to stock cocoa for all year round production due to seasonal availability of the commodity. Nigerian firms lack the financial capacity to import cocoa beans to satisfy local production demands during off season. Firm A also reported that the locally produced spare parts are inferior to imported spare parts. This is a reflection of the weakness of the Nigerian capital goods sector. The imported spare parts are relatively expensive while use of the local spare parts results in frequent maintenance schedules and sometimes production system breakdowns. For the spares that have no local alternative, their relatively high costs serve as disincentive to production and also reduce the competitiveness of the Nigerian products.

Table 10. Factors that discourage value-addition

Factor discouraging value-addition	Firm A	Firm B	Firm C
High cost of machinery/equipment	x	x	x
Poor government industrial policy	x	x	x
Inadequate power supply from PHCN	x	x	x
Poor government policy on cocoa production	x	x	x
International competition in cocoa processing	x	x	-
Lack of skills to operate critical machines and/or equipment	-	x	-

Source: Field data, 2007

5.3. Effectiveness of cocoa re-birth measures

The perception of the three case study firms on the effectiveness of the various measures under the cocoa re-birth initiative is shown in table 11.

Table 11. Firms' perception of the elements of cocoa re-birth initiative

Cocoa re-birth measure or element	Firm A	Firm B	Firm C
Rehabilitation of old cocoa farms	+	+	-
Establishment of new cocoa farms	+	+	-
Supply of high yielding and early maturing cocoa seedlings	+	+	+
Supply of disease resistant seedlings	+	+	+
Subsidized inputs (e.g. agrochemicals, knapsack sprayers, solo pumps, hydrocarbon free jute bags, & cutlasses)	+	0	+
Free cocoa beverages served in primary schools	-	-	-
Use of cocoa based beverages in govt. offices	-	-	-
Ban on importation of cocoa butter, cake and powder	+	+	+
Establishment of cocoa related cottage industries	+	-	+
Revival of cocoa cooperative societies	+	0	+

Notes:

Positive sign indicates measure is considered effective

Negative sign indicates measure is considered ineffective

Zero indicates undecided

Source: Field data, 2007

All the firms agree on the effectiveness of supply of high yielding, early maturing and disease resistant seedling to farmers by public agencies and one of the case study firms. Firms A and B affirm that old farms are being rehabilitated and new farms are being established. These elements of cocoa re-birth are thus likely to provide opportunity for farmers to learn to innovate in farm practices. All the firms also agree on the effectiveness of the ban on the importation of cocoa intermediate products produced by the cocoa processing firms. This has apparently encouraged production as capacity utilization of the firms has generally been on the increase since 2003 (see figure 5). However, whether this has translated to significant improvement in capacity to innovate by these firms is unclear from our findings. Measures considered effective by two of the three firms include: subsidized inputs such as agrochemicals, knapsack sprayers, solo pumps, hydrocarbon free jute bags, and farm implements (e.g. cutlasses); establishment of cocoa related cottage industries; and the revival of cooperative societies. However, the policies of serving free cocoa beverages in primary schools and the use of cocoa based beverages in government offices are perceived as being ineffective by all the firms apparently due to the non-implementation of these measures.

It is also important to note that all the three case study firms claimed to be actively engaged in exporting their products. The firms however claimed that the cocoa re-birth initiative has had no impact on the export of their products. For all the firms, cocoa butter ranked highest as the main export. The other exports in order of importance are cocoa cake and cocoa liquor for firms B and C; while the order is cocoa liquor and cocoa cake for firm A. While export destination includes African countries, the most important export destination for each of the firms is Europe.

6. Conclusion: Measures for Promoting an Innovation System for Effective Cocoa Re-birth

This study has examined in considerable detail the features of the cocoa innovation system in Nigeria and its relationship with the cocoa re-birth initiative. Generally speaking, the findings of the study demonstrated that the cocoa innovation system in Nigeria is still relatively weak and measures to strengthen it appear unarticulated. As emanating from the foregoing, we wish to suggest the following measures as necessary for strengthening the cocoa innovation system in Nigeria. As stressed by this study, an effective cocoa innovation system would enable the achievement of the cocoa re-birth objective of sustainable growth of the Nigerian cocoa industry.

i) While it is good that CRIN has a focus and mandate on cocoa R&D, it would be necessary to encourage the private sector to be directly involved in the initiation, organization and conduct of cocoa related R&D. This would ensure that users of R&D outputs are directly involved in the research process such that they are able to build confidence in the R&D, and have better understanding of the risks involved in commercial application of the R&D outputs.
ii) The cocoa re-birth initiative should be more innovation focused in its approach. There is currently no direct emphasis on innovation in farm practices and in the industrial processing of cocoa. This emphasis is necessary to re-orientate productive activities in the Nigerian cocoa economy towards learning to do things in new ways that can meet the competitive challenges of modern agricultural and industrial development.

iii) The adoption and diffusion of improved cocoa seedlings under the cocoa re-birth initiative currently thrives on subsidy provided by government. While subsidy for agricultural production in a developing country such as Nigeria may not be discouraged, it is important to have a phased programme of subsidy withdrawal on the cocoa seedlings programme when it is certain that farmers have proven the viability and economic importance of the new variety. This should result in a market driven diffusion which will be healthy for the sustainable growth of the cocoa industry.

iv) The linkages and interactions between four critical actors (individual cocoa farmers, cocoa processing firms, CRIN, and NCDC) in the cocoa re-birth programme should be strengthened. This may be done through periodic joint review of the activities of each of these actors and active participation in specific projects that are of common interest. For example, a project on improving the quality of cocoa butter from the Nigerian cocoa may involve the cocoa processing firms and CRIN as initiators, cocoa farmers as input suppliers that learn desirable processing methods which would ensure cocoa beans meet specified quality standard, and NCDC as facilitator and major financier.

v) Our findings showed that export is a major concern of the cocoa processing firms, and this appeared to have led to close interactions of the firms with the NEPC. However, the findings also indicated that this has not been effectively linked with the cocoa re-birth initiative. In order to further encourage export by the cocoa processing firms, it would be good to integrate the NEPC export incentives into the cocoa re-birth initiative. Moreover, the NEPC should also ensure that an innovation system approach to export promotion is adopted. This would essentially begin by

laying emphasis on demonstrable innovative activities of firms as an important requirement for firms' benefiting from export incentives.

vi) The involvement of the financial sector in the cocoa innovation system is an important challenge for policy and proactive measures that direct financial institutions to invest in the real economy. The financial sector is aware of the significance of innovation for a competitive economy. However, their response to investing in the real sector of the economy has been slow due to perceived relatively low return on investments and the non-competitive nature of the real sector of the Nigerian economy. The Bank of Industry and the Central Bank of Nigeria should provide leadership in investing in innovative new start-ups in cocoa processing and in carefully identified innovative ideas or projects in existing cocoa processing firms. This demonstration should be carried out in partnership with interested commercial banks with the CBN guaranteeing the banks' investment in the project. Once the banks are convinced that innovative projects/programme in firms are able to provide satisfactory returns on investment they would be on the search for such projects.

vii) The findings of the study indicated that cocoa processing firms depend largely on foreign technical partners for technological solutions and locally fabricated spare parts are considered not durable. This suggests that the Nigerian manufacturing industry is weak in its engineering sector. Policies aimed at reviving the engineering sector will be crucial for improving the innovative capability of the cocoa processing firms. The starting point to address the problem of the sector would be to survey the few firms operating in the engineering sector in order to ascertain their most critical current needs that should inform public sector support. It is imperative

that heavy subsidy programmes such as duty waivers on imported machinery/equipment and raw materials, tax incentives for local R&D, etc would be required to give the sector a boost at least in the short-term.

viii) Efforts should be made by the educational and training institutions to improve on the quality and quantity of skills being produced for the cocoa processing firms. As part of the cocoa re-birth initiative, special training programmes should be organized for skills upgrading and new skills development relevant to the cocoa industry. The result of this study suggests that skills development in the areas of cocoa farm management and the operation of modern cocoa processing equipment/machinery would be particularly useful in enhancing the cocoa output and the performance of cocoa processing firms.

ix) The cocoa re-birth measures involving the serving of free cocoa beverages in primary schools and the use of cocoa based beverages in government offices should be implemented because of their potential of being able to stimulate increased local processing of cocoa and manufacture of cocoa based products.

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