THE IMPACT OF MACRO-POLICIES ON TECHNOLOGY CHOICE, DEVELOPMENT AND EMPLOYMENT: A NIGERIAN CASE STUDY

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1. INTRODUCTION

Empirical studies, at both micro- and macro-levels, on the impact of policy on technology choice in Nigeria are scarcely available. The ATI project has therefore created the rare opportunity for examining the Nigerian situation in the context of the experience of other parts of the world. The outcome of the comparative studies at both regional and international levels will be most valuable in helping individual countries to re-examine existing science and technology policy.

This Nigerian study is divided into four major sections. Information on the structure of the Nigerian economy is provided as background for understanding and evaluating existing macro policies and their probable impacts. Secondly, the results of a survey of characteristics of technology users in Gongola State are presented. Such characteristics would be indicative of the extent to which macro policies are expected to affect technology choice, learning and its effective use. Thirdly, the actual effect of macro-policies on technology choice, development and employment are examined based on empirical surveys of technology users in Gongola State and major producers of technology in Nigeria. Finally, the last section discusses the political economy of technological transformation in Nigeria.

2. AN OVERVIEW OF THE NIGERIAN ECONOMY.

2.1. Structure of the Economy

Information available at the Central Bank of Nigeria (1986)

shows that in 1986, the gross domestic product at constant 1987/78 factor cost was estimated at ₦25.290 million, representing the lowest value over the period 1978 to 1986. The 1986 GDP figure reflected poor performances of the manufacturing, crude petroleum wholesale and retail trade sectors. Thus the index of industrial production declined by 3.4 percent in 1985. The contribution of the agricultural sector to GDP showed annual declines between 1978/78 to 1983, with slight upward movements between 1984 and 1986. Such improvements moderated inflationary pressures with composite consumer price indices rising by 5.5 percent and 5.4 percent in 1985 and 1986 respectively.

Between 1962 and 1979 crude petroleum output increased from 5.3 million metric tons to 120.4 million (Angaye, 1986, p. 54). The period 1973/74 - 1979/80 witnessed a drastic rise in oil prices and therefore oil revenue. In 1960 the agricultural sector contributed 89 percent of Nigeria's export earnings, while oil contributed only 2.7 percent. In 1980/81 however, the reverse was the case. Oil contributed 90 percent while agricultural sector contributed only 2.5 percent of export earnings. While in 1960, oil contributed only one percent to government revenue, in 1980, the sector contributed 80 percent (Angaye, 1986, pp. 54-58). The unexpected increases in oil revenue and the total mismanagement of the economy resulted in unnecessary food import bills which increased from ₦2.98 million in 1975 to ₦1,052.1 million in 1984 (Balogun, 1986, p. 121). By 1982/83, Nigeria started experiencing external balance of payment deficits and could not settle its short-term trade debts.

2.2. Large-scale Industry

The major capital-intensive manufacturing activities in the Nigerian economy include the steel, fertilizer, petrochemical, paper and machine tools projects. Table 1 shows that among the growth sectors identified in the Third National Development Plan, petroleum products and coal had the largest share of government investment followed by iron and steel, petroleum refineries and fertilizer and pesticide projects, in that order.

2.2.1. Fertilizer Projects

The Kaduna-based Federal Superphosphate Fertilizer Company has a capacity of 100,000 tonnes of single phosphate per year while the National Fertilizer Company of Nigeria (NAFCON) at Onne, just commissioned at Port Harcourt will produce annually 400,000 metric tonnes of granulated urea and 300,000 metric tonnes of NPK.

The petrochemical projects are yet to take off. Planned in three phases, the Ekpom (Warri) plant is to produce 35,000 tonnes of polypropylene a year while the carbon black plant is to produce 18,000 tonnes a year. A third phase I plant is located at Kaduna and is designed to produce various kinds of petrochemical products. The site for phases II and III projects is Eleme near Port Harcourt, Rivers State.

2.2.2. Iron and Steel Projects

The Nigerian Government has opted for two routes for iron and steel manufacturing. The Aladja Steel Plant at Warri in

Table 1. Government Investment by Industrial Groups Under the Third National Development Plan (1975-1980)

Industrial Group	Total Investment in ₦ million	Percentage Shares
Petroleum Refineries	731.0	15.74
Products of Petroleum and Coal	1,301.5	28.13
Iron and Steel Basic Industries	1,043.5	22.47
Fertilizers and Pesticides	383.0	8.25
Factory Chocolate and Sugar Confectionery	363.0	7.82
Paper Products	332.0	7.15
Cement, Lime and Paster	240.7	5.18
Other Industries	389.2	8.33
Total for all Industries	4,788.9	100.00

Source: S.O. Olayide, Economic Survey of Nigeria, Aromolaran Publishing Company, Ibadan, 1976, p. 72.

Bendel State is based on the direct reduction/electric arc furnace process (DR/EAF) while the Ajaokuta Plant, yet to be completed and located in Kwara State, adopts the blast furnace route (DF/BOF).

When compared with the more traditional BF/BOF steel making route, the Aladja plant is a small-scale technology. Its investment cost is about 60 percent of the BF/BOF route up to 2 million tonnes of capacity. The capacity of the Aladja plant can be increased at an annual rate of 200,000 tonnes, whereas the BF/BOF route has to be increased at an annual rate of one million tonnes. Each of the two modules of the Nigerian midrex plant has a capacity of 520,000 metric tonnes of iron a year, thus yielding a total installed annual capacity of 1.02 million metric tonnes. During the first phase of the Nigerian BF/BOF plant at Ajaokuta, an annual production capacity of 2.5 metric tonnes will be attained. This is double the plant capacity of the Aladja small-scale plant.

The Aladja plant has some advantages over the BF/BOF route. It can be set up within a shorter period of time. For example, physical work started at the Aladja site in January, 1978 and the plant got commissioned in January, 1982, a period of only four years. The BF/BOF route would take 5-7 years. The Nigerian BOF/BF plant at Ajaokuta in Kwara State whose agreements were signed in the late 1960s is projected for commissioning in 1988. The shorter gestation period of the DR/EAF process has advantages of ensuring savings on interest payments on loans and savings in foreign exchange due to import substitution. The choice of

Aladja for the new steel plant was based on the following advantages, namely; proximity to hitherto much flared-off natural gas, location on the Warri River bank necessary for providing port facilities for delivery of materials and shipping out of products, and proximity to electricity supply from the nearby Ogorode Power Station at Sapele.

A disturbing feature of the Aladja Steel Plant is its high dependence on foreign sources of inputs. To meet its annual ore requirements of about 1.5 million tonnes, the Aladja plant imports iron ore from Brazil, Guinea, Liberia and Mauritania. Contracts worth 130 million naira have been signed since July, 1983 to start mining the Itakpe deposits, but as of April, 1985 only 100,000 tonnes of iron ore have been mined.

It is believed that there are over one million tonnes of steel scraps in Nigeria. One forecast (Ogegbo and Igwe 1984) indicates that if the available steel scrap that is littered everywhere is locally processed, Nigeria could save 400 million naira by the year 2,000. There are no efficient scrapyards with the necessary machinery or skills for presmelting treatment or upgrading of scrap in Nigeria. Under these circumstances, Aladja scrap requirements are being filled from abroad under a long-term agreement with some American firms.

2.2.3. Machine Tools Project

The Nigerian Machine Tools Limited at Oshogbo is designed to fabricate basic tools and equipment for the manufacturing sector. Work commenced on the site in 1979 and the plant was expected to

commence work in 1987. Work delays occurred due to shortages of raw materials, and foreign exchange.

2.2.4. Paper Projects

There are three paper mills - The Nigerian Newsprint Manufacturing Company (Limited (NNMC) at Oku Iboko in Cross River State, The Nigerian Paper Mills at Jebba, Kwara State and the National Paper Manufacturing Company at Iwopin, Ogun State. The three mills are supposed to render Nigeria self-sufficient in paper products. In 1986, the NNMC hit 50 percent of 300,000 tonnes of full capacity a year. The Nigerian Paper Mill achieved 66 percent of installed capacity in 1986.

All the large-scale projects enjoy a favourable policy environment. As pioneer industries, they enjoy the privilege of Income Tax Relief for a period of three or more years. They also avail themselves of the advantages of the Approved User Scheme so that they enjoy exemption from import duty or are subject to concessionary low rates of import duty on imported inputs and accelerated depreciation on capital.

2.3. Extent, Magnitude and Composition of Small-scale Industries

Information on Nigeria's small-scale industry is very fragmentary (Chuta, 1980). Therefore, it is difficult to make any general statements concerning the extent or magnitude of the small-scale industrial subsector. In the South-East States (Iwuji and Okoroafor, 1975), where it could be assumed that a

total survey coverage of the State was undertaken, a total of 4,062 establishments were counted, employing about 13,000 people. On the basis of the 1963 population survey, therefore, less than one percent (0.7 percent) of working age people (15-64 years) were involved in small-scale labour-intensive industrial activity. Experience from other countries suggests that employment in small-scale industries in Nigeria could exceed the figures revealed in previous survey results.

The available information (University of Ife, 1973 and Kilby 1962) on small-scale industries reveals that similar enterprises are found in each of the Nigerian States. With the exception of the Western State and Port Harcourt, tailoring was found to be the most numerous small-scale enterprise, constituting 49 percent, 42 percent, 41 percent, 31 percent, 27 percent, and 76 percent of the total number of establishments in Lagos, Mid-West, Kwara, South-East, Benue Plateau States and the cities of Aba and Onitsha respectively. In these locations, tailoring was followed by carpentry and bicycle repair. In contrast, carpentry was the leading small-scale industry in the Western State as well as Port Harcourt. However, unlike the rest of the States, goldsmithing was the second most important industry in the Western State followed by bicycle repairs.

The employment figures reveal that, with the exception of South-East State, self-employed and apprentices constituted the two most important employment categories in the enumerated States. In fact, in the Mid-West apprentices constituted up to 63 percent of total employment, while in Kaduna State the self-

employed category constituted 48 percent of total employment. By subtraction therefore, employees or paid labour as a proportion of total employment ranged from 5 percent in Kwara State to 35 percent in South-East State. In five states, namely Mid-West, Kwara, Lagos, Western and Kaduna, employees did not constitute more than 10 percent of total employment. Average firm size (employment per firm) ranged from 2.1 in Kaduna to 3.5 in the Mid-West. In Aba, Onitsha, and Port Harcourt cities, average firm sizes are 2.8, 3.2 and 2.7 respectively.

The average level of capital investment in small-scale industry ranged from ₦254 in the Mid-West State to ₦687 in South-East. In Kaduna State, 46 percent, 58 percent, and 89 percent of the 6,615 small-scale enterprises enumerated in 1973-74 had capital investments of less than ₦100, ₦150 and ₦1,000 respectively. In both the South-East and Benue Plateau states, initial capital investments observed were on average ₦395 and ₦282 respectively. Although it is clear that existing data on small-scale industries in Nigeria are not comparable, the figures suggest that small enterprises in Nigeria were much smaller than their official definitions would imply.

In the six states surveyed, at least one quarter of small-scale entrepreneurs had primary 6 education (Benue Plateau State) and at most 58 percent had up to the level of primary 6 education (Mid-West). In terms of lack of formal education, Lagos State ranked lowest with one percent followed by South-East State with 13.3 percent. The highest percentage for lack of formal education was observed in Kwara State (56). With the exception

of South-East State (where 40 percent was observed to have post-primary education), education beyond the primary school was not a common feature among small-scale entrepreneurs from those States.

2.4. Agro-industrial Sector

For the entire agro-industrial sector, a report by Laurent (1968) provides some indication of sectoral composition and the contribution of food processing establishments. The report reveals that in 1963, an estimated 32,500 persons were employed in agro-industrial enterprises employing over 10 workers, with over 70 percent in textile mills, saw mills and the rubber industry. About half of the workers were unskilled and about 40 percent were skilled or semi-skilled. About 16 percent of agro-enterprises were located in Lagos, 28 percent in Western, 20 percent in Mid-Western, 17 percent in East and 19 percent in Northern parts of Nigeria. Saw milling was most important in Lagos and West Nigeria, rubber in Mid-Western Nigeria, bakery in Eastern Nigeria and textiles in North Nigeria.

An interesting aspect of locational patterns of agro-industries is that to a great extent natural resource base determined the regional predominance of enterprise type. Even when these enterprises were not rural-based, they had important linkages with agricultural products, such as lumber, rubber, cotton, cashew nuts, cassava, cocoa, oil palm, palm kernel, sugar and groundnut. Below we provide an economic assessment of some food processing technologies to highlight certain choice options.

2.4.1. Oil Palm Processing

Miller's study (1965) of oil palm processing technologies in mostly rural parts of Eastern Nigeria identified five technologies of oil palm processing, namely, hand processing, the small screw press, the small hydraulic hand press, the large pioneer mill and the major stock mill. Factor proportions differed widely between the different technologies. Labour use ranged from 9.2 person-day equivalent per cwt of oil processed in hand processing to 0.7 for he major stock mill, while capital investment per firm in 1964 ranged from 1.4 pounds sterling in hand processing to 55,210 pounds sterling for the major stock mill. The large mills were more technically efficient than the small labour-intensive techniques. The quantity of oil per cwt of fruit extracted ranged from .154 cwts in hand pounding to .213 cwts in the major stock mill.

In his analysis of alternative technologies, Miller constructed an efficient index defined as average revenue divided by average total costs (including assembly costs) multiplied by one hundred. Based on the similarity of this index for the screw press, hydraulic hand press, and pioneer mill, he recommended that investment continue in these three techniques. Miller also estimated the loss of rural employment in Eastern Nigeria that would result from a shift from exclusive use of one of the three optimum techniques to exclusive use of another. However, Miller's analysis suffered from two limitations: (1) no correction was made for distorted input and output prices, and (2) distribution costs of final products were not considered.

2.4.2. Cereal and Groundnut Processing

In both 1971 and 1972, surveys of rural processors were carried out in two villages of Zaria Province of Northern Nigeria - Hanwa and Dan Mahawayi. The surveys focused on the processing of sorghum and millet to produce "fura", "koko" and "kunu", cowpeas to produce "alele" and "kosai" and groundnut to produce groundnut oil and "kuli kuli". "Dan wake" is obtained simply by mixing sorghum flour, cassava flour, cowpea flour, baobob leaves, sweet potato and millet. Thus, for each of the rural small-scale food processing enterprises, information was obtained for amounts of raw materials processed, costs of raw materials and purchased services, estimated value of sales, wages, profits, returns on cash investments and value per ton on primary raw materials purchased. In addition detailed information based on actual observation was obtained for the various stages of processing.

The results of the Emmy Simmons survey revealed that all enterprises except Dan Wake have been known to be profitable, earning returns on initial investments of from 23 to 40 percent. The largest proportion of costs in all cases was attributable to the purchase of raw materials: the variable costs of the grains or other major ingredients accounted for nearly 90 percent or more of the daily cash operating costs. In no firm did the wages-profits account for more than 30 percent of total revenue.

While the processing of groundnuts into groundnut oil and kuli kuli is the enterprise most likely to earn a substantial wage-profit on an hourly basis for its producer, assuming 1971/72 profit margins, it also demands a substantially larger amount of

working capital than any other enterprise.

The survey also revealed that these rural small-scale food processing enterprises are well suited to the productive capacity, income and employment of rural women. However, these enterprises face competition from two sources: the larger-scale modern industrial plants producing similar products - groundnut oil, etc. - and urban-based firms of all scales and levels of technology producing competing products from largely imported raw materials, e.g. bread, biscuits, etc. The present and future impacts of the different kinds of competition on rural small-scale food processing industry need to be ascertained.

2.4.3. Garri Processing

Ngoddy's work (1974) on garri processing is noteworthy. Cassava tubers, once harvested must be consumed or processed for storage. Available data show that over 70 percent of Nigeria's annual output of cassava is processed into garri which in some southern parts of Nigeria contributes up to 60 percent of people's daily intake of calories.

From the point of view of processing technology, self-sufficiency in garri production is hampered by declining production of cassava (as more of other cash crops are produced for exports), and drudgery of traditional methods. On the other hand the process of mechanization has progressed without ensuring divisibility of production units to generate massive adoption at the grassroots, and without catering for the traditional tastes of consumers with changes in fermentation and frying processes.

Fortunately, development of an intermediate technology as a result of local engineering efforts has led to an increase in both labour and capital productivities.

2.4.4. Sugar Cane Processing

Nigeria is still a net importer of sugar despite processing plans now operational at the Savanah Sugar Company in Gongola State and Bacita. Actual production capacity is only about 25 percent of installed capacity and about 4 percent of total sugar demand in Nigeria. Both brown and white sugar are locally produced and the prevailing technology is sugar mill operation with open pan sulfitation.

2.4.5. Bread Processing

The imposition of a ban on wheat imports has raised the question of attaining self-sufficiency in wheat bread production in Nigeria. Choice of processing technology will depend on what is feasible for local sources of flour (sorghum, millet, maize, cassava, etc.) other than wheat.

Available literature shows that bread making technology ranges from the traditional labour - intensive technology of hand operation and use of mud/burnt brick oven to the use of sophisticated capital-intensive automated ovens (Chuta, 1985). In between the two types are intermediate ones such as the multiple deck, reel and peel ovens. Each oven type, particularly the intermediate ranges, could adopt various kinds of capital-intensive equipments for mixing and rolling dough, as well as

slicing and packaging baked bread. How each technology suits the composite flour situation as substitute for wheat flour is the crucial problem.

2.4.6. Yam Storage and Processing

No significant increase in the volume of yam production would be very meaningful unless such products could be safely preserved or stored over a reasonable length of time. Yam tubers are susceptible to various diseases and pests. For example, the eelworm (scutellonema bradys) causes rotting of yam tubers during storage. Scale insects and mealy bugs often infest stored yam tubers thus affecting the vigour, quality and palatability of yam tubers. To a large extent, the traditional yam barn is still the favoured storage system. Under conditions of poor ventilation, rain and extreme sunlight, rotting sets in. It is estimated that about 30 - 50 percent of harvested yams in Nigeria are lost due to spoilage (Federal Ministry of Education, Science and Technology, 1985). To combat these problems, the Nigerian Storage Products Research Institute in Lagos has introduced new methods to ensure success in yam storage.

The most significant development in yam storage is in the nature of forward linkage with yam production. About 20 - 25 percent of yam harvested in some states in Nigeria are processed into yam chips which are eventually converted into yam flour (Federal Ministry of Education, 1985, p. 5). The yam varieties that have proved to be most outstanding in the production of flour are the D. Rotunda and D. Alata specis. Yam flour is used

in preparing yam foo-foo, a delicacy of high demand in Nigerian restaurants and hotels. Individuals also purchase yam flour stored in airtight polythene bages for use in private houses. Thus yam foo-foo can be prepared within seconds without resorting to the tedious and boring use of morter and pestle for pounding boiled yams. To ensure all season self-sufficiency in yam production, divisible and economically viable methods of storage at the village level will have to be found.

2.5. Conclusion from Overview

The foregoing review of the structure of the Nigerian economy reveals that scope exists for achieving increased output, productivity and employment in the various industrial sectors. Appropriate macro-policies are needed for achieving optimal balance between mixes of production technologies and products. With respect to products, the steel industry will be used for illustration.

The existing five steel products, namely the Aladja DR-EAF plant, the Ajaokuta BF/BOF plant and three rolling mills, focus on the manufacturing of long products such as rods, angles etc., that are mostly in demand by the construction industry. There is therefore a need to diversify the steel industry in order to cater to the short-fall in the present and future demand trends. No only should emphasis be put on production of long products, but various flat and alloy steel products will have to be produced.

In order to achieve the socio-economic development

objectives of equity and social justice, appropriate macro-policies are needed to attain an appropriate combination of market forces and official intervention, private and public participation in investment, large-scale capital intensive and small-scale labour-intensive activities in the use of available local resources in a self-reliant manner.

3. CHARACTERISTICS OF TECHNOLOGY USERS

In order to undertake a micro-level examination of technological characteristics of equipment-using companies in the metropolis of Jimeta/Yola in Gongola State, a survey was undertaken using a structured questionnaire. One-person enterprises were not included in the study as these do not constitute important sources of technological information. Budget constraints did not permit extension of the study beyond the environs of the State capital. A total of twenty firms were visited out of which fifteen gave the required information. The focus of the study covered aspects of the firm's activity which related to innovation, in terms of introduction of new products and processes, problems with spare parts and components, machinery adaptation, local sourcing of raw materials, staff training, research and development. Although the experience of Gongola State may not statistically reflect the entire Nigerian situation, our findings are indicative of likely expectations and future research gaps.

The general characteristics of enterprises studied are quite diverse. Nine of the firms are privately owned, two are

government owned, three are joint-ventures between the government and private domestic/foreign partners, while one is a family enterprise. The firms' ages range from one year to twelve years, while firm size includes small (with less than ten workers), medium (with less than 50 workers) and large-scale (with greater than 50 workers). There are more bakeries than any other type of equipment user. Even among bakeries, there are differences in ownership pattern, age and size of firm and capital or labour intensity.

3.1. Sources of Equipment

The results of the study show that the pieces of equipment used by firms in Gongola State were generally imported. Sources of supply for the various equipment include countries such as Italy, West Germany, United Kingdom, Hong Kong and Sri Lanka. Two of the fifteen firms purchased locally manufactured equipment. Ten of the fifteen companies had their equipment delivered more or less on turnkey basis. In effect, the equipment was fabricated abroad and assembled in Nigeria by foreigners who took responsibility for training Nigerians for the local running of plant and equipment.

3.2. Nature and Extent of Technological Change

As table 2 shows, ten out of the fifteen firms indicate that they had made some changes in their products and processes, six firms effected some modifications and substituted local raw materials for imported ones, while none of the firms undertook

Table 2. Frequency of Positive Response for Variables of Technological Capability by Industry

Industry Group	Any Changes In Products and Processes?	Any Problems With Spare Parts?	Any Modifications?	Any Local Raw Material Substitutes?	Any R&D?
Feed Production	-	2	-	-	-
Rice Processing	1	1	1	-	-
Fish Production	1	1	-	1	-
Drinks	1	1	1	1	-
Tomatoe Processing	-	1	-	1	-
Tea Processing	1	1	1	-	-
Foam Industry	1	1	1	1	-
Furniture Industry	1	1	-	-	-
Bakery	4	6	2	2	-
Total	10	15	6	6	0

Source: Survey data in Yola.

local research and development activity. In general, the changes in products and processes reported were minor, such as effecting different shapes and quality of bread, refrigeration of fish for storage, and switching from the use of diesel to firewood in the drying of tea. Some of the equipment modifications were substantive. For example, the bottling company modified the starwheel on the filler to avoid time wastage, a bakery equipment was changed from auto to manual operation, the rice mill modified the conveyor belts to minimise breakage, while the foam/upholstery enterprise modified air-conditioners to perform the function of the original chilling machines. In all cases of major modifications, the enterprises relied on the expertise of expatriate staff or foreign manufacturing agents. The costs of such modifications were obviously very high.

The study also revealed that all the fifteen firms had problems in securing space parts. This result is corroborated by another piece of evidence. In a just completed Ford Foundation/ Social Science Council of Nigeria study of food processing industries in Gongola State carried out by the author, 43 percent of 131 randomly selected firms reported that they had repair problems with their equipment, while 34 percent had problems securing spare parts of their grain threshing and milling machines.

The study also reveals some minor substitution of local raw materials and parts for imported ones. For example, the bottling company now uses caps, bottles, and crates produced in Nigeria rather than import these from West Germany. The fishery

enterprise substituted plastic propellers for imported metal ones. The bakeries have attempted without much success to substitute maize flour for wheat while the tomato company now grows and uses fresh tomatoes rather than import the concentrates. When asked to provide solutions for the scarcity of spare parts and components, the general response was an increase in imports of needed items. However, three out of the fifteen firms suggested that arrangements should be made for the local manufacture of spare parts and components.

3.3. Technical Role of Local Staff

As table 3 shows, local staff is predominantly involved in routine jobs like plant operation and general supervision. About one-third or less of the firms responded that local personnel play a major role (in terms of initiating action) with respect to choice of technology, design of products and processes, trouble shooting and plant installation. In other words, expatriate personnel undertake these activities for most of the firms. Moreover, most of the feasibility studies are done by foreigners who are not conversant with local conditions, and products are designed without due reference to the cultural peculiarities of the Nigerian consumer. The dominance of foreign personnel in crucial technical activities reflects their dominance in ownership or control of those industries in which they are partners.

3.4. Technical Training

The enterprises visited were asked to indicate the system of

Table 3. Frequency of Role of Local Staff in Technical Activities of the Firm

Subject	Major	Minor	None
Feasibility Study	5	3	7
Choice and design of Production method	5	3	7
Choice of Products	6	3	6
Choice of Process	4	5	6
Trouble Shooting	3	4	8
Installation of Plant and Machinery	3	6	6
Routine Plant Operation	12	2	1
Supervision	10	3	2

Source: Survey data in Yola.

staff training (formal and informal) being adopted in their establishment. The response pattern showed that twelve out of the fifteen firms gave informal on-the-job training to their staff, while only five provided facilities for formal training. Three firms did not have any form of training whatsoever. The formal training offered was in fish, animal feed, tea processing activies and soft drink manufacturing. The bakery industry provided no formal training. Those firms which offered formal training utilized facilities available in the Nigerian polytechnics, universities and specialised institutions, such as Federal School of Fisheries and private companies. In the tomato company, on-the-job training is offered by expatriate staff, while in the bottling company, the staff of the Industrial Training Fund provides most of the on-the-job training.

What comes out clearly from our brief study of Yola equipment users is that there is almost total dependence on foreign countries for technology supply. Local manufacture of spare parts and components is at an infant stage. Even minor repairs and modifications of imported technology are undertaken by foreign experts. No significant and effective learning of imported technology is really underway. The role of macro-policies in filling the gaps is crucial for any country which aspires to achieve meaningful technological development.

4. MACRO-POLICY FRAMEWORK

The present economic problem in Nigeria defies any attempt to rely solely on an existing theoretical macro-economic framework

to provide any remedy. The Keynesian model which relates employment generation to aggregate demand via the multiplier cannot be very useful given the structural imbalances of the Nigerian economy. With wage rigidity, a low capital base, declining real income and high growth in the labour force, the neoclassical model of factor substitution in response to relative changes in factor prices cannot be seen to cope with the present unemployment problem in Nigeria. Supply rigidities (especially with respect to agricultural products) may also frustrate high hopes of diversifying sources of foreign exchange earnings in the short-run. Moreover, the policy of trade liberalisation, with its theoretical gains from territorial speclisation and division of labour, cannot be undertaken by Nigeria alone while the rest of the world hide behind tariff walls. In spite of huge profits reported by banks and commercial houses, private investment is not taking place at a pace that could mop up the pool of unemployed. It is against the foregoing background that the effect of macro-policies will be discussed.

The impact of macro-policies on technology choice will be examined in the context of the economic crisis of the mid 1970s and early 1980s, mainly associated with over-valued naira currency. As a result, an era of conspicuous consumption of mainly foreign goods emerged, there was massive capital flight out of Nigeria and the situation created utter disincentive to private and foreign investment in domestic productive activities. There were no incentives to invent, through research and development, or adopt appropriate technologies.

In 1984, Nigeria had an overdue trade debt of about ₦5.4 billion out of a total outstanding external debt of ₦12.1 billion (Central Bank of Nigeria, 1986, p. 94). The deficit problem in Nigeria's balance of trade situation had persisted after 1981, with food imports as a percentage of trade deficits of 115 percent, 53 percent, 70 percent respectively for 1981, 1982 and 1983. Nigeria's external reserves declined from ₦5,734.2 million in June 1981 to ₦828.3 million in May 1982 (Aluko-Olokun, 1987, p. 56).

In January 1984, the Nigerian authorities adopted exchange rate policy of ₦1 = $1.3359 and later allowed a gradual depreciation lending to a 10.12% depreciation of the naira by December of 1985 (Aluko-Olokum, 1986, pp. 56-57), and 50.27 percent depreciation against the dollar in June 1986. With the collapse of the OPEC price structure, oil revenue fell by 45 percent between 1985 and 1986 worsening the external liquidity crisis.

The problem of unemployment worsened as fresh secondary school leavers, university graduates and retrenched workers swoll the unemployment pool. The nation's rejection of the International Monetary Fund Structural Adjustment Loan aggravated matters as industries continued being starved of the inputs necessary to sustain industrial production. Thus the 1987 budget contained far-reaching economic policies which were designed to restructure and diversify the economy and reduce dependence on oil revenue.

4.1. The Structural Adjustment Program SAP (1986-1988)

At the centre of the new policies was the self-imposed Structural Adjustment Program (SAP). The main strategy of the SAP lay in the adoption of a realistic foreign exchange rate for the naira, through the introduction of the Second-Tier Foreign Exchange Market (SFEM) which took off on the 29th of September 1986. It is significant to note that while the First-Tier rate was ₦1.5 to the dollar in September 1986, the SFEM rate which was determined by forces of supply and demand recorded a rate of ₦4.6 to the dollar. by December 1986 the official First-Tier rate was ₦2.6 to the dollar while the market rate was ₦3.3. Today, both market rates have coincided and existing rates are about four naira to the dollar (Central Bank of Nigeria, 1986, pp. 10-14).

As well as the foreign exchange rate adjustment, the SAP included other policy changes. The Monetary policy changes included an increase on bank lending rates from 13 to 15 percent. Fiscal policy changes included reduction of import duties on industrial raw materials, agricultural inputs and tractors by 5 percent, imposition of 50 - 100 percent import duties on agricultural commodities (grains, chocolate powder, rubber tiles) and total ban on wheat importation, etc. These policies notwithstanding, the four-fold increase in the cost of dollar escalated the costs of domestic production and had some adverse effects on the domestic economy. Thus, in 1986, GDP at 1977/78 factor cost fell by 3.3 percent and the composite consumer price index increased by 5.4 percent while the index of food production

rose marginally by 0.1 percent compared with a 3.5 percent increase in 1985.

4.2. SAP and the Agricultural Policy

There were four main policies within the Structural Adjustment Program which were targeted on the agricultural sector (Titilola, 1987). First, certain agricultural items were curtailed and others such as wheat were banned totally. Second, institutional reforms introduced abolished commodity boards since these bodies turned out to be ineffective and exploitative of farmers through their buying agents. Third, the number of River Basin and Rural Development authorities was reduced from 18 to 11 and their functions redefined. Finally, a Directorate of Food, Roads and Rural Infrastructure was set up to encourage farmers to increase agricultural production. With the various measures national maize production was targeted as 3.3 million metric tons in 1986 and 3.6 million in 1987. Rice production was supposed to increase by 36.4 percent over the same period.

Functions of the Directorate for Foods, Roads and Rural Infrastructure (DFRRI) include the following:

1. Building of 60,000 kilometres of feeder roads;
2. Implementing rural water supply scheme through the provision of boreholes;
3. Implementing a rural market program and Food Market information dissemination system;
4. Launching a rural electricification program with emphasis on agro-industry; and

5. Implementing other programs on crop, livestock, fruits, vegetables, rural health and education.

4.3. SAP and the Industrial Policy

Industrial strategy under SAP (Kayode, 1987) included the following:-

(a) Encouraging the use of local raw materials rather than dependence on imported ones;

(b) Development and use of indigenous technology;

(c) Maximising growth in manufacturing value-added;

(d) Diversification of the export base;

(e) Encouragement of private sector small- and medium-scale industries;

(f) Removing infrastructural, manpower and administrative bottlenecks to industrial production; and

(g) Encouragement of foreign investment.

On the whole, the industrial sector was supposed to exhibit equitable distribution of income, enterprise efficiency and technological self-reliance.

As can be seen from the aforementioned, the current policies of the Nigerian Government are a reversal of previous policies of official policy intervention in factor prices and tariffs, involving foreign exchange and petroleum subsidies, political patronage in the award of contracts, maintenance of highly bloated and inefficient parastatals etc. Such policies did encourage inefficient resource allocation, public investment in

projects which have no justification from point of view of economic or commercial viability, and indiscriminate implementation of capital-intensive projects without due consideration for acute unemployment problems. the Structural Adjustment Program with its package of deregulation of the foreign exchange rate, interest rate and petroleum subsidy, and privatisation of inefficient public institutions, etc., aims at restoring sanity in the use of scarce resources and achieving self-reliant technological development.

5. IMPACT OF MACRO-POLICIES

5.1. Effect of SAP on Technology Users

In order to assess the impact of SAP on equipment users, a more in-depth study of equipment users was undertaken among a selected number of industrial establishments in Yola/Jimeta/Numan in Gongola State. The companies interviewed included a bottling company, a modern bakery, foam and polythene manufacturing company, beverages manufacturing company, sugar company and flour mill. Total fixed capital investments in these companies range from 200,000 to 200 million naira. The companies are joint ventures, mostly in the form of private or public limited liability companies.

In almost all the cases the impact of the SAP was the same. The foam maker reported that due to SAP, raw material prices have gone up by 70 percent due to high cost of foreign exchange. For the sugar company cost of chemicals was reported to have gone up by 200 percent and the quantity of spare parts imported declined

by 50 percent. For the bakery, cost of flour has risen by 50 percent in the last one year and by 300 percent over the last five years. In fact, most bakeries in the State of Gongola have closed down due to lack of wheat flour and inadequacy of flour made from local sources, like corn and sorghum. The bottling company also experienced a 50 percent increase in the cost of raw material.

Other supporting information from Kayode (1987) showed that post SPEM prices of manufactured produces increased. For example, the price of Peugeot 505 GL increased from ₦7,000 in 1981 to ₦37,000 in 1986. Self-reliance in automobile manufacturing was rendered difficult by the multiplicity of brands handled by a single manufacturer. For example, the Peugeot Assembly Plant handles cars such as Toyota, Moskovitch, etc., while the Volkswagen of Nigeria Limited deals in the Beetle, Passat, Gulf, Santana, etc. The Nigerian market is full of all brands of cars and this situation makes it impossible for small entrepreneurs to master the technology of any specific car let along fabricating its spare parts.

The extent of capacity utilization for the four companies are as follows: 30 percent for bottling company, 30 percent for the sugar company, 65 percent for the beverages company and 20 - 50 percent for the foal/polythene manufacturer. It is noteworthy that Winston (1981) recorded capacity utilization of about 80 percent for Nigerian manufacturing plant and equipment in 1976. When asked to suggest government policies necessary for attaining fuller capacity utilization, the general response of Gongola

State respondents was increased foreign exchange value for the naira and reduced interest rates on bank loans.

5.2. SAP and the Technological Development

Perhaps, the major positive impact of the SAP is the drive towards self-reliance. By banning wheat importation, Nigerians are forced to produce bread or bread substitutes from flour made from corn, sorghum, cassava, etc. At the same time, serious challenge is now being faced by agencies like the Federal Institute for Industrial Research, Oshodi and Project Development Agency, Enugu to fabricate equipment which can manufacture bread out of locally produced flour. Some research has paid off with respect to biscuit manufacture. Since July 1987, Nasco Food, Jos-based confectionery makers have totally substituted maize and sorghum composite flour in the production of biscuits and wafers (African Giardian, September 24, p. 31). Consumers hardly know the difference between wheat and maize flour biscuits.

The sugar company visited is now working towards a ratio of 50 : 50 in mechanical vis-a-vis hand harvesting of cane from the existing ratio of 60 : 40, due to scarcity of spare parts. Simultaneously, it is shifting from the use of sprinklers for irrigation purposes to surface/gravity irrigation. The imported noozles and seals of the sprinklers are hardly available due to foreign exchange restrictions. Also because the cost of chemicals doubled and the quantity imported declined by 75 percent, the company has been forced into the production of brown sugar to reduce the cost of down stream refining. Since brown

sugar is new in the market, the company spent ₦40,000 for advertisements in 1987 and succeeded in selling over 1,000 tons at reasonable profit. The sugar company has intensified efforts to operationalise its outgrower scheme. At the moment 240 hectares out of the companies 6,000 hectares are owned by small holders who cultivate sugar cane on their own At maturity the company purchases the cane from the farmers. By the scheme, the company encourages the use of manual operations and cuts down on its capital costs.

Within the business community, it is believed that the policy of trade liberalisation is inconsistent with the entire Structural Adjustment package which emphasises self-reliance. The sugar company will be used to illustrate the point. In 1986, out of a total domestic demand for sugar of 800,000 tons, domestic production from the two Nigerian plants was about 7 percent. The rest was imported. Thus SAP has had little effect on the dumping of sugar in Nigeria with huge profit accrual to Nigerian importers and their multinational counterparts.

There might be substantial employment gains in the imposition of a sugar subsidy within the SAP. According to the general manager of the sugar company, to produce 50,000 tons of sugar, you require 3,000 regular workers and 200 casual workers. Out of every 1,000 regular workers, 50 are in the professional cadre while 200 are in the technical grades. It is therefore apparent that huge employment potential exists in the sugar industry where about 93 percent of domestic demand is filled from imports.

Other information available (Onimode, 1987, pp. 126-127) shows that SAP has had positive impact on artisanal technology. In the late 1970s and early 1980s, it was common to find Nigerians queuing for essential commodities whose import was made possible by the availability of cheap foreign exchange. Today the story is different. Rural artisans and cottage industries have revived the art of making traditional soap and detergents to the extent that the Lever Brothers have intensified the advertisement and hawking of their products.

Indeed, the SAP has created a fertile ground for the DFRRI to promote artisanal technology. The Directorate has commissioned the fabrication of simple farm implements and food processing equipment through agencies such as Rural Agro-Industrial Services (RAIDS). The manufacture of burnt bricks and roofing-tiles is now common place as costs of corrugated iron-sheets have become prohibitive. The World Bank has endorsed a plan by the Nigerian Railway Corporation to reactivate its central workshop for the local fabrication of tools, implements, spare parts, etc.

The SAP has also been responsible for the rationalisation of technological institutions in Nigeria. For example, due to reasons of nonviability and waste of foreign exchange, he excessive number of vehicle assembly plants has been reduced to two. Volkswag of Nigeria (VON) and Peugeot Assembly Plant of Nigeria (PAN). However, these assembly plants and similar organisations like the Delta Steel Company (at Aladja) and Makeri Tin Smelter at Jos are yet far from inducing technological linkages between themselves and small to medium scale enterprises

for the fabrication of various kinds of spare parts.

Indeed one serious flaw of the 1988 Budget is the lack of adequate protection for the capital goods industry. A tariff reduction from the 1987 budgetary provision of 10 to 185 percent import duty on CKD components to a uniform rate of just 25 pe cent cannot be seen as promoting self-reliant growth. This policy dimension stands to benefit only the elite who would now purchase cars at lower prices.

Another serious flaw of the 1988 budget is its unrealistic provision for promotion of small-scale industries. Merely instructing the banking system to set apart 16 percent of bank credit for small-scale industries does not guarantee their accessibility to such funds. Bank funds are generally fungible and nothing prevents the banks from continuing to lend to their traditional borrowers who naturally have a quick and high turnover. The lack of adequate and institutional facilities for effective promotion of small-scale industries is a serious constraint to employment generation. Equally, the creation of a National Economic Recovery Fund for extending short- and medium-term loans to small enterprises will not be effective with the total absence of public or private institutional arrangements form promoting small industry. In this regard, the lack of implementation of certain provisions of the Third National Development Plan for the Creation of a National Extension Training Institute for coordinating the promotion of small enterprises at the national level is a major handicap.

Available information on capital goods in Nigeria, though

very scanty, shows that Nigeria is a net-importer of capital goods mostly in the form of machines and equipment. Between 1960 and 1980 (World Bank, 1983) capital goods as a percentage of total merchandise imports increased from 24 to 39 percent. There is clear indication therefore that to a great extent Nigeria relies on foreign capital goods and that the domestic investment pattern does not ensure a future replacement of such imports. In terms of its contribution to national income, available data show that capital goods as a percentage of total manufacturing value-added and employment in 1976 were respectively only 11 and 10 percent (Barbour, 1982, p. 108). When compared to China, and Japan, countries where self-reliant technological development has taken place, there has been a more consistent and faster rate of capital goods production.

5.3. SAP and Unemployment

The findings of a recent study (Oni, 1987) show that the Nigerian economy is highly capital-intensive. The scholars showed that between the planning periods 1975/76 and 1919/80, capital investment grew at a rate of 22.5 percent while employed labour grew at 13.4 percent. The author also showed that the employment generation capacity of labour-intensive sectors have been low. Thus during the pre-SAP era, expenditure patterns did not incorporate the real social values of capital and labour. A close examination of the Nigeria's Third National Development Plan, as already depicted in Section 2.2, shows that the aggregate share of three sectors, namely petroleum refineries,

products of petroleum and coal, iron and steel in total government industrial investment was 66.25 percent, while "other industries" including small-scale industries received a total share of only 8.3 percent. Thus the government investment pattern was biased against labour-intensive sectors, ignoring acute problems of unemployment. The introduction of SAP was a way of rationalising public expenditures to ensure viability and accountability. However, with the near introduction of SAP, massive retrenchment of workers took place; unemployment of university and polytechnic graduates reached astronomic proportions. Recent information from the Federal Office of Statistics, Lagos shows that urban unemployment increased to 12 percent in September 1987 from 10 percent of the previous year while rural unemployment also rose from 4 to 6 percent during the same period.

Apparently, the government became so alarmed at the increasing rate of unemployment that it has within one year introduced various job creation projects within the National Directorate for Employment (Offong, 1988, pp. 6-9). In 1987, through the National Open Apprenticeship Scheme, training was provided for over 70,000 participants throughout the country. The Entrepreneurship Development Program which was administered through the National Youth Corps Service members enlisted over 5,000 participants, out of which over 1,000 business loans were granted. A Job Creation Loan Guarantee Fund of 55 million naira has been created with the participation of twenty banks. The fund is to be used as collateral for lending to young graduates.

With the special Public Works Program, 24,000 unemployed Nigerians have been trained out of which about 15 percent now have permanent jobs. The Waste-to-Wealth Program has been expanded to cater for 20,000 participants. Participants in the program are trained to utilise discarded objects and fabricate them into utilitarian products such as shoes, ash-trays, furniture, etc. These figures have to be understood in the context of an estimated unemployment figure of three million for the year 1987.

The fact that the government claimed to have created 30,000 temporary/permanent new jobs through its various job creation projects does not indicate that those jobs have become permanent. A one week entrepreneurship development program after which graduates with feasible proposals were given ₦25,000 each cannot ensure the survival of entrepreneurs who have no access to any follow-up extension services. It is noteworthy that the jobless graduates include medical doctors, pharmacists, dentists, accountants, engineers, surveyors. Needless to mention there are still countless jobless graduates in the liberal arts and social sciences. The SAP does not seem to have any answers to the unemployment issue, especially in a recession. It is yet to be seen what the SAP will achieve with the reflation budget of 1988.

5.4. SAP and Appropriate Technology Producers

The following table 4 outlines the major indigenous appropriate technology producers in Nigeria and the products and processes being fabricated by each institution. Parts,

Table 4. Achievements of some Appropriate Technology Institutions

Appropriate Technology Institution	Products and Processes Accomplished
Federal Institute of Industrial Research, Oshodi (FIIRO)	Garri, Soya-Ogi, Vinegar, smoked fish, composite flour, tomato, peanut butter, Jam, Bottled palm wine, Alcoho., Fruit wines, malt, starch, gum, gypsum and kaolin soap and detergents, electro-plating, dye, cosmetics, agricultural equipment prototype, etc.
Project Development Agency, Enugu (PRODA)	Yam pounder, laboratory equipment, ceramic wares, washing machine, industrial adhesive, industrial alcohol, school chalk, traffic control equipment, bricks, foundary products, steam cooker, wood and pulp machines, welding processes, etc.
Rural Agro Industrial Development Services (RAIDS)	Cassava, rice, grain, processing equip-ment, etc.
Nigerian Founderies Limited	Water pumps
Institute of Agricultural Research, Samaru (IAR)	Maize sheller, corn thresher, groundnut decoticator, multicrop thresher, herbicide applicator, hand tools, etc.
National Institute for Oil Research Benin City	Sterilizer/cooker for fruit bunches, horizontal digester or macerator, clarifier, hand-operated hydraulic press, rotary stripser
National Cereals Research Institute, Umudike	Cassava planter, harvester and peeler, mini-boom sprayer, cassava chipping machine
National Root Crop Research Institute, Umudike	Miniset yam seed multiplication technique
Universities	Computer hardware/software (Anambra State University of Science and Technology, Enugu); diodes, capacitators, resistors, transistors (Obafemi Awolowo University, Ife); solar house (University of Sokoto)

components, tools and equipment are areas of major foreign exchange expenditure. Therefore, one expects that the Structural Adjustment Program should have substantial impact on the activities of various producers of technology.

An attempt was made to assess the impact of macro-policies on technology producers. A separate questionnaire was therefore designed and mailed to institutions such as the Institute of Agricultural Research, Zaria; International Institute for Tropical Agriculture, Ibadan; Project Development Agency, Enugu; and Federal Institute for Industrial Research, Oshodi. We summarise the response of these institutions in respect of present government policies.

Appropriate technology is generally defined by the technology producers as the technology that is suitable to the cultural and environmental needs of Nigeria. Objectives for fabricating appropriate technology include producing substitutes for imported equipment and products, conservation of foreign exchange, upgrading of local technologies and ensuring maximum utilization of local raw materials. Usually the major target group is the small-scale entrepreneur.

Government policies most favourable to the activities of technology producers include the banning of wheat and other imported raw materials, withdrawal of import licenses which was made possible by the introduction of a more realistic foreign exchange rate for the naira via the SAP. The new policies have so far challenged the technology producers into fabricating local substitutes in the areas of food, drink, raw materials and

cosmetics. However, other government policies militated against their efforts. One example of such a policy was that of inadequate funding of industrial research to the extent that many projects have not gone beyond laboratory stages.

Available secondary information seem to buttress claims of under-funding. Table 5 shows that Federal Government expenditure (recurrent and capital) as a percentage of national output decreased from .4 to .35 percent from 1981 to 1983. At the sectoral (agricultural) level, the trend in the Federal Government allocation to agricultural research is also low. For example, table 6 shows that for the different plan periods from 1960 and 1980, Federal allocation to agricultural research consistently declined. Agricultural research as a percentage of total allocation to the agricultural sector declined from 22.66 percent to 5.74 percent, while agricultural research as a percentage of total public expenditure research declined from 3.30 to .28 percent. These negative trends cannot sustain any effort aimed at achieving national technological self-reliance.

5.5. Research and Development

According to the OAU Lagos Plan of Action, each member state is expected to spend at least one percent of its annual GDP on Science and Technology activities by 1990. Due to inadequate funding of R and D by the Nigerian Government, the Blueprint on National Policy on Science and Technology (Emovon, 1986, pp. 28-29) has recommended that Federal Government must allocate up to 5 percent of its total annual Budget to the development of Science

Table 5. Federal Government Allocations* to Science and Technology Research

Item	1981	1982	1983
	(Million Naira)		
Recurrent Expenditure on Science* and Technology Research	86.2	84.5	76.2
Capital Expenditure on Science and Technology Research	123.5	100.3	88.0
Total Science and Technology Expenditure*	209.7	184.8	164.2
Gross domestic Product at Current factor cost**	48,274.25	46,921.03	46,672.77
Science and Technology expenditure as percentage of GDP	.43%	.39%	.35%

Source: *Federal Republic of Nigeria, Approved Budget 1983 Fiscal Year, Lagos, Federal Government Press; Idem, Recurrent and Capital Estimates of the Government of the Federal Republic of Nigeria, 1979-80,

**Arinze Nwobu, "New issues contribution to GDP minimal" in (Nigeria) Business Times, Vol. 10, No. 21, May 27, 1985, p. 1

Table 6. Federal Allocations to Agricultural Research within the Planning Framework

Plan period	Research as percentage of total allocation to Agriculture	Research as percentage of total public sector expenditure
1962/68	22.66	3.30
1970/74	16.13	0.99
1975/80	7.96	0.31
1975/80 Revised Plan	5.74	0.28

Source: Adapted from F.S. Idachaba, Agricultural Research Policy in Nigeria, Research Report, 17, International Food Policy Research Institute, August 1980, p. 32.

and Technology while state governments earmark not less than one percent. The recent Federal Budgets are yet very far from meeting the recommendations of the National Policy on Science and Technology. For example, capital budgetary allocation to Science and Technology increased from .1 percent to .3 percent respectively in 1987 and 1988. Recurrent expenditure for the same periods were respectively .5 percent and .7 percent of total recurrent budget. The budgetary allocation to Science and Technology for 1988 is disappointing in view of the fact that the budget is the largest in recent years, approximately ₦25 billion naira ($6 billion).

There seems to be a national consensus that the funding of R and D should not be totally left to the government. Recently there has been a call for the establishment of a Central Research and Development Fund (Kalu, 1987) to which firms (public and private) will be expected to contribute. Others have specifically recommended that R and D should be funded by a contribution of some 2 percent of the pre-tax profits of all private sectoral industrial activities (Okonqwu, 1986, p. 181). Recommendations on appropriate R and D institutional arrangements include a National Science Research Foundation, Central Research and Development Fund (Kalu, 1987) National Science Research Council and National Technology Development Council (Okonkwu, op.cit, p. 179). Meanwhile, the Federal Ministry of Science and Technology, which was created in 1979, has been mandated to coordinate and undertake scientific and technological research and development. The Ministry controls the activities of all

indigenous research institutions in Nigeria (see table 4).

The Blueprint on National Policy on Science and Technology (Emovon, 1986, pp. 30-31) has provided for the establishment of a National Council for Science and Technology (NCST) to map out plan of action and a National Science and Technology Fund (NSTF) to mobilise the necessary funds and allocate as necessary. However, the ten year Ministry of Science and Technology has yet to develop concrete technology choice policy especially within the context of Nigeria's political economy.

6. POLITICAL ECONOMY OF TECHNOLOGICAL TRANSFORMATION

A major objective of the present Military administration in Nigeria is the achievement of social justice and distributional equity. This principle of egalitarianism is also fully reflected in the Nation's Science and Technology Policy which provides that "products of research shall be actively promoted and dispersed throughout the national socio-economic system" with a view to ensuring "that the (entire) society benefits from the scientific and technological activies of the nation ....." (Emovon op.cit. p. 33).

Unfortunately, the good intentions of the national policy are very much predicated on the Western approach of technological development whereby incentives are given to existing economic, social and political structure to acquire and/or transfer technology and spread its benefits. Thus national research and development priorities and programs are a result of interactive forces of international commercial interests, interests of

international donors and scientists, and local elite (made up of technocrats, bureaucrats and large-scale enterprises). The involvement of marginalised groups, namely, rural women, small peasant farmers, craftsmen, artisans, small enterprises, students, unemployed (university and high school graduates and illiterates) is hardly considered while formulating national technology policy. If the fruits of technological progress are not to bypass the dominant client groups, their interest must be placed in the forefront of national technology policy and implementation. This is more so, if national development objectives are to be realised.

The mass-oriented policy of the present Military administration has been epitomised in the establishment of the Directorate for Mass Mobilisation, self-reliance and economic recovery (MAMSER). The essence of social mobilisation is the political, social and economic awakening of individuals and group responsibilities as a nation. Social mobilisation should therefore mean increased participatory role of the masses in owning, controlling and running the various means of production. Technology embraces both the mode of production and its ownership. To the extend that workers can own a significant (not token) portion of the equity share capital in profit-oriented public companies, the sense of social responsibility of Nigerians is being increased. The present Military administration should therefore pave the way, through appropriate legislative changes for the involvement of different cadres of workers in the ownership and control of public enterprises. By implication,

different segments of workers should be represented in the governing boards of such companies.

What is lacking in National Technology Policy is strategy for involving the end users of technology at the grassroots in the processes of identifying technological problems, and finding solutions. The end users of technology, must be involved in the production and adaptation of technology. In this regard the new trend in Nigerian agricultural research is noteworthy. the farming systems approach which places the small farmer at the centre of technological research should receive the full support and encouragement of the government. By utilising the system of on-farm adaptive research, the small farmer is involved at the stages of identifying and developing new and appropriate technologies, testing the effectiveness of such technologies and modifying and adapting them. In the same manner, it is important to involve small entrepreneurs, rural women, craftsmen, etc., in relevant technological research efforts. In other words, the traditional methods of product development, namely, idea generation, screening, concept development, product development, market testing and commercialisation, without involving the small entrepreneur needs reassessment for its effectiveness and adaptation.

For any new technology to have impact at the grassroots, such technology must be highly divisible, affordable and cost-effective. The more divisible the innovation is, the more self-reliance the technology will be in terms of catering to the basic needs of the masses of the population. The "side cars" which are

principally being designed for rural dwellers by the Kwara State Polytechnic are a classic example of technological transformation that is targeted to benefit the masses. Nigerian Health programs such as the Expanded Programme on Immunization, Oral Rehydrated therapy have been most successful in reaching the grassroots. The masses can at very little cost adopt the new skills. When combined with improved literary and numeracy of mass-oriented primary, adult and nomadic education programs, public Health Care delivery systems are bound to have a permanent impact on the lives of the people. The new access roads now being constructed by the Directorate for Rural Infrastructure are well targeted at the masses who should now be mobilized with appropriate rural technology programs to maintain these roads. These political economy directions should guide our Science and Technology development efforts so that the masses are not bypassed in the process of technological transformation.

For technology to be self-reliant, it must be widely diffused within the populace either directly or indirectly through linkage effects. The existing automobile companies, iron, steel and tin companies should provide inputs, equipment, blue-prints or guidelines and the necessary supervision to ensure that intermediate inputs such as spare parts are produced to the required specifications by small enterprises. In this way, the masses of small businesses get involved in the process of a self-reliant technological development.

Specifically, backward linkages in the steel industry will involve industries producing natural gas, iron ore, scrap

processing, limestone, pelletizing, sintering fluxes, refactory bricks, graphite electrodes and petroleum coke. Forward linkages will involve marketing and transportation activities, ship building, railway construction, road and general construction, agricultural and industrial machinery, automobiles manufacturing and other mineral processing industries such as tin. In fact, imported scrap is about 80 percent of Aladja scrap requirement. The electric furnace process of steel making at Aladja is based on the compound melting of DRI (77 percent) and scraps (23 percent) (Kaneko, 1984, p. 19). Therefore, a simultaneous development of facilities for providing aladja with the necessary domestic iron ore and scrap may be crucial for enhancing the viability of the Aladja project. Unless the various linkages are identified and prioritised, steel production would proceed in a haphazard manner with little or no impact on the economy.

It is however heartening to see that some multinational companies are integrating vertically and horizontally to produce raw materials or utilise waste products in the manufacture of new lines of products. For example, breweries are trying to grow sorghum to displace malt in beer brewing. Recently, the Makeri Tin Smelter has decided to start manufacturing solder for electrical and electronic works. Although these efforts will lead to savings in foreign exchange, they still do not result in self-reliant technological development. The technology and skills remain within the multinational companies are are not diffused throughout the system.

The total lack of decentralised foundery facilities is a

major handicap in involving the masses in the process of technological transformation. It is significant that the present science and technology policy recognises this important lacuna. But strategies for implementation, especially within a political economy framework, are lacking. If the development of Nigeria's capital goods sector is to become a reality, the establishment of National and State laboratories or workshops with adequate foundries and materials testing facilities must be pursued vigorously. Furthermore, properly zoned rural technology centres are needed to serve as antennae of National or State-level technology laboratories or workshops.

In other words, political economy considerations are important in the formulation and implementation of technology choice policies in Nigeria. The target group for achieving political economy objectives include the newly mobilised social structures, namely, peasant farmers, young farmers clubs, village industrial and agricultural cooperatives, development associations, rural women's organisations, artisan/handicraft cooperatives, associations of small entrepreneurs, drivers, market women, small-scale food processors, etc.

Any meaningful technological transformation which is to impact on the target group should include the following measures:-

1. Improving the reward system, image and status of technicians and artisans.
2. Significantly involving workers of all cadres in the ownership and control of profit-oriented public

companies by offering them increased equity share capital and board membership.

3. Involving the end users of technology in identifying, developing, and adapting new technologies.
4. Emphasising the production of divisible, affordable, cost-effective technologies for widespread diffusion at the grassroots.
5. Encouraging technological linkages between large-scale industry and small entrepreneurs through subcontracting arrangements for production of spares and components.
6. Establishing national, state-level and local government level foundries/workshops to embark on relevant capital goods production.

Any socio-economic system is bound to work imperfectly. Some groups benefit while others become marginalised and suffer severe consequences. The present Military administration should continue to strive to redress the imbalances, not only in the field of technological transformation, but also in the various sectors of the economy. Here lies the importance of political economy considerations in mass mobilisation and national development.

7. CONCLUSION

The brief survey of the structure of the Nigerian economy shows that wide scope exists for choice of technology in virtually all sectors of the economy. Based on micro- and macro-

level evidence presented, the technological capacity of Nigerians is low. However, existing macro policies, especially the Structural Adjustment Program contains the necessary ingredients for achieving sustained self-reliant technological development. But, first, certain inconsistencies in the SAP have to be resolved. For example, the inward-looking orientation of SAP has to be reconciled with trade liberalisation policy. There is need to ascertain the tolerable or minimum level of control to engender reasonable amount of self-reliant technological development. National Science and Technology policy is devoid of the specific technology choice criteria. The country still pays lipservice to the issue of technological development. If he masses are not to be bypassed by a form of technological transformation, political economy issues have to be considered and incorporated into National Science and Technology Policy.

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