FACTORS AFFECTING THE ADOPTION OF INTERMEDIATE FARM TOOLS AND EQUIPMENT IN KADUNA STATE OF NIGERIA

BY

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DECLARATION

I hereby declare that apart from references to other people's work, which have been duly credited, this thesis is a record of my own research work. It has neither in whole nor in part been presented elsewhere for the award of higher degree.

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CERTIFICATION

This thesis, entitled "Factors Affecting the Adoption of Intermediate Farm Tools and Equipment in Kaduna State of Nigeria", by Joseph Gambo Akpoko, meets the requirements governing the award of a Degree of Doctor of Philosophy of Ahmadu Bello University. It has been approved for its knowledge and literary contributions.

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ABSTRACT

There is a widespread recognition that non-adoption of labour- saving devices is a significant constraint on increasing farm productivity and output. This constraint has persisted inspite of the fact that intermediate farm tools and equipment have been introduced to farmers in Nigeria over the past seventy years. In this thesis, a number of factors were conceived as affecting adoption of these tools and equipment.

The relevant data were collected from secondary and primary sources. The secondary data were obtained through an intensive study of documents. The primary data were collected using four sets of questionnaire administered to Research and Development Institutions, fabricators and dealers, the Kaduna State Agricultural Development Project, and 240 farmers comprising randomly selected adopters and non-adopters. Percentages, means and t-test were used to analyze certain aspects of the study. Product-moment correlation was used to determine the existence and strength of relationships between selected variables and level of adoption, while step-wise multiple regression model was used to determine the individual contributions of the independent variables.

It was found that some farm tools and equipment proto-types were available and being fabricated and sold to farmers. Farmers had high levels of awareness of the farm tools and equipment. The equipment being adopted intensively was the ridger, while the planter recorded the least adoption. The most critical problems hindering the development, introduction and adoption of IFTE were finance, lack of good quality raw materials, lack of market demands and high cost. Farm size, use of biological/chemicals inputs, manual labour availability, age of farmers and cost of IFTE in particular were all highly significant determinants of level of

adoption. The study shows that adopters cultivated larger farm sizes, achieved higher yields in most of the crops grown, and had higher income.

The policy implications of the study and recommendations are viewed from four perspectives. First, there are implications for government policy planning purposes. The study suggests that government should provide an enabling environment basic to the development, introduction and adoption of IFTE. Secondly, there are theoretical implications. Some of the variables such as farm size, extension contact and age were found to be significantly related to the adoption of IFTE in support of previous studies. Thirdly, there are practical implications. The factors affecting the adoption of IFTE identified in this study can be used by extension agencies as criteria for the selection of farmers who will serve as innovators. Fourthly, there are methodological implications. Some important variables were not studied. Additional variables need to be considered in future studies.

DEDICATION

Dedicated to the late Gambo Akpoko who sowed the seed but could not live to see it through the struggle moments of life.

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ABBREVIATIONS AND ACRONYMS

ABU	-	Ahmadu Bello University
ACGS	-	Agricultural Credit Guarantee Scheme
ADPs	-	Agricultural Development Projects
AID	-	Agency for International Development
ALSD	-	Agricultural Labour Saving Device
AMMOTRACs	-	Agricultural Machinery Mechanics Operators Training Centres
CIMMYT	-	Centro International de Majoramiento de Maize Y Trigo (International Maize and Wheat Improvement Centre)
FACU	-	Federal Agricultural Coordinating Unit
FTIs	-	Farm Training Institutes
IAR	-	Institute for Agricultural Research
IFTE	-	Intermediate Farm Tools and Equipment
IITA	-	International Institute for Tropical Agriculture
JHAEC	-	John Holt Agricultural Engineers Company
KADP	-	Kaduna Agricultural Development Project
LGAs	-	Local Government Areas
NACB	-	Nigeria Agricultural and Cooperative Bank
NAERLS	-	National Agricultural Extension and Research Liaison Services
NALDA	-	National Agricultural Land Development Authority
NCAM	-	National Centre for Agricultural Mechanization
NGOs	-	Non-Governmental Organizations
NSAE	-	Nigerian Society of Agricultural Engineers
NTC	-	Nigeria Tobacco Company
NTCAES	-	National Technical Committee on Agricultural Engineering Standards.

PTF	-	Petroleum Trust Fund
RAIDS	-	Rural Agro-Industrial Development Scheme
RATSU	-	Rural Artisans Training and Support Unit
R & D	-	Research and Development
SG-2000	-	Sasakawa Global 2000
SON	-	Standard Organization of Nigeria
SPSS	-	Statistical Package for the Social Sciences
THU	-	Tractor Hiring Unit
TP	-	Treadle Pump
UAC	-	United Africa Company
UNICEF	-	United Nations International Children Education Fund
USA	-	United States of America
VEAs	-	Village Extension Agents

CHAPTER ONE

1.1: INTRODUCTION

The task of achieving self-sufficiency in food production in Nigeria has been the concern of every Nigerian, particularly now that it is generally realized that the problem of revitalizing the nation's economy can only be solved if due recognition is given to the agricultural sector. This concern derives not only from the fact that agriculture has hitherto played a dominant role in molding the country's economy, but also from a development perception which recognizes that the country can no longer depend solely on her oil resources to the neglect of the agricultural sector.

Nigeria has a land area of 98.3 million hectares, out of which 72 per cent is considered as potentially cultivable and only about 40 per cent is under actual cultivation (World Bank, 1993). Besides, agriculture provides livelihood, directly or indirectly, for nearly 80 per cent of the population (Baba, 1985). Unfortunately, the population of the food producers is fast decreasing (World Bank, 1993). The following partially explain the observed trends. First, the proportion of young farmers replacing the aging ones is insignificant. This may be blamed on the prevailing educational system that has led young people to believe that farming is not an occupation for anyone with some degree of literacy. Farming is generally viewed as a way of life for the illiterate and a last resort for literate job seekers. Consequently, the massive movement of young people out of the agricultural sector in the last decade to other fast growing sectors including manufacturing, mining, construction and services in the urban centres, contributes to the problems of scarce labour on the farms. Second, the rudimentary agricultural tools and implements such as hoes, cutlasses, axes, sickles, knives, mortar and pestle, sticks and sacks methods of threshing and shelling, in use, do not allow for mass food production to meet the demand of the growing population. The fewer the number of people involved in

farming, the more there is the need to shift away from traditional farming systems to mechanized agriculture.

Evidently, tractors and other imported farm machinery were distributed to farmers for quite some time. Their adoption, however, has been limited to a very small, privileged percentage of the farming population and has contributed little in boosting production and productivity. This has been compounded in recent time by the astronomical prices of the tractor and other imported farm tools and equipment. Moreover, the enormous increases in petroleum and lubricant prices have accentuated the need to examine alternative less costly farm tools and equipment for agricultural production.

Furthermore, the National Agricultural Land Development Authority (NALDA) (1993), admits in its Blueprints that the Nigerian soils are very fragile and land preparation using heavy equipment such as the tractor is a necessary evil in agricultural development. The need to preserve the fragile soil by using simple farm tools and equipment was therefore advocated. Thus, the Federal and State Governments are aware that imported tractors and other farm machinery are generally unsuitable in the Nigerian socio-economic and agro-ecological context (Williams, 1988). Similarly, Anazodo (1988), recommended, among others, the introduction of appropriate technologies that will reduce work loads and expand productivity as the strategy for ending hunger and enhancing welfare of the nation. Earlier, Kline, et. al, (1969), and Berlign (1970), warned that the fragile top soil lost through the use of heavy equipment in just one farming season may take up to fifty years to replenish. They recommended the use of simple farm tools and equipment. In these circumstances, the engineering profession have the responsibilities to explore local sources of raw materials and to provide the low-cost and simple indigenous technologies needed by the Nigerian farmers.

1.2: Research Problem

There is a widespread recognition that seasonal labour bottleneck and lack of appropriate tools and equipment, especially during field preparation, weeding and harvesting are significant constraints on increasing farm productivity and output (Yayock and Karikari, 1989; Etuk and Nwagbo, 1981). The problem of the labour bottlenecks differs with different farm operations, but in general these cut across the various farm operations, viz: land preparation, mounding, ridging, planting, weeding, fertilizer application, irrigation, processing and transportation.

However, available statistics (Federal Office of Statistics, 1987), show that between 1975 – 1987, assorted Intermediate Farm Tools and Equipment (IFTE) amounting to over N684 million were introduced into Nigeria to ease the labour bottlenecks. A lot has also been written about the indigenisation of the agricultural machinery industry in Nigeria (Makanjuola, 1978; Odigboh, 1978; Anazodo, et al, 1989). Already useful amount of work have been done by individuals in Universities, Polytechnics, Research Institutions and Industries, some of which are located in Kaduna State, in developing proto-types of various intermediate farm tools and equipment for the Nigerian farmers. Attempts are also being made by some indigenous manufacturers/fabricators to produce and market on commercial scale, various types and sizes of intermediate farm tools and equipment. These efforts have, however, encountered a major obstacle in terms of lack of effective demand for their adoption. Efforts to identify the causes of these problems and promote widespread adoption. of the farm tools and equipment offer considerable promise in overcoming the labour constraints.

The purpose of introducing intermediate farm tools and equipment is to reduce human drudgery of farm work, assist farmers to conduct their agronomic work in an adequate and timely manner, bring more land under cultivation, increase crop yields, bring harvested crops home from distant fields, ease the burden of head loading for women, preserve the quality of

agricultural products, and improve the social and economic status of the farmers (Promsberger, 1976; Anazodo, 1986; Singh, 1988; Panin, 1989; 1992). Secured storage structures in combination with improved ways of handling harvested grain such as careful drying and shelling of maize can sharply reduce losses, which in traditional storage may amount to 20 to 40 per cent of the grain (Singh, 1988). Better storage gives farm families greater nutritional security, enables them to save more of their crops to consume or sell, and lessens the pressure to sell when prices are low (Anazodo, 1986).

At this stage, the need for a systematic study of the available intermediate farm tools and equipment, problems associated with their adoption and impacts, raises four fundamental research questions. The research questions are:-

1. What efforts have been made towards introducing and developing intermediate farm tools and equipment innovations in Kaduna State?
2. What is the extent of awareness and level of adoption of intermediate farm tools and equipment?
3. What are the problems associated with the adoption of intermediate farm tools and equipment innovations by farmers? and
4. What are the consequences of adopting intermediate farm tools and equipment innovations on the existing farming systems, and standard of living of small scale farmers?

1.3: Aim and Objectives

The aim of the study was to determine the availability, level of adoption and factors affecting the adoption of intermediate farm tools and equipment in Kaduna State of Nigeria. The specific objectives were to:-

1. describe the development and availability of intermediate farm tools and equipment in the study area;

2. describe the IFTE and identify the extent of awareness and level of their adoption by the farmers;
3. identify the factors affecting development, production and level of adoption, and non-adoption of the tools and equipment; -
4. to analyse the consequences of adopting the tools and equipment, and
5. make appropriate recommendations on the basis of the findings for the production and adopt of intermediate farm tools and equipment innovations.

1.4: Justification for the Study

Basically, this study was undertaken to provide data and analytical guidance for understanding the development, production, location, types, conditions and problems associated with the adoption and impact of intermediate farm tools and equipment in Kaduna State. Since the 1970s, much work had been done by Research Institutes, Universities, indigenous manufacturing companies and individuals in the State in developing IFTE. Scientific information about these IFTE is, however, generally scanty. Specifically, there is a paucity of data on the various farm tools and equipment being developed and fabricated for the local farmers. There is also a paucity of data on the problems associated with the use and impact of these innovations. This study focused on these areas of research, to find out the development, production and introduction of IFTE and whether or not the effort already committed is making the desired impact. In general, identification of the available IFTE could serve as analytical frame of reference which can be used by researchers, policy-makers and extension workers in planning and implementing current and future IFTE programmes. Without farmers' feedback, further modifications for better performance cannot be envisaged by the research workers. This could also form a source of information for future individual researchers and organizations who may want to study related subject.

Explanations of the problems of improved practices must involve many factors. Previous surveys have given too much emphasis to characteristics of farmers who adopt improved practices to implying that those characteristics cause adoption. It is more useful to exploit the survey situation further to find out the institutional constraints and why farmers themselves say they do or do not adopt. There is the need to know from the farmers, some of the localized constraints imposed by the introduction of improved practices among other things and determine how to remove or alleviate them. Similarly, unlike previous adoption studies which looked at technological packages in terms of individual ownership and adoption, this study is concerned about individual ownership, collective ownership, as well as adoption on hired basis.

Accordingly, the theoretical justification of the present study is in terms of the contribution that it has in explaining the problems associated with the adoption, non-adoption, level of adoption, and the impact of new technology. Specifically, the findings will add to the existing body on knowledge of the adoption or non-adoption and the impact of new practices on end-users, and might identify areas of future research.

CHAPTER TWO

2.0: LITERATURE REVIEW

2.1: Agricultural Mechanization Policies and Strategies

Efforts directed at agricultural mechanization in Nigeria date back to the colonial era. During this period, attempts were made to improve agricultural mechanization or move away from the hand-tool technology by introducing the draught oxen technology in the northern parts of the country in 1928 (Musa, 1990). Animal traction has therefore remained an important source of draught power up to date.

In the early 1950s a few tractors were introduced both in the South and North of the country (Aboaba, 1988). By 1956 a Tractor Hiring Unit (THU) was established in the then northern Nigeria and ploughing was done for farmers at a nominal charge. Similar Tractor Hiring Units were started in the Western and Eastern parts of the country at later dates (Aboaba, 1988).

Following the nation's independence in 1960, intensified efforts were made to improve agricultural production through improved mechanization technology. Such efforts were directed at mass purchase of tractors and associated implements for use by farmers and the introduction of less complex technologies like animal traction implements. In the late 1960s, Farm Training Institutions (FTIs) were established in eight different locations in the northern part of the country to train farmers on the use of oxen for farm work (Makanjuola, et. al, 1991). It was hoped that when these farmers returned to their villages, they would pass on the technology to others. In the 1970s the policy makers became more concerned with the pace and scope of agricultural mechanization in the country. This concern led to the importation of assorted simple farm mechanization machinery such as shellers, threshers, sprayers and animal drawn implements amounting to over 34 million dollars (Fed. Office of Statistics, 1987). A

couple of Research and Development Institutions were also established to promote the local design and adoption of simple farm mechanization technologies.

During the Third National Development Plan: 1975-1980, the Government policy on agriculture gave rise to the World Bank - assisted Agricultural Development Projects (ADPs). A component of the ADPs was the establishment of Farm Service Centres from which small-holder farmers could obtain items of farm inputs including simple farm machinery. In later years, the ADPs established central and mobile workshops to provide repairs and maintenance of farm machinery. The projects also undertook the purchase of agricultural equipment and spare parts for resale to farmers at subsidized prices (Brian, et. al, 1980).

In addition, the National Centre for Agricultural Mechanization was established with the following objectives, among others:

i. provision of guidelines with respect to importation of simple agricultural machinery;

ii. encouragement and motivation of local design and maintenance of farm equipment and machinery;

iii. provision of supplementary facilities for manpower training and development in the different fields of agricultural engineering.

During the Fourth National Development Plan: 1981-1985, Government Policy was directed at making agricultural machines available to the farmers through subsidizing the purchase of mechanical equipment by individual farmers, establishment of 285 mechanical workshops for facilitating access by farmers to agricultural machines and the provision of subsidy to encourage farmers to mechanically clear land (Gwani, 1990).

The latest policy document emphasizes reduction of the drudgery of agriculture by providing mechanical power and a reduction of high cost of agricultural production which

arises from high labour rates (NALDA, 1993). The strategies mapped out for achieving the stated policy include:

i. subsidy on agricultural land clearing;

ii. assistance to entrepreneurs to enable them to get private agricultural mechanization enterprises and/or repair workshops;

iii. identification of small motorized farm machines, ox-drawn equipment and processing equipment for local development and fabrication by small-scale artisans;

iv. encouragement of Universities, Polytechnics and Research Institutes to accelerate the development and local fabrication of suitable equipment for use by intermediate and small farmers; and

v. promotion of participation of the private sector and NGOs in the commercialization of prototypes of simple farm machinery.

The discussion above summarized the thrust of the pre- and post-independence efforts in promoting access of farmers to agricultural mechanization. Indeed, millions of dollars have been spent, by the State Governments, Federal Government and donor agencies, such as the World Bank, in popularizing agricultural mechanization technologies over the past 60 years, but the adoption rates, from the empirical evidence available are quite low. It is important that research is undertaken to determine why agricultural mechanization technologies have not been adopted to the desired magnitude, inspite of their apparent advantages and long time extension efforts. This requires research. There is no point in spending millions of dollars on agricultural mechanization if what can be shown, after about 70 years is that 86 per cent (Makanjuola, et. al, 1991) of the agricultural cultivation and processing are still being done by the traditional methods.

2.2: Introduction and Development of Farm Equipment in Nigeria

Since the British colonial days, efforts have been directed in one way or another at the introduction of improved farm equipment for the production of cash crops such as cocoa, oil palm, groundnut and rubber which were in great demand for the British industry. This trend has continued until now with emphasis on IFTE. The main thrust of these efforts aimed at replacing the cutlass and hoe cultivation with draught oxen technology and small or large tractors.

The northern part of the country which is tse-tse free, and where farmers have the tradition of keeping livestock was a suitable area for draught oxen technology. Thus, the introduction of IFTE started in Nigeria with animal draught technology in Daura in 1922 (Musa, 1988) by the British Administrators as a means of overcoming the critical problem of seasonal labour shortages and also to increase the cultivation of the two important cash crops in the Savanna ecologies namely: groundnut and cotton. Farmers were trained to adopt mixed farming and each was given a pair of work-bulls with an Ox-cart and a cow for milk production. By 1940, the number of successful mixed farmers had risen to 1,820 and thereafter to about 15,452 in 1955 (Chambers, 1958). Musa (1988) has shown that animal drawn implements for tilling ,planting ,fertilizer application and groundnut lifting imported from overseas have been in use in Zaria, Katsina, Kano,and Maiduguri since the 1950s. The use of animal traction for ploughing, ridging, weeding ,planting and carting has been promoted in recent years by almost all the ADPs in the northern part of Nigeria. Current reliable figures on the types of animals and total number of farmers who employ animal draught implements and equipment in Nigeria are not available. The estimated figures, however, ranged from 100,000 to 300,000 work bull owners and less than 100 work camels in the 1980s (Musa, 1988), with 80 per cent of the work bull owners concentrated in areas north of latitude 12°. The use of draught animals in the Central and Southern areas of he country is minimal. Farmers in the southern

part of the country, due to a high incidence of tse-tse fly problem, had no tradition of keeping draught animals, and relied entirely on the hand tool technology for their farming operations. In addition, the southern farmers have different subsistence food crops - cassava, yams, plantain and palm trees which required less primary tillage compared with the subsistence crops of the northern farmers where maize, sorghum, millet, cowpea are the subsistence crops (Makanjuola, et. al, 1991). Animal traction was therefore readily introduced in the north and has remained an important source of draught power up to date. In general, the use of animal power is, however, greater now, at the end of the 20th century, than it was at the end of the 19th century because the population, therefore the demand for food, has tripled.

In the early 1950s, a few tractors were introduced both in the northern and southern parts of the country (Aboaba, 1988). By 1956, a Tractor Hiring Unit (THU) was established in the then northern Nigeria, and ploughing was done for farmers at a minimal charge. Similar Tractor Hiring Units were started in the western and eastern parts of the country (Aboaba, 1988).

The Federal Government had also introduced Tractor Hiring Units (Makanjuola, et. al, 1991). The THUs were owned by Government - Ministry of Agriculture or by cooperatives or individuals entrepreneurs. They provided tractor hiring services to farmers for land preparation and in some cases even planting and were used for transportation.

In the mid-1970s, the Federal Government and the World Bank established the Agricultural Development Programmes and the River Basin Development Authorities to improve socio-economic activities of the farmers. A component of the programmes was the establishment of Tractor and equipment Hiring Units from which small-scale farmers could obtain items of farm inputs including low-cost farm equipment (Wallace, 1979) such as shellers, threshers, sprayers and animal drawn implements amounting to over 34 million

dollars(Federal Office of Statistics,1987).The Project also undertook the purchase of spare parts for re-sale to farmers at subsidized prices(Brian, et. al, 1980).

Engine-powered farm Technology equipment mainly imported such as the tractors are being used by large-scale farmers and government establishments. The major operations which the engine-powered technology are used for include ploughing, harrowing, weeding chemical application, threshing, drying and transportation.

Certain trading companies, notably, John Holt Agricultural Engineers, (JHAEC) Ltd., Zaria have taken a plunge into fabrication and introduction of intermediate agricultural technology, concentrating on tillage implements, trailers and tanks, shelling and grinding machines. Modern ventilated cribs have also been developed and introduced for the southern and middle belt areas of Nigeria by such organizations as the Nigerian Stored Products Research Institute and National Center for Agricultural Mechanization(NCAM). The mud rhumbu and pit designs have been modified to ensure complete air and water tightness (Oje, 1986).

The "EMCOT" ridger which is the most common animal drawn implement in Nigeria was introduced over fifty years ago. It was then manufactured by Ransomes in the United Kingdom, and imported mainly to be sold to cotton farmers in Nigeria by John Holt Company Ltd. The success of the product among draught animal users then led to the establishment of JHAEC in Zaria in 1966 which eventually took over the manufacturing of the Emcot ridger and in later years the manufacturing of the cultivator, the plough, the groundnut lifter, the weeder and the ox-cart (Makanjuola, et. al, 1991).

Several Research and Development institutions have also been established to promote the local design and fabrication of simple farm mechanization technologies. Thus, other farm machinery production and introduction activities are based in the Universities, Polytechnics and Research Institutes where some pro-totypes of dryers,mills, rollers, shellers, threshers and

cassava processing equipment have been developed and in some cases, patented. A few local entrepreneurs, especially in and around Ibadan, Benin, Ilorin and Kano, have ventured into manufacturing and marketing of these proto-types (Ikeme and Uvere, 1995). In addition, the Federal Agricultural Coordinating Unit (FACU) is engaged in the popularization of intermediate farm equipment, especially, animal drawn implements.

There are also networks of agricultural equipment programmes established by international agencies. The International Institute for Tropical Agriculture (IITA) has developed and fabricated a rolling injection planter capable of planting cowpea, maize, soybeans and sorghum under conventional and minimum tillage for Nigerian farmers. NOVA Technologies (Nigeria) Limited has made several improvement to enhance the performance and acceptability of the planter (Anazodo 1988).

2.3: Introduction and Development of IFTE for Crop Cultivation in Kaduna State.

The utilization of IFTE Kaduna State started with the introduction of animal traction in Shika in the 1930s. This was initiated by the British Colonial administrators. The IFTE were intended for groundnut and cotton production programs which were the crops emphasized at that time. Farmers were provided with a pair of work-bulls with imported ox-ploughs, ridgers, and ox-carts. As in most parts of Nigeria, the priority given to animal traction technology shifted with changes in agricultural policies. Shortly after the creation of the State in 1967, the government decided that animal traction technology was not capable of modernizing the States' agricultural sector. Consequently, government interest in animal traction shifted to tractor technology.

This policy change hindered further spread of the technology by government. However, JHAEC continued to supply farmers with traction equipment. After a long period of somewhat frustrating experiences with tractors technology in the State, coupled with a weak economy, attention was again, directed to animal traction technology by the government.

The major responsibility of popularization of IFTE rests with the Kaduna State Agricultural Development Project (KADP) established in 1974. The popularization was done through demonstrations, training and use of audio-visual aids (radio and television). The efforts of the KADP in providing credit facilities and subsidies available during the late 1970 and the 1980s also encouraged a wide distribution and use of animal-drawn implements. The KADP sold ox-drawn ridgers at subsidized rate of N200 to farmers in 1986, while its market price was estimated at about N300. The KADP also distributed 300 pairs of work-oxen with implements on a loan basis between 1987 and 1988 to encourage mass adoption. In particular, the KADP had established a three-week training centre at Maigana for both farmers and draft animals and had organized eight training sessions in which 112 farmers and 62 work-bulls had been trained. With this extension efforts, animal traction utilization had gradually increased in the State. The data collected on the number of ox-drawn users, shows that there were at least 2000 animal traction users and over 300 ox-carts in the villages studied.

The National Animal Production Institute (NAPRI), Shika, the Department of Animal Science, and the Faculty of Veterinary Medicine all of Ahmadu Bello University (ABU), Zaria had also devoted efforts at extension activities on animal traction, concentrating their efforts on management as well as work efficiency of work-bulls. Efforts had also been made by the IAR and the College of Agriculture, ABU, Zaria where ox-drawn farming had been made a special course in the curricula offered, to train extension staff for effective extension communication with local farmers.

The National Agricultural Extension and Research Liaison Services acted as an agent and a catalyst for disseminating proven animal traction technology through organizing training workshops for Subject Matter Specialists working in the Agricultural Development Project (ADP) and Research Institutes. The efforts of the NAERLS had helped in disseminating information on IFTE to farmers for wider adoption. The National Livestock Project Division

(NLPD) established in 1979 and some commercial banks had similarly contributed their efforts through the provision of soft loans to farmers for the purchase of work-oxen and implements. Apart from the Agricultural Credit Guarantee Scheme (SCGS), which was administered through Commercial banks, the Nigeria Agricultural and Cooperative Bank (NACB) also financed investment in IFTE. The NLPD had disbursed a loan package in Kaduna State through the NACB, specifically for the acquisition of animal traction implements.

The introduction efforts were not left to government establishments alone. Several Non-Governmental Organizations (NGOs) and private extension agencies operating within Kaduna State had some form of components relating to the introduction of IFTE. These included the Sasakawa Global 2000 (SG-2000), United Nations International Children Education Fund (UNICEF), the Nigeria Tobacco Company (NTC) and the United Africa Company (U.A.C). For instance, the SG-2000 and the NTC had provided some credit facilities to purchase animal-drawn implements and jab planters.

2.4: Level of Adoption of IFTE by Small-scale Farmers

Intermediate farm tools and equipment may be more relevant to certain types of crop farming. For example, Kumwenda and Kunkwenzu (1988) have found that draught implements were adopted for 70 percent of the cotton production in the south of Mali and for 90 percent of the groundnut production area of Senegal. It was also found that these were used for growing food crops such as maize in East Africa and rice in Madagascar.

Although the adoption of intermediate farm tools and equipment in Nigeria is very slow, it suffices to say that there has, at least, been some adoption. A few studies have confirmed this. For instance, Chamber (1958) reported that in 1928, three farmers were trained to adopt animal traction technology for cotton and groundnut production. A spectacular success was recorded

so much that effort and zeal were put into training more traction farmers. Musa (1990) in a survey of available labour saving devices found that the adoption rates were generally low, the highest being about 39 percent for animal-drawn equipment, 13 percent for cowpea/groundnut threshers, 11 percent for cassava graters, 6 per cent for grain dryers, 8 per cent for garri frier, 10% for rice parboilers, while mechanical weeders had zero per cent adoption.

Anazado (1988) reported the wheel barrows and trolleys as the major hand tools adopted by peasant farmers in Nigeria. The planters, cultivators, harvesters, threshers, shellers and dryers are currently being adopted across the country (Oyeniyi, 1986). Buyers include the ADPs, large scale farmers, small holding farmers and farmers' cooperatives. Even though the sale and adoption of these equipment spread across the country, nevertheless, their acceptance is in the view of many Nigerians, slow. For farmers to adopt new techniques, however, they must learn about them and be willing and able to apply them.

2.5: Factors Affecting the Adoption of Improved Agricultural Practices by Small-scale Farmers

Much has been said about the problems associated with farmers and their resistance to learn and adopt new techniques and practices. Whatever the contention, before a farmer adopts a practice, he must be aware of it and this is done through communication (Leagans, 1979; Rogers and Shoemaker, 1968). Lack of information about improved weeding implements as reported by Kumwenda and Kunkwenzu (1988) in Mali explains the unpopularity of their use among farmers. Lionberger (1964) also wrote that personal factors such as age, education, farm income, size of farm, and sources of information, affect adoption of innovations generally. Perrin and Winkelmann (1976) concluded that differences in farmers' adoption behaviour can

be explained by differences in information, the availability of inputs, in marketing opportunities, farm size and farmer risk aversion or perception.

In a farm enterprise, the wife often acts as an accountant, supervises the farm business and may purchase inputs for the farm when she travels to market centres (Sawer, 1974); Leuthold (1966) suggests that the farm wife's education may be a better predictor of farm adoption behaviour than is the husband's education. The number of children living at home was observed by Clark and Akinbode (1968) and Alleyne and Verner (1969) as positively related to adoption of agricultural practices. This may be because young people who are susceptible to new ideas influence their parents to accept new ideas. Another reason is that children can provide the labour required to adopt new ideas. The adoption of an innovation may also be a means of attaining security or investment for the children.

Most often, the farmers may reject the innovation because such innovations are inappropriate or unrelated to their needs and problems (Mokonnen, 1991). Lambie (1983) advanced yet other reasons for farmers rejection of some innovations, as when he sees the risks involved in adopting the idea are not worth the trouble and when he fails to see and understand how the practice will benefit him.

From their experience, Tait and Napompeth (1987) were able to deduce that farmers resist some changes due to some failure of the extension system itself. Rogers and Burdge (1972) noted that high income, higher level of living, higher achievement and participation in group activities are factors that affect adoption. According to Lionberger (1960), social factors such as neighbours, cultural factors such as values and attitudes are among forces that encourage or discourage adoption. Similarly, Mosher (1978) upholds that credit facilities affect adoption.

The attributes of innovations in relation to use have also been studied. In general, the more complex a practice, and the more change it requires in existing operations, the more

slowly it will be accepted (Lionberger, 1960). Attributes of innovations which are mutually exclusive and universally relevant are relative advantage, compatibility, complexity, trialability, observability and accessibility.

Rogers and Shoemaker (1971), summary of studies on the perception of these attributes of innovations by farmers shows that they are related to use of recommended farm practices. Whatever is the merit of this summary, the general view is that a technology does not need to be too sophisticated to facilitate adoption, rather it must be appropriate and relevant to local needs and circumstances.

2.6: Constraints to the Adoption of Intermediate Farm Tools and Equipment in Nigeria:

The scanty information available on constraint to the adoption of animal traction include lack of appropriate implement, the oil boom in the 1970s which led to farmers' preference for socially more prestigious mechanical power cultivation, and imperfect access to credit facilities (Gwani, 1990; Phillip, et. al, 1990; Gefu, et. al, 1990; Otchere, et. al, 1988). In the same studies, it was found that some farmers could not adopt the technology due to diseases, economic cost of implements, availability of implements, stumps and terrain. From experience, it is economic constraits which hold back animal traction.More often than not, farmers want to invest in animal power but the cost is too high and financial outlets are limited. Gwarzo (1986) has also identified non-availability of a variety of animal-drawn equipment, lack of sufficient capital, frequency of equipment breakdown, research and extension training, and the presence of animal disease and lack of adequate veterinary health centres, as the major constraints to the adoption of animal traction for agricultural production in Nigeria. Factors frequently attributed to causing limited adoption of draught animals in the central and southern areas of the country include tse-tse fly infestation; unfavourable soil type and vegetation; unavailability of work

animals, animal-based implements and credit facilities; poor extension and veterinary support (Anazodo, et. al, 1989).The problem of feeding draught animals has also been identified (Musa,1988) as one of the constraints to the development of animal traction. In general terms, Suleiman and Braide (1986) have identified lack of trained personnel, lack of adequate supporting industries, scarcity and high cost of raw materials, government attitude, financial constraints, poor credit system, marketing, and uncoordinated research and development activities as the major constraints to the development and use of improved farm equipment. Similarly, constraints to effective introduction and use of improved farm equipment have been summarized (Anazodo 1986) as:-

i. the land tenure, farm size and farm fragmentation problems;

ii. labour under-employment;

iii. traditionalism and poor attitude to work;

iv. rural infrastructure inadequacy;

v. poorly funded and inappropriately conceived research programmes;

vi. Nigerians' taste for imported products, and

vii. the more-sophisticated the better mentality;

viii. inadequate training coupled with poor management techniques;

ix. non-availability;

x. lack of finance to purchase equipment;

xi. relatively high cost;

xii. unawareness of the existence of the equipment, and

xiii. unsuitability.

Poor extension services, unwillingness of some farmers to change, varying farming practices across Nigeria, unawareness of farmers that improved locally fabricated farm equipment are available have also been reported (Oje, 1986) as major constraints to use of

processing farm equipment. Similarly, Yayock and Misari (1991) have reported that the major constraints which have led to low adoption rates of improved farm equipment in Nigeria are the inappropriateness of technology and high cost-benefit ratio.

Ease of use of technology, relative advantage and compatibility were found to be significantly related to the adoption of some intermediate farm technologies by rural farmers in Nigeria (Gunwa, 1978). In Cote d'Ivoire, Mokonnen(1991) found lack of spare parts, inadequate training, insufficient workshop equipment, absence of support services, poor management and maintenance of machinery and poor infrastructure as the major factors affecting mass production and use of intermediate farm tools and equipment. Lack of awareness on the part of most farmers about different aspects of agricultural machinery uses, inadequate facilities for repairs, maintenance and after sale services; lack of regional farm mechanization policies for manufacture, sale and distribution; non-availability of spare parts have been identified as constraints to improved farm equipment adoption (Promsberger, 1976). Other reasons identified by the same authors were that farmers generally doubted the efficiency and return from these equipment.

Rikj (1989) in his study in Thailand, found that well-designed farm equipment resulted in marked adoption. Similarly, Francis (1974) in the Republic of Togo, found positive associations between variables such as age of the farmer , rotating crops, sale of crops and adoption of intermediate farm technologies. In contrast, Gunwa (1978) in Nigeria found no significant relationship between the adoption of intermediate farm technology and age, except in the case of grain and tuber mills. Gunwa (1978), however, found that membership of social groups was associated with adoption of fish kiln and grain and tuber mills.

2.7: A Review of the Evidence Relating to the Economic and Social Benefits of Promoting Farm Tools and Equipment Innovations

Adoption of improved technologies has been known to produce a wide variety of benefits including restructuring the production base for the substantial improvement of production and productivity. Through such improvements, financial and material resources can be generated for achieving a better standard of living.

Modern farm equipment are usually seen as a technological package capable of radically bringing about increases in area under cultivation, shifts in cropping emphasis and changes in farm labour use. This hinges largely on their capacity to ease drudgery and introduce new inputs and farm management practices. Some of the earlier studies on this aspect (Phillip, et. al, 1990; Panin and de Haen, 1989) show that improved farm equipment farmers increased the area of land under cultivation and achieve higher income. Aboaba (1988) has also reported that farmers who used improved farm equipment, increased the area of land under cultivation and achieve higher income and standard of living. Similarly, Anazodo (1986) noted that the adoption of agricultural improved farm equipment for crop production led to an increase in total production by improving yields, expanding the agricultural area, increasing land use intensities and changing the nature of crop enterprise, hence farm management practices generally.

In the same vein, the introduction of new technologies in a farming system has been known to result in significant shifts in the labour requirement among men, women and children within the same household. With respect to labour contributions made by men and women, Panin (1992) reported that animal traction slightly increased those of males (69%) compared to 66% in the hoe households, but reduced those of women by 4% in either household. In the same study, it was found that more than 90% of the labour requirements for farming operations such as land clearing, ridging, mounding and weeding were contributed by males in both animal

traction and hoe households. Women, on the other hand, dominated in the share of total labour requirements for planting, contributing 65% and 70% in the hoe and animal traction households, respectively. In contrast to boys and active male workers in the animal traction households, girls (10-15 years) worked fewer hours than their counterparts in the hoe households (Panin, 1988). A general observation made by Starkey (1990) is that farm equipment technologies may be labour switching rather than saving.

In a number of ways, radical alternations of the farming system can be brought about by the adoption of improved farm equipment. This is because the adoption of these devices means that certain traditional practices must be either abandoned or considerably modified. The new farming system will also depend on increased adoption of new farm inputs such as fertilizers and insecticides. Thus, for example, investigating the evidence for fertilizer use by improved farm equipment users, it was found that virtually all farmers had become users of fertilizers (Baba, 1985).

Available evidence suggests that technical change is one major component of output growth. As evident from the literature on farm equipment technologies, yield effect is usually negligible (Donaldson and Mclnerney, 1973; Pingali, et. al, 1987). Major increases in output which arise from farm equipment technologies are mostly attributable to other yield increasing factors such as fertilizer, high-yielding seed variety with farm equipment technologies playing only a catalytic role in the process. As reported for Ghana (Panin, 1992) and Burkina Faso (Singh, 1988) mostly, crops like maize and groundnut for which improved farm equipment innovations demonstrate positive effect were those crops which normally receive either fertilizer application or high-yielding seeds. The yield effect on millet, sorghum and cowpea, the dominant crops in the study area in terms of acreage and utilization, was very modest or negative. This was because these crops were normally not fertilized (Panin, 1992; Singh, 1988) and relatively less attention with regards to high-yielding seeds, was paid to them.

Invariably, all comparative studies of farm equipment innovations vis-a-vis traditional cultivation systems conclude that improved farm equipment farmers cultivate large farm size than those relying only on manual cultivation. Increases of 50% are commonly cited (Lassiter, 1982; Singh, 1988). Whatever impact the increase in cultivated farm land will result on crop yield is not clear.

Anazodo (1986) summarizes the major benefits of using intermediate farm equipment innovations as follows:-

i. increased farm size and productivity of the land;

ii. increased economic returns to the farmer;

iii. improved timeliness and precision of operations;

iv. reduced losses and improved quality of food products;

v. improvement of the working environment;

vi. reduction of the drudgery of farm work;

vii. improved dignity of the farmer;

viii increased agro-business activities;

ix. fostering of indigenous design and manufacture of agricultural equipment.

x. low cost of the technology, with the possibility of putting it at the door step of the majority of poor farmers, and

xi. foreign exchange conservation because the raw materials can be obtained locally while spare parts could be manufactured by local artisans.

Some of these facts are supported quantitatively with the results of a study earlier conducted by Olatumbosun (1975). In this study, it is shown that the use of farm equipment innovations more than doubled the increase in wheat production. Survey results on animal traction technology have shown that the farmers achieved higher crop yields and higher net incomes than their hoe counterparts (Panin and de Haen, 1989). Besides, investment in animal

traction was profitable, producing internal rates of return of 46 percent and 54 percent for short and medium term periods, respectively, with equity financing and 79 percent and 90 percent with credit financing (Panin 1989). Singh and Chancellor (1980) had shown also that the percentage increase in the yields of rice, maize, wheat, sugar cane and oil seed ranged from 16.9 to 32.0% as a result of using farm equipment innovations instead of the hand hoe cultivation. However, there was a decrease in the yield of cotton as a result of using tractorized cultivation. This single exception emphasises the need for judicious choice and efficient application of farm equipment.

The potential impact of farm equipment innovations on farmers' income has also been shown in a study by Boer and Schryer, (1979). Estimated income per farmer in an irrigated rice system increased from ₦2,363.18 when all operations were hand-powered and the average size of farm was 0.25 ha. to ₦4,576.97 when cultivation and threshing were mechanized and average size of farm was 0.8ha. Increasing the average size of farm from 0.8 to 4.0 ha. and using the same level of mechanization further increased the estimated income per farmer to ₦18,784.86.

The economic benefits of improved processing and storage over traditional hand methods have been estimated based on data from Indonesia by Teele (1976). In another analysis using data from Cameroon, Teele (1976) estimated the percentage economic return from using a traditional rice mill (300kg/h.) to be 21% while the figure was 61% for an improved rice mill (4500kg/h.).

On the issue of drudgery of farm work, Musa (1990), shows that while it takes between 4 - 8 hours per hectare to complete weeding with oxen - traction, it takes a man about 40 to 150 hours to accomplish the same task. Similarly, data from Brazil (Rask and Stitzlein, undated) showed that family labour used per year, hired labour used per year and total labour used per year all increased as the degree of mechanization and farm size increased. However, total

labour per hectare of land cultivated declined with an increase in the degree of mechanization. Similarly, data from Philippines (Singh and Yadao, 1979), showed that on per hectare basis, there was only an increase in hired labour for rice and maize farmers when improved farm equipment were used compared to when hand hoe cultivation were adopted.

Intermediate farm equipment innovations will also foster indigenous design and manufacture of agricultural equipment which would generate additional benefits, such as job creation, reduction of import, increase in export, lower sale price of farm equipment and increase in national income (Anazodo, 1986). There is, therefore, considerable scope for increasing the adoption of IFTE in Nigeria which could lead to benefit at both local and National levels.

CHAPTER THREE

3.0: THEORETICAL FRAMEWORK

The theoretical perspective which guides this study is the theory of social change and the factors studied are based largely on adoption studies and personal experience.

3.1: The Theories of Social Change

There are many definitions of social change. For instance, Miles (1964) states that social change is the process through which alteration occurs in the structure and function of a social system. Cultural anthropologists view social change as, "spontaneuos change" caused by the diffusion process. To Moore (1965), the concept connotes the alterations of goals, structures or processes in a social system. This definition is similar to that of Horton and Hunt (1980), who opined that social change is the transformation of social structures and social relationships in society. An adequate working definition has been provided by Zaltman, et. al,. (1972 :34), that "Social change is a term used to describe changes in social and economic life styles and values of people, technological innovations and social institutions".

Furthermore, scholars have reasoned that in any social system, change is caused by certain forces. Lippit, et. al. (1953), recognized three types of such forces as:-

i) change forces that motivate people to change by creating dissatisfaction with the status quo and favourable judgement of potential future situations;

ii) resistence forces, which motivate people not to change, that arise from uncertainty of the unknown and inability to change, and

iii) interference forces which obstruct change without being directly related to it.

Social change may therefore manifest itself in various ways. For instance, the forces which cause social change may have their origin inside the social system or from outside the social system. Regardless of the source, the force may be a planned series of change efforts or may be an unplanned sequence of events. Planned social change refers to deliberate efforts by change agents to effect a change in a target system of individuals. Planned social change originates with a declared intention of objectives, it starts with a purpose of altering the free play of those social consequences that have ensued from demographic and technological change. On the other hand, unplanned social change is a result of natural forces causing changes in society. It is free change and unintended consequence of the interaction of the forces of society (Zaltman, et. al, 1972). The present study is concerned about the planned social change. The distinction between planned and unplanned change is important in the context of this study. First, it enables an understanding of the different social changes that can occur in a society. Second, it emphasizes the kind of change the present study should be concerned with .

Following the overview of social change, three perspectives for explaining the occurrence of social change have been identified (Zaltman, et. al, 1972). These are:

(1). The social-psychological perspective;

(2). The conflict theory, and

(3). The diffusion and adoption perspective.

The social-psychological perspective emphasizes the psychological mechanism involved in social interaction and change. The individual beliefs are seen as helpful in differentiating the total population into meaningful audiences for designing social change programmes to gain acceptance of new ideas among farmers. The social-psychological perspective was used to analyse the perception of the farmers with regards to the cost, breakdown and energy/skill requirement of the IFTE.

There are two main conflict ideologies - Marxian Socialism and Social Darwinism. The Marxian Socialist conflict theory is an outgrowth of Marxian dialectic. According to this perspective, individuals come together to form interest groups to more effectively compete for scarce resources. In this paradigm, conflict is seen as been able to manifest itself in three different ways. It can be non-violent, quasi-nonviolent and violent. Accordingly, conflict can be used in any of these three ways to achieve social change.

The Social Darwinism ideology, stressed the fact that the history of all human societies past and present has been a history of class struggles. This class struggles in the past occurred under slavery and feudalism. At the present time, it is occurring under capitalism. The class struggle has been thought to be a process of exhibiting conflicting interest of individuals and of groups in society over scarce values. This conflicting interests, lead man successively to form more comprehensive social structures or groups to more effectively compete for scarce resources in society. They argued that the mechanism of social development is located in economically based class conflict. Marx in particular, left no doubts that many social changes can best be traced to economic conflicts. The conflict theory has been used to examine the relative cost and benefits of innovations. It has also been used to analyse the conflicting views of potential adopters with regards to the adoption of innovations. In the present study, the conflict theory provided a useful analytical framework to further study the conflicting views of the farmers regarding the cost, break-down and energy/skill requirement of the IFTE, so that the homogenous sub-groups become target groups for extension programmes.

The classical diffusion –adoption theory is made up of two components – the diffusion process and the adoption or innovation decision process. The diffusion viewpoint emphasizes the process of spreading a new idea or innovation from its source of invention or creation to it ultimate users or adopters (Rogers,1983). Viewed sociologically, the process of diffusion may be characterized as the (i) acceptance, (ii) overtime, (iii) of some specific items an

idea or practice, (iv) by individuals, groups or other adopting units linked, (v) to specific channels of communications, (vi) to a social structure, and (vii) to a given system of values, or culture.

According to Rogers (1983), the diffusion process comprises of four critical elements (i) the innovation; which is an idea, practice or product that is perceived as new by the potential user or adopter, (ii) its communication through various channels, (iii) Over a period of time in stages instantaneous, (iv) among members of a social system. Thus, the process involves the transmission of information about an innovation from an originating source to the potential adopters, the effectiveness of which is seen as a function of the way in which change agents go about their businesses, and of the inherent characteristics of the adopters who may be either venturesome or traditional in their attitudes; the institutional environment and the technologies attributes. These perspectives informs much of the practice of agricultural extension in the Third World, and have clearly influenced many IFTE dissemination efforts at least in their earlier stages. The diffusion –adoption perspective was, therefore, another theoretical framework chosen for this study. The innovations examined were the IFTE, the originators or sources of the technologies were the R & D Institutes, the communicative system was the KADP, and the potential adopters were the farmers in Kaduna State.

The adoption process is a social psychological decision making process that an individual goes through in accepting or rejecting a new practice. This socio-psychological decision making process has been recognized to occur over a period of time in at least five stages rather than instantaneous. These are:-

i) awareness stage: whereby an individual becomes aware of the existence of a new idea, practice or product. At this stage, the individual lacks details concerning the way it works, how to use it, and its benefits;

ii) interest stage: the individual develops an interest in the new practice and actively seeks additional facts on how it works and its potentialities;

iii) evaluation stage: the individual puts the new practice or product through a mental evaluation to determine its relevance to his own personal situations and then decides whether or not to try the new practice;

iv) trial stage: based on the individual's judgement of worth of the innovation, he actually tries it on a small scale to determine its relevance and usefulness;

v) adoption stage: based on the individual's mental or practical evaluation, he makes a final decision whether to adopt or reject it. This is characterized by large scale and continued use of the new practice.

The five-stage adoption process model has, however, been criticized because it views the process as always ending in adoption whereas in reality rejection may be the final decision. It also gives the impression that the steps always occur in a sequential order, whereas some of the stages may either be skipped or occur simultaneously.

The adoption of farm technologies has been studied extensively in the past. However,, the need for further study in the area of the diffusion of innovation still exists (Rogers, 1983). The present study is concerned with the awareness and adoption stages; that is being aware and large scale adoption of IFTE. In the analysis of the factors affecting the IFTE level of adoption, the diffusion-adoption theory is particularly useful. It has also been designed to determine personal factors of the farmers, institutional factors and attributes of the technology that affect the IFTE level of adoption.

The diffusion- adoption process has also been conceptualized in terms of a macro-diffusion system framework involving three major subsystems, namely: innovative, communicative and practitioner (Rogers, 1983). The innovative subsystem is one from which most innovations emerge; the communicative subsystem refers to the social organizations

created to communicate new ideas, such as extension, mass media, and commercial companies, and the practitioner subsystem refers to the individuals or social organizations that use the new ideas. In this study the R & D institutions are the innovative subsystem, the Kaduna ADP and the mass media are the communicative subsystem, while the farmers are the practitioner subsystem.

Attributes of innovations as perceived by the potential adopter that affect their use or adoption have also been identified. The amount of time spent at certain adoption stages and for the complete adoption to take place is partly dependent upon the attributes of the practice. Generally, seven attributes of innovations which are universally applicable are (Rogers,1983):

i) relative advantage: which refers to the degree to which an innovation is perceived as better than the idea it supercedes. This may be measured in economic terms such as profitability, time/energy saving, convenience and satisfaction;

ii) compatibility: the degree to which an innovation is perceived as consistent with the existing values, past experiences and needs of the potential adopter;

iii) complexity: the degree to which an innovation is perceived as relatively difficult to use or understand;

iv) trialability: the degree to which an innovation may be experimented with on a limited scale;

v) divisibility: the degree to which an innovation may be experimented with in small units; and

vi) observability: the degree to which the results of an innovation are visible to the potential adopter and others.

Three specific processes by which the diffusion-adoption process occurs have consistently been identified by social theorists. These are invention, diffusion and change. Invention, is the process by which the innovations are created or developed; diffusion is the process by which these innovations are communicated through various channels to members of

a social system; and change (consequence) is the change that occurs within a social system as a result of the adoption of innovation. The terms "use" and "adoption" are used synonymously in this study. Consequently, the diffusion-adoption perspective is the theoretical framework chosen for this study.

Adoption studies have shown that the adoption diffusion process of agricultural innovations, whether in Nigeria or elsewhere, is a function of a number of variables which can be grouped as socio-economic, socio-psychological, socio-cultural, environmental, institutional and innovations factors. The socio-economic, institutional, and attributes of the innovations comprise the categories of factors considered in this study.

Available studies both in Nigeria and elsewhere have demonstrated that knowledge of innovations and use are all influenced by socio-economic characteristic of the farmers, institutional factors, attributes of the innovations and so on. For instance, Clark and Akinbode (1968) in Nigeria and Rach, et. al, (1994) in the Dominican Republic, found such characteristics as age, education, frequency of extension agents contact and farm size to be significantly and positively related with adoption. Alao (1971), also found participation in social organizations, credit, cost of innovation, availability and years of experience to be positively and significantly associated with adoption.

The more risk averse the farmer is, the less willing he will be to adopt, and even if he adopts, he will try to minimize the risk by devoting only a small proportion of land to the new practice. Access to information about the existence of a new practice and knowledge about how it can be optimally used, can also be an important factor in determining the differential rate of adoption (Pears, 1980). Attributes of innovations have also been studied. Atala (1980) finding of the perception of the farmers on attributes of innovations shows that attributes are related to rates of innovations' adoption.

In the context of small-farmer peasant economy as in Nigeria, the shortage of working capital is often emphasized as a major constraint to adoption of new technology. Farmers who earn some income from non-agricultural sources may, however, have less capital constraint than those who depend mostly on agricultural production (Hossain, 1988). So, access to non-agricultural income may ease the capital constraint to adoption of new technology. Obibuaku (1967) found access to non-agricultural income, credit, and savings to be positively associated with the adoption of the hydraulic oil press, grain and tuber mills.

According to the Chanyanovian theory of peasant economy, the consumption unit of the family may be an important determinant of the adoption of new technology (Chayanov, 1988). This theory argues that the motive force behind the economic activity of a peasant is the consumption need which increases with the growth of the family. The farmer responds to the increased consumption requirements by using improved technology and expanding hectarages. In land-scarce areas, however, the possibility of expanding hectarages is limited for the farmer. In this situation, the adoption of improved technology provides the opportunities for increasing production from the same amount of land. Hence, the adoption of I.F.T.& E may be more attractive to small-scale farmers like the ones considered in this study than the traditional hand tools.

Agricultural production can indeed be expanded through the adoption of IFTE which bring more land under cultivation. Similarly, increase in crop yields per hectare and farmers income can also be brought about through intensive use of IFTE. The adoption of the innovations by farmers, therefore, is expected to effect some positive changes towards their overall development. In the present study, these findings provided additional focus for analysing the personal characteristics of the farmers, institutional factors and the technology attributes as factors affecting the adoption of IFTE.

3.2: Theoretical Model

In developing the model for this study, an attempt was made to integrate the theories and findings of various experts, including those of Lippit, et. al. (1953); Rogers (1969, 1983); Zaltman, et. al. (1972); Atala (1980); Clark and Akinbode (1968); Alao (1971); Pears (1980), and Chayanov, (1988). Emphasis in the model (Figure 1) is placed on the major factors affecting level of adoption of IFTE and the ultimate effects (consequences).

The causal relationship in the model starts with the farmers' personal characteristics, institutional factors, technology attributes as factors affecting level of adoption and ends with impact. The farmers' characteristics include age, years of formal education, years of farming experience, family labour capacity and farm size. The institutional factors are amount of credit received, extension contact and biological/chemical inputs. The technology attributes are frequent breakdown, high energy/skill requirements and high cost. These categories of factors are posited to affect level of adoption of IFTE and level of adoption in turn was expected to directly have impact on the social system. The specific proposition was that the personal characteristics of the farmer, the institutional factors and technology attributes, determined the level of adoption of the equipment, while, level of adoption in turn determined the ultimate outcomes, i.e. land under cultivation, crop yield and farmers income from crop production.

In the model, one-way arrow starts from the determining variables to the dependent variable. That is, the variables at the head of the arrow should be interpreted as functions of variable(s) at the tail of the arrow. The dotted arrow links the consequences

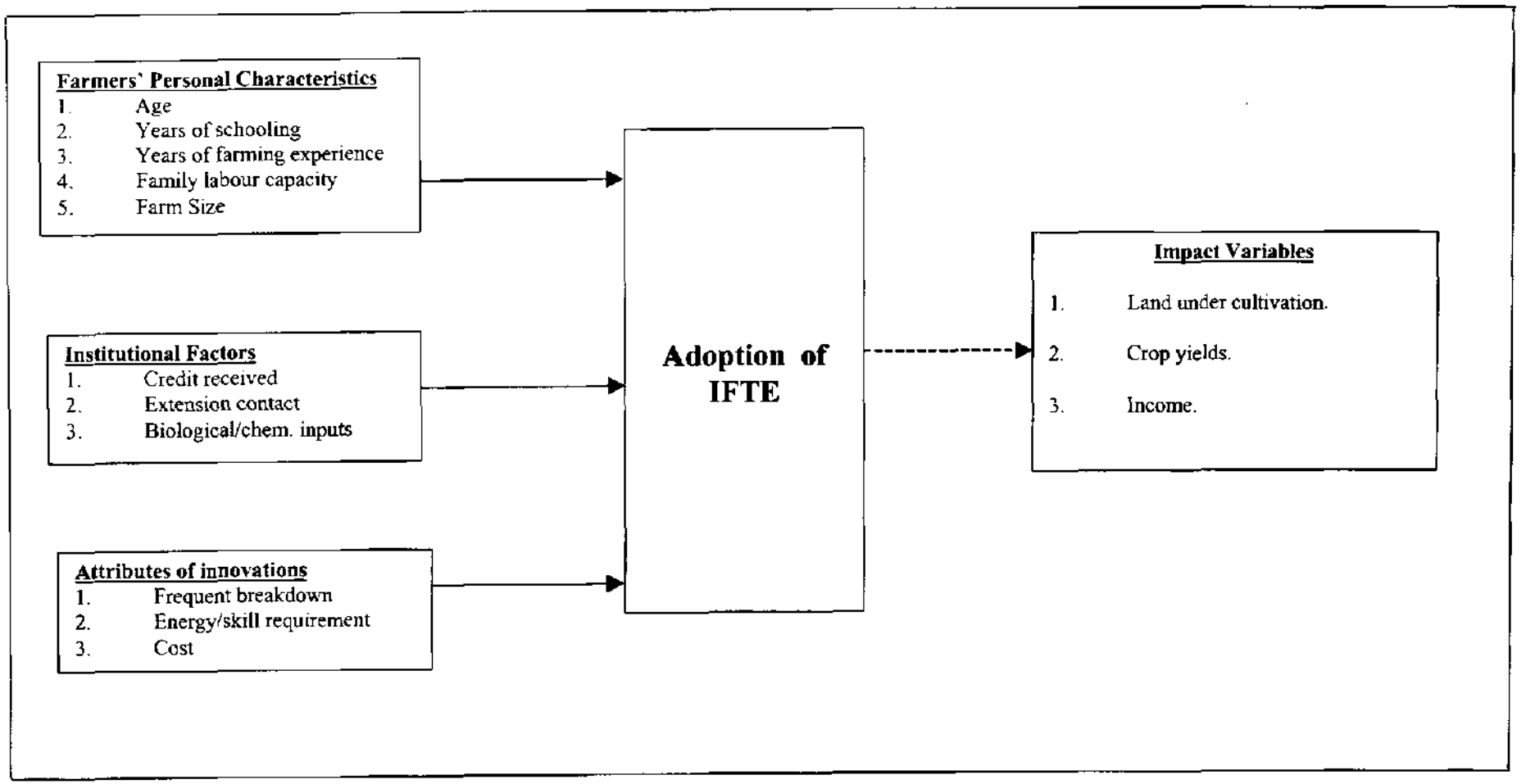


Figure 1: A Model of Factors Affecting the Adoption of IFTE.

of using IFTE. The arrow is drawn dotted to call attention to the fact that these variables were not included in the regression model.

3.3: Discussion of Variables in the Model

The variables discussed in the literature review and theoretical framework sections, are too many to be all included in this study. Therefore, only the variables that are of critical importance were considered. These are discussed under the headings " The independent variables" and " The dependent variables" .

3.3.1: The Independent Variables

The level of adoption of IFTE innovations in a given locality is dependent on the extent to which certain variables permit their acceptance. The independent variables chosen for this study were categorised as personal characteristics of the farmer, institutional factors, and technology attributes. The personal characteristics of the farmer chosen for investigation were age, years of schooling, years of farming experience, family labour capacity and farm size. While the institutional variables were credit received, extension contact and use of biological/chemical inputs; the technology attributes were frequent break down, energy/skill requirement and cost. These variables were seen as affecting level of adoption of IFTE in the study area.

Age

Some studies indicate that younger age is associated with adoption of new ideas and that elderly farmers seem to be somewhat less inclined to adopt new farm practices (Copp, et. al, 1958; Lionberger, 1955; Hess and Miller, 1954). Vabi and Williams (1991),however, had shown higher adoption at middle age. Obviously, younger farmers will tend to be more flexible in their decisions to adopt some new ideas particularly those with long gestation period, more readily because of anticipated longer life-span within which the investment in new technology will pay off. Similarly, younger farmers are more likely to adopt a new technology ,

because they have had more schooling than the older generation or perhaps have been exposed to new ideas as migrant labourers. On the other hand, older farmers may have more experience, resources or authority that would allow them more possibilities for trying a new technology.

Rogers (1983) shows that age is positively related to innovation adoption. Similarly, Anderson, et. al (1956); Patel and Anthonio (1971) found that age seems to be related to use of new agricultural practices.

The relevance of the age variable in this study is that a farmer's age may influence adoption in one of several ways. Older farmers may have more experience and resources that would allow them more possibilities for trying IFTE. Older farmers may be too weak to perform difficult farm operations without the help of labour saving devices. On the other hand, it may be that younger farmers have been exposed to new ideas on IFTE migrant labourers. They may also have the energy required to operate the equipment. The present study, however, assumes a positive relationship between age and adoption of new practices.

Years of Schooling

The use of recommended farming practices is a managerial concern that requires certain managerial skills. Such skills are often gained through education. The assumption is that education facilitates learning which in turn is presumed to instill a favourable attitude towards the use of improved farm practices. Education may make a farmer more receptive to advice from an extension agent or more able to deal with technical recommendations that require a certain level of numeracy or literacy. Educated farmers can also gather reliable information through such media as newspapers, magazines, handouts, radio and television. A few studies (Galjart, 1968; Atala, 1984) have found a positive relationship between education and use of new farming practices. Similarly, Rogers (1983) found that education significantly increased farmers' knowledge on improved practices.

In contrast, Havens (1965), Gatrill, et al (1973) and Pampel and Van Es (1977) found education to be related to level of use of commercial practices but not related to the use of environmental protection practices. The level of education is relevant in this study in that education may make a farmer more receptive to advice from an extension agency or more able to deal with technical recommendations that require certain skills. In this study, it is assumed that the educated farmer is more active in trying to get information about the most recent research findings than an uneducated farmer who remains passive in this respect. He also possess the skills required to operate the equipment. Years of schooling is therefore expected to be positively related to the adoption of IFTE.

Farm Size

Farm size is a common variable examined in adoption studies and is often a good proxy for wealth. It is often assumed that large-scale farmers will be more likely to adopt a technology, especially if the innovation requires an extra cash investment. Large farm size means more resources available for the adoption of recommended practices.

Previous studies have found farm size to be related to use of recommended farming practices (Beal and Sibly, 1967; Brown 1981; Sandhu and Allen, 1974; Atala, 1984), to mention a few. Support for this proposition is not, however, universal. Fliegel (1956) for example, found no relationship between farm size and level of use of recommended practices. Other researchers report that the relation between farm size and use of recommended practices holds only for particular types of farmers (Havens, 1965) and for particular types of practices (Pampel and Van Es, 1977). On the other hand, Feder, et. al. (1985), have shown that in Africa, adopters of ox-cultivation crop larger areas and operate significantly larger farms than those using hand cultivation. In Asia, a similar positive relationship has been observed between farm size and adoption of improved farm equipment (Feder, et. al, 1985).

The relevance of farm size in this study is that farm size is often a good proxy for wealth. It is often assumed that larger scale farmers will be more likely to adopt a technical recommendation, especially if the innovation requires an extra cash investment. It may also be that a certain threshold farm size is necessary before the investment in a technology is worthwhile or more appropriate. In this study farm size is expected to be positively related to level of adoption of IFTE.

Years of Experience in Farming

One important variable in explaining adoption behaviuor is the years of experience in farming. For example, the number of years the farmer has spent in farming will increase the experiential base and this should assist in making adoption decisions. In one study, the number of years spent in farming was found to be related to adoption of recommended practices(Pampel and Van Es,1997). In Nigeria, however, Basu (1969) found no significant relationship between farming experience and adoption, while Clark and Akinbode (1968) reported a positive relationship for poulty farmers but not for maize and cocoa farmers. In the present study, years of experience is expected to be positively related to level of adoption of intermediate labour saving devices.

Farm Family Labour Capacity

The family plays an important role in determining what occurs on the farm. It provides the human factor in farming through labour and management inputs. The family also has certain demands. These family demands may motivate the adoption of recommended practices as a means to meet these demands. On the other hand, family demands may also compete with the farm enterprise for the scarce capital needed for the adoption of certain practices. The actual relationship between family factors and adoption will depend on the balance of these effects. For example, Lionberger (1960) reported that family factors are related to the adoption

of recommended practices. South, et. al, (1965), found that family size, measured as the number of available farm family labour, was positively related to adoption.

Peasant farming in Nigeria is carried out as a family enterprise which may range in size from the small nucleus family to the aggregate structure as found in the extended family. According to Olayide, et. al., (1980), more than 50 percent of the labour used on small farms in Nigeria comes from family sources. This assertion was confirmed in his study of peasant farmers where he found that family members constituted the major source of farm labour. The availability of nucleus and extended family labour is therefore one of the critical factors that might encourage the use of labour saving devices.

Generally speaking, labour availability implies greater planting precision, better weed control, more timely-complete harvest, and minimum-waste during processing. Family labour availability for these farm operations is, however, frequently a great constraint. In some families, hired labour has been used to off-set this constraint. This situation has been corroborated by a study by Etuk and Nwagbo (1981). Although the study shows that 43 percent of the respondents used a combination of family, hired and cooperative labour, most farmers indicated heavy reliance on hired labour. To this extent, many respondents claimed that hired labour was their major source of agricultural labour. Similarly, as Panins' (1992) study in Ghana shows, hired labour was significantly related to adoption of animal traction for production of improved maize practices. Labour availability in the household is expected to have a negative relationship with adoption of IFTE. The number of adult agricultural workers in a farmer's household is expected to ease labour constraints thereby reducing the need for the use of labour saving devices. In this study, farm labour is expected to be negatively related to the adoption of IFTE

Extension Contact

Awareness or knowledge of a new technique is the first stage in the process of using a new technique. In India, Singh and Shaukariah (1967), found that knowledge of improved practices was significantly related to use of the practice. Voh (1987), has similarly found that knowledge is positively related to use of improved crop technologies. It is in this regard that the importance of extension contact comes in.

The agricultural press, the radio and other mass media are, of course, important means of diffusion of innovations. Van den Ban (1962) shows these as the principal sources of information, followed by "other farmers" and the extension service (demonstrations, meetings, etc), and local advisers. Similarly, Anazodo (1988) points to the fact that farm magazines, farm newspapers, radio and extension agents have proved to be the most useful sources of initial information for disseminating information on farm tools and equipment in Nigeria.

Contact with extension officers can affect adoption. Beal and Sibbly (1967), Singh, et. al. (1967) found a high significant and positive relationship between extension contact and innovation adoption. Gefu's (1980) study on goat management practices reported that contact with Extension Officers affected adoption of goats management practices. Studies by Faulkner and Howard (1975), have also indicated that the number of innovations adopted by farmers declined with frequency of extension contact. Extension contact is expected to be positively related to the level of adoption of IFTE .

Use of Biological and Chemical Inputs

There is an array of farm inputs which could affect agricultural production. Ogunfowora (1996) identified four categories of such inputs, namely:

- biological inputs, consisting of high yielding seed varieties and planting materials;
- mechanical inputs, consisting of tractors, hand tools, implements, animal draught technology, threshers, mills, sprayers, etc;
- chemical inputs, consisting of fertilizers, pesticides, insecticides, herbicides, etc, and
- other inputs which are indispensable to any form of crop production; e.g, land, labour, capital and management.

The importance of any of these inputs depends on:

- the share of the input in total cost of production;
- relative contributions of the input to incremental output and productivity, and
- the extent of indispensability of the input in the production process.

The use of IFTE is often associated with higher crop yields than those obtained by non-users. However, this may not necessarily be a direct effect of the use of IFTE for the yield increase may be due to factors associated with, but not caused by, the IFTE used. For example, farmers that have adopted work oxen have been found to be more inclined to use fertilizer than others (Panin, 1988).

Credit:

It is generally acknowledged that credit to farmers is most important instrument in improving farm productivity. This applies especially to peasant small-holders whose lack of capital seems to be a crucial factor limiting farm development. According to Colling Wood (1967) and Miller (1977), credit provides the means for innovations' adoption.

Osuntogun (1973) opined that success of adoption of new technologies will depend on the availability of credit. In the same vein, Olayide, et. al, (1971), viewed credit inadequacy as

a major constraint in agricultural production and suggested that for the small-scale farmer to grow and become medium and eventually large scale farmer, he must have, among other incentives, an assumed supply of credit. Olayide, et. al, (1971), therefore, contended that farm credit is the necessary input for the adoption of innovations.

Studies carried out in Asia and Japan (Chaudhry, 1972), the Nertherlands (Van de Ban, 1962) and Japan (Lindstrom, 1958) show that credit is one of the most important variables of acccelerating innovation adoption among peasant farmers. In Nigeria, Osuntogun (1973), found lack of credit to cover input costs, is the most crucial impediment to the use of livestock innovations. One of the important factors that influence the adoption of innovations is finance and most farmers cannot afford the level of capital they need to acquire an innovation. Credit is therefore expected to be positively related to the adoption of IFTE.

Cost of Intermediate Farm Tools and Equipment

One of the most important determinants of the outcome of the innovation-decision process, is the adopters' perception of the attributes of the innovation. Perception refers to respondents' view of the IFTE. This is seen in terms of high cost of the innovations considered in this study.

Rogers (1983), states that the perceived cost of the technology is the key determinant of adoption behaviour in the innovation decision process model. Rogers (1983) found that between 49% and 89% of variance in the rate of adoption were explained by the perceived cost of the innovation. In this study, high cost is expected to be negatively related to level of adoption of the innovations.

Frequent Breakdown

Njoku (1991) investigated the adoption of improved oil-palm production equipment. The result of the study shows that the greatest constraint to the adoption of the improved technologies was farmers' perception that the equipment breakdown too quickly. In this study

the frequency of equipment breakdown is expected to be negatively related to level of adoption of IFTE.

Energy/skill requirement

High energy/skill requirement is another constraint often cited in the literature on adoption studies. Anazodo (1988), has identified this variable to affect the adoption of fertilizers and chemicals applicator. In this study, high energy/ skill requirement as perceived by the farmers is expected to be negatively related to level of adoption of IFTE.

3.3.2: Dependent Variable

The dependent variable considered in this study was the level of adoption of the IFTE investigated.

Level of Adoption of Intermediate Farm Tools and Equipment

An important constraint in Nigerian farming systems is the peak-season labour scarcity. There are labour bottlenecks especially during field preparation, weeding and harvesting. During these periods the introduction of labour-saving technologies is justified. But, since eliminating one labour bottleneck at one stage may aggravate another at a subsequent stage (animal traction implements may break labour bottlenecks during field preparation seasons, while, however, aggravating weeding - season labour bottlenecks), labour bottlenecks should be viewed together not in isolation.

Panin and de Haen (1989) opined that the agricultural Labour constraint is best reduced by means of integrated package of farm equipment to overcome constraints due to critical farm operations. The critical farm operations according to them include land clearing, land preparation, planting, weeding, fertilizer application, irrigation, harvesting, crop protection, processing, storage, transportation, threshing and drying. Reduction in the agricultural labour shortage problem will depend on the extent to which these operations are performed using improved farm equipment. In Nigeria, however, it has been noted that improved farm

equipment are commonly applied to land preparation, irrigation, shelling and threshing (Yayock and Misari, 1991). In recent years, various farm equipment have been extended to farmers (NCAM, 1993). It was reasonable, therefore to undertake a research of this nature to determine their level of adoption, defined as the percentage of adopters, the total number of IFTE adopted and the total number of hours an IFTE was put to use on farm operations during the 1997 cropping season.

CHAPTER FOUR

4.0: METHODOLOGY

4.1: The Study Area

This study was undertaken in Kaduna State of Nigeria. The State is 45,567km^2 which is about 4.6 per cent of area of Nigeria. It occupies almost the entire central portion of the northern part of the country and shares borders with Kano, Katsina, Zamfara, Niger, the Federal Capital Territory, Nassarawa, Plateau and Bauchi States (Figure 2). The State lies between 9° 00^{1}N, 6 ° 00^{1}E and 11°30^{1}N, 9°00^{1}E. By 1997 when this study was started, the population of the State was estimated at 3,859,660, based on projections from the 1991 national census figures. The Local Government Reform of 1996 divided the State into 23 Local Government Areas (L.G.As) namely: Ikara, Makarfi, Giwa, Lere, Birnin-Gwari, Soba, Kaura, Kachia, Zango-Kataf, Jema'a, Sanga, Jaba, Kagarko, Kudan, Chikun, Kaduna-South, Kaduna-North, Igabi, Sabon-Gari, Zaria, Kauru, Gwagwada and Kubau. Six L.G.As, namely: Giwa, Zaria, Sabon-Gari, Soba, Makarfi and Kudan were selected purposively for the study. These L.G.As are located within the area known as Hausaland which has a high concentration of IFTE adopters and formed the sample frame for the village selection. The L.G.As were also selected in consideration of location of relevant R and D institutions such as the I.A.R, NAERLS, Samaru College of Agriculture, NAPRI and the John Holt Agricultural Engineers. These organizations have been involved in the introduction and development of IFTE in the selected L.G.As.

The climate of the area is characterized by alternating wet and dry seasons. Monthly temperature averages, range between 20°c and 32°c. The rains start around April and end in October. Annual totals range from 1,399mm to 1,555mm falling over a period of between 130 to 150 days (Walter, 1967). The length and spread of the rainy season is of great importance to the rain-fed agriculture of the area. It determines the crops grown and their productivity.

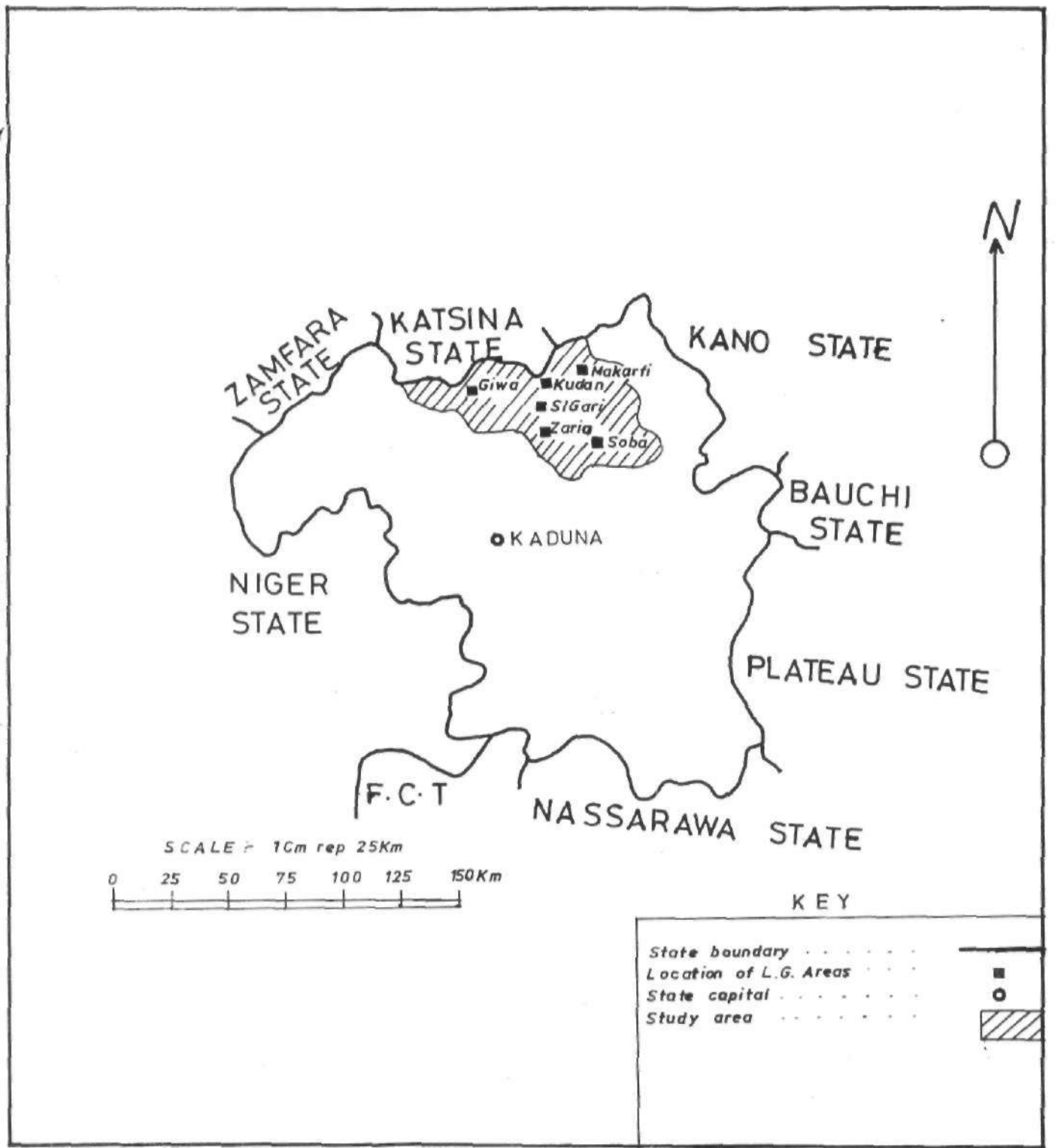


FIGURE 2: KADUNA STATE SHOWING THE STUDY AREA

The highest amount of rainfall is usually recorded in the month of August. The consequence of this high August rain is that the soil is saturated and waterlogged if proper drainage facilities are not provided to remove excess water. Consequently, crop would suffer from excessive moisture during this period. Also, in exposed and hilly areas, erosion could be a major problem.

At present, there are no detailed soil surveys for the villages. Most of the soils however, are of two types: the upland soils and lowland (fadama soils). The upland soils are of the ferruginous red tropical types, derived from crystalline acid or sandy rocks formed by high proportion of silt. Their high proportion of silt and fine sand causes poor infiltration and consequently, high erosion under impact of heavy rain-fall and deforestation. They are also of low fertility but are suited to cereal and tuber crops production.

The lowland soils, called fadama, occur either in areas of low depressions with fairly high water table or along the banks of rivers and streams. They are heavy, blackish and fine-textured and of partly alluvial origin. They are of high fertility, and unlike the upland soils which can only support rain-fed agriculture under the current farming system, fadama soils hold high moisture, or can be easily irrigated for year round crop production. However, the upland soils predominate.

Kaduna land area falls principally within the Northern Guinea Savannah (Keay, 1959), being surrounded marginally by the Southern Guinea, and derived Savannah. As in most part of the country, the natural vegetation of the State has been adversely affected by past cultivation, fire and grazing.

A majority of the people are engaged in farming, and this they do mainly on a subsistence level. A conspicous feature of the area is the production of such crops as maize, sorghum, millet, cowpea, groundnut, yams, rice, cassava, tomatoes and an assortment of fruits and vegetables. The production of any of these crops depend on how important the farmer

considers it in his farming system. Cattle, sheep, goats, donkeys and birds such as chickens, guinea-fowl, ducks and other domestic poultry are kept.

Several small-scale industries exist. Black-smithing, basket making, furniture making are found and these provide employment for the people. In addition, transportation business and trading in various goods are also other sources of economic activities in the area.

White collar jobs and industries perform a relatively insignificant role in the economy. Most of these industries are based on farm products such as cotton and groundnuts, and are totally dependent on agriculture for the supplies of raw materials. Thus, the government views industrialization as next only, to agriculture in providing gainful employment and as providing the most visible modernization and progress in the area.

The basic unit of social organization is the household in which economic activities are organized. The household head is responsible for organizing and controlling the economic and social activities of the household members. Age, sex and status are considered in the assignment of responsibilities to members.

The Hausa people among whom this study was conducted enjoy a high degree of uniformity in terms of language, domestic life, and religion. Each study village consists of a number of separated residential clusters under one administrative unit sharing common land and history. The administrative head usually lives in the main residential cluster which is usually referred to as the central village or central settlement. The separated clusters known as hamlets (ungwayoyi), are scattered around the central village.

4.2: The Study Villages and IFTE

The bulk of the primary data needed for this study was gathered between June, 1997 and February, 1998 through two phases of fieldwork. The first phase which covered the months of June and July, 1997, was devoted largely to identification of the villages with high concentration of IFTE and familiarization visits to R & D Institutions. During that period,

village heads and public officials connected with IFTE. assisted in identifying the villages with high concentration of users of IFTE.

Before identifying the villages, the consent and cooperation of the District Heads and the Village Heads was sought and obtained. It was stressed at all levels that the study had nothing to do with taxation nor was it directed by any government agency and that the report, when published, would not feature as data relating to an individual, but information expressed in aggregate form. This was done to alleviate any suspicion and consequently, distortion of information by the respondents. Based on the background information obtained during the familiarization visits and discussions, ten villages with 673 IFTE. users were identified for the study. The ten villages identified for the study are: Yakawada, Giwa, Yelwa, Kakangi, Basawa, Shika, ,Kudan, Hunkuyi, Musawa and Soba (Table 1).

Table 1: Study Villages, Population of Farming Families and Number of IFTE Adopters

Village	Farming Family		Percentage
	Total Number	Number of Adopters	of Total
Yakawada	1008	103	10.2
Giwa	868	63	7.3
Musawa	1104	78	7.1
Yelwa	877	74	8.4
Soba	1159	93	8.0
Shika	300	39	13.0
Basawa	906	35	3.9
Hunkuyi	1308	49	3.0
Kudan	1209	101	8.4
Maigana	1146	38	3.3
Total	9885	673	6.8

4.3: Sample and Sampling Procedures

The second phase of field work started in early December, 1997 and ended in February, 1998. Each village head was requested to provide a list of adopters of IFTE in his domain.. From these lists, all the respondents were stratified according to the types of IFTE and selected using simple random sampling technique and where the numbers of adopters were small, all were taken as respondents. The total sample drawn was 120 from the list of 673 adopters (Table 2). From the same set of villages where adopters were interviewed, a matching number of non-adopters was selected from the total farming families using simple random sampling procedure. In all, a total of 240 farmers were involved in this study (Table 2).

Table 2: Distribution of Respondents (Adopters/Non-adopters) According to L.G.As and Villages

L.G.A	Village	Sample size(n)	
		Adopters	Non-adopters
Giwa	Yakawada	8	8
	Giwa	7	7
	Kakangi	4	8
	Yelwa	7	7
	Shika	6	6
Zaria	Gabari	8	8
	Angwa Lima	5	5
Sabon-Gari	Bomo	5	5
	Nassarawa Buhari	7	7
	Bassawa	5	5
Soba	Soba	5	5
	Dinya	4	4
	Maigana	3	3
	Tudun Tsebu	10	10
Makarfi	Makarfi	6	6
	Unguwar Fawar	4	4
Kudan	Kurdan	6	6
	Hunkuyi	4	4
	Jaja	5	5
	Musawa	9	9
	Total	120	120

4.4: Data Collection

The relevant data for this study were collected from secondary and primary sources. The secondary data were obtained through a review of the existing literature and an intensive study of documents kept by Research and Development (R & D) Institutions, and other agencies. The primary data were collected using four sets of questionnaire(Appendices 1-4).

The first and second sets of questionnaires were intended for R & D institutions and the Kaduna State Agricultural Development Project (KADP), respectively, and generated information on the production of IFTE proto-types and the dissemination efforts. The third questionnaire consisted of questions directed to dealers and local fabricators of IFTE. Relevant photographs were also taken to supplement the information on the questionnaire. The fourth set, which was the farmers' questionnaire was designed for the head of households' males or females and generated information on characteristics of respondents, attributes of the innovations, level of use and impact of the innovations on land under cultivation, crop output and income.

A pilot test for reliability of the instrument was conducted using a test-retest procedure(Fraenkel and Wallen, 1990) in Giwa and Maigana in November,1997. The reliability score was r = 78. After the questionnaire had been tested and modified, the actual fieldwork was conducted from January to February, 1998 through face-to-face interviews.

The farmers' questionnaire was administered by a selected team of five enumerators after giving them a thorough training. The enumerators were chosen from a general pool of technical staff in the NAERLS, on the basis of their ability to communicate in the local language and observed competence during previous field assignments. At the same time when the farmers' questionnaire was administered, the other three sets of questionnaire were administered to the respective agencies. Information from key informants, such as the KADP Project Manager and the Director of Agricultural Engineering, the Director General, Ministry of

Agriculture and Natural Resources, the National Livestock Project Division (NLPD), and Village heads also provided useful information on the introduction and development of intermediate farm tools and equipment in the study area.

In this study, the relative importance of crops was based on area planted, its importance in subsistence farming and income generation, and the crops that the farmer considered the most important in his/her farming system. Minor crops and their share of total cultivated area per household were excluded from the analysis of the study. Minor crops were okra, amaranthus, tobacco, cotton, pepper, carrot and sugarcane. Not unexpectedly, maize and sorghum top the list of most important crops for the respondents at about 37 and 28 percent, respectively. Millet ranked third with 10 per cent of the farmers. Cowpea ranked fourth and rice ranked sixth. Only about 4 per cent of the respondents indicated that groundnut, traditionally cash crop since the colonial era, was their major crop. Apparently, the crop has declined in its importance as a major cash crop. This is probably not unconnected with the current relatively low price being paid, as perceived by the farmers, for a crop that requires high labour input. Against the above background, the impact of IFTE on the most important crops grown was investigated.

Since most rural households did not keep records of their crops, each farmer was asked to estimate (Appendix 5) physical outputs consumed, sold, given out as gifts, quantity remaining and market prices (Appendix 6). From this information, estimates of crop outputs and gross income were obtained.

4.5: Measurement of the Variables

4.5.1: Independent Variables

Age: The age of the farmer was measured as the number of years from birth given by the farmer at the time of the survey.

Years of Formal Schooling: Years of schooling was measured as the total number of formal school years the respondent attained (including primary, secondary, post-secondary school training) .

Farming Experience: Farming experience was measured by the number of years the farmer had been farming.

Farm Size: Farm size referred to the total number of hectares of farm land cultivated in the previous year.

Farm Labour: This was measured as the reported total hours manual labour spent in farm activities (household members, hired and cooperative) aged 6 and above during the 1997 farming season. This was later converted into man- hour equivalents (ME) in the analysis.

Extension contact: Contact with extension was measured by an eight-item scale covering a wide range of possible extension contacts in the previous year, including visits by extension agents, visits to extension agents, visits by contact farmers, visits to contact farmers, radio programmes listened to, television programmes viewed, agricultural publications read and others. A response of "Yes" or "No" to each item was scored 1 or 0, respectively.

Biological/chemical inputs: This was the reported total amount of money spent on biological and chemical inputs.

Credit: Credit was measured by the reported amount of credit facilities obtained. The sources of credit were credit from friends, relations, village money lenders, traders, commission agents, cooperative credit societies, commercial banks, and government development agencies.

Cost of the IFTE: This was measured by the difference between the respondents' reported desired and the actual cost of IFTE.

Breakdown: This was the reported number of times the equipment broke down during the 1997 cropping season.

Energy/skill requirement: This was measured by responses of very high = 4, high = 3, not so high = 2, no problem at all = 1.

4.5.2: Dependent Variable

Adoption of IFTE.

Intermediate Farm Tools and Equipment are terms used to describe any level of farm technologies of very simple design that have been developed systematically above the traditional hand-tools but below the conventional engine - powered technology (Anazodo, 1988). They are farm tools and equipment that do not necessarily incorporate high technology precision parts, that is, parts that can be produced only by specialized manufacturers. They may be powered by animal or human energy or engine - powered and their manufacture requires only locally available raw materials except the engine power in some cases, and should be within the capacity of local artisans. A list of IFTE, therefore, included ox-ploughs, ridgers, cultivators and other soil working implements; seed planters, threshers, grinders, decorticators, milling machines, handling equipment such as ox-carts and trailers; reapers, harvesters, sprayers, storage bins, and simple hand tools. However, the items selected for this study were:

i) Ox-drawn ploughs,

ii) Ox-drawn harrow,

iii) Ox-drawn ridgers,

iv) Ox-drawn weeders,

v) Ox-drawn carts,

vi) Improved hand weeders,

vii) Fertilizer/chemical applicators,

viii) Jab planters, and

ix) Treadle pumps.

One of the most important issues in adoption studies is the selection of criteria for measuring adoption. If the study is interested in the diffusion of a new variety, for instance, what constitutes adoption ? Are farmers who plant even a few rows of the variety considered adopters, or do they have to plant a certain minimum proportion of their fields with the new variety ? If interested in the adoption of crop management practices, how closely does the farmer has to follow a recommendation before being considered an adopter ? Is any fertilizer use to be counted as adoption, or does the rate and timing of application have to fall within certain limits ?

In defining the criteria for adoption, some researchers have considered a farmer to have adopted a new practice if he uses it on a continuous and large-scale basis. Other researchers have measured adoption in terms of the number of people adopting a particular technology. Still, others have measured adoption in terms of hours of usage.

In any case, the adoption of any technology can be full adoption, partial or no-adoption. It is always difficult to give a clear cut-off point between full, partial and no-adoption. Murphy and Marchant (1988), however, suggest 1/3 (0.3) or 33% as no-adoption, more than 1/3 but less than 2/3 (0.7) or 67% as partial adoption and more than 2/3 as full adoption.

Musa (1996) and NAERLS (1997) have provided the standard potential outputs (hours) of work per hectare per operation for different IFTE. (Appendix 7). Using these standard outputs, adoption was measured in this study as actual hours used divided by potential hours. A farmer with less than 1/3 hours of use was regarded as a non-

adopter, while those who obtained proportions greater than 1/3 were considered as adopters. Values of "one" and "zero" were used to denote adopters and non-adopters, respectively in the analysis of the data collected. Adoption of IFTE was, therefore, measured as the total hours of use of an IFTE during the 1997 cropping season.

4.6: Hypotheses of the study

Study Objectives 1 and 4

There is no hypothesis offered for this descriptive part of the study.

Study Objectives 2 and 3

On the basis of the literature review and theoretical perspectives, the following general and empirical hypotheses were proposed:

General Hypothesis :

There is a relationship between the personal characteristics of the farmers, institutional factors and technology attributes, and the adoption of IFTE.

Specific Hypothesis 1: Age is positively related to level of adoption.

Specific Hypothesis 2: Years of schooling is positively related to level of adoption.

Specific Hypothesis 3: Farming experience is positively related to level of adoption.

Specific Hypothesis 4: Farm size is positively related to level of adoption.

Specific Hypothesis 5: Farm labour is negatively related to level of adoption.

Specific Hypothesis 6: Biological/chemical inputs used are positively related to level of adoption.

Specific Hypothesis 7: Amount of credit received is positively related to level of adoption.

Specific Hypothesis 8: Contact with extension is positively related with level of adoption.

Specific Hypothesis 9: Cost is negatively related to level of adoption.

Specific Hypothesis 10: Frequent breakdown is negatively related with level of adoption.

Specific Hypothesis 11: Energy/skill requirement of the IFTE is negatively related with level of adoption.

4.7: Statistical Techniques

The techniques of analysis used in analysing the data to achieve objectives 1, 4 and parts of objectives 2 and 3, were primarily descriptive statistics using frequencies, percentages, cross tabulation means and standard deviation. The major portion of objectives 2 and 3 were analysed by means of correlation, and step-wise multiple regression techniques.

The correlation analysis provided a means of determining the existence and strength of relationships between the personal characteristics, institutional factors and technology attributes and level of adoption of the IFTE. The technique also provided a means of determining which of the selected independent variables were more closely related to the dependent variable. It did not necessarily indicate a cause-and-effect relationship but rather, it indicated whether or not there was a relationship between the independent and dependent variables, and if there was whether the relationship was positive or negative.

The value of the sample correlation coefficient, denoted "r" is always between –1 and +1. A value of r equal to –1 indicates a perfect linear relationship between the sample values of x and y, with the value of y decreasing as the value of x increases – the larger x becomes, the smaller y becomes, and the smaller x becomes, the larger y becomes. A value of r equal to +1 also indicates a perfect linear relationship between the sample values, but one in which the value of y increases as x increases. Larger values of y are associated with larger values of x; and smaller values of y are associated with smaller values of x. If there is no linear relationship between the sample value of x and y, then r will have a value near zero. As r increases from 0 to +1 (or decreases from 0 to –1), the linear relationship between the sample values of x and y becomes more pronounced. A zero value is indicative of no relationship between variables. In order to analyse the degree of association, the sample correlation coefficient, "r" was calculated using the formula (Hayslett,1970):-

$$r_{xy} = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sum_{i=1}^{n}\sqrt{(X_i - \bar{X})^2 (Y_i - \bar{Y})^2}} \qquad (1)$$

Where x_i and y_i are the observations on X and Y, respectively, n is the sample size, x and y are sample means of the variables.

Sociological research emphasise the fact that understanding adoption behaviour often requires that the researcher looks beyond relationships between single explanations as is done in correlation analysis. Although much can be accomplished by re-examining two-variable relationships and by breaking contingency tables into component tables, there are definite limits on the capacity to manage or interpret multifactorial relationships in this way. There are a number of well-developed methods for looking at multivariate relationships. One of the most common is multiple regression analysis. This technique, which is useful for

There are a number of well-developed methods for looking at multivariate relationships. One of the most common is multiple regression analysis. This technique, which is useful for estimating variations in the dependent variable based on a linear combination of many independent variables was applied to determine the best variables predictive of adoption. By employing this technique, the individual contributions of the selected independent variables in predicting the dependent variable can be determined Thus, the regression model specified for the study to achieve objectives 2 and 3 was as follows:

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + - - - + b_{11}\ x_{11} + U \qquad (2)$$

Where: Y = Adoption of IFTE (measured as total hours of used of an IFTE).

a = a constant

X_1 = Age

X_2 = Years of schooling

X_3 = Years of farming experience

X_4 = Farm Labour

X_5 = Farm size

X_6 = Biological/chemical inputs

X_7 = Amount of credit

X_8 = Contact with extension

X_9 = Cost of IFTE

X_{10} = Frequent breakdown

X_{11} = Energy/skill requirement

b_1-b_{11} = Regression coefficients

U = Error or stochastic term

To execute controls in the above analysis, the personal characteristics variables (X_1 – X_5) were first entered consecutively, then the institutional variables (x_6-x_8), followed by the technology attributes (X_9 – X_{11}). The purpose of this procedure was to detect those independent variables that best contributed in explaining the dependent variable.

t-test was also used to determine whether the differences in some of the characteristics among adopters and non-adopters were significant.

CHAPTER FIVE

5.0: RESULTS AND DISCUSSIONS

This chapter contains the results of analysis of the data collected for the study. The chapter is divided into three major sections. The first section deals with introduction and production of IFTE for crop cultivation in the study area. Section two is a detailed discussion of the level of use of IFTE and factors affecting level of use. Section three presents the impact of the IFTE investigated on agricultural production and farm income.

5.1: The Development and Production Efforts.

The study also examined the progress made by R&D organizations towards the development and production of appropriate IFTE, particularly those that focus on cultivation. It was found that a number of R&D organizations were engaged in undertaking the design, development and production of agricultural machinery for various farm operations.

Design and development activities gained momentum after the establishment of the Agricultural Mechanization Programme of the Institute for Agricultural Research (IAR), Samaru. The Programme operated on three sub-programmes namely :

(1) Machinery Development;

(2) Machinery/Technique Evaluation, and

(3) Machinery Management.

Efforts made by the machinery development sub-programme included the development of the straddle raw rotary weeder, EMCOT rotary weeding attachment, animal drawn land leveller, seed planter and fertilizer applicator (Table 3). A coupled system of EMCOT ridger with a planter pulled by two bulls for simultaneous ridging and planting had been developed. The coupling is such that the planter unit could be detached from the ridger when the need arises by mere loosening of bolts and nuts.

The machinery/technique evaluation sub-programme was involved in testing and evaluating the suitability of all types of both imported and locally developed IFTE to be used by farmers. Toolbars such as arara, Ariana, John Holt straddle, EMCOT, Unibar, Occidentale, Kazaure and two units of equipment for top dressing of fertilizer had been evaluated and intensified efforts made in incorporating additional modifications based on feedback from users. Similarly, a Japanese light "turn-wrest" plough having characteristics of a local hoe has been evaluated and found to perform better than the EMCOT ridger. The implement which could perform two functions of ploughing and ridging, was simple to construct, low cost and could be easily fabricated by local blacksmiths. The Mechanization programme therefore had the unique responsibilities of research, development and testing of IFTE under actual field conditions.

Other IFTE efforts were based in the Samaru College of Agriculture where researchers had successfully developed some prototypes (Table 3). Notable development in IFTE had also taken place in one of the foremost development – oriented Institute, namely the National Agricultural Extension and Research Liaison Services (NAERLS). This Institute had not only tested and fabricated acceptable IFTE; but aggressively marketed them to farmers and trained local artisans. Its efforts had resulted in the springing up of local fabricators of the treadle pump technology in Samaru and Shika (Table 3).

The JHAEC, was mainly involved in the production efforts. The JHAEC in Zaria was found to be the major producer of the animal drawn EMCOT ridger and the ox-cart (Table 3). The EMCOT ridger developed and manufactured by JHAEC was introduced in the mid 1960s. The company was also found to be involved in the production of ox-plough, harrows and ox-carts. It was estimated during this study that some 12000 EMCOT ridgers and 2800 animal-drawn carts had been produced. The company had produced one other animal-drawn implement for crop cultivation namely, animal drawn weeder.

The fabrication of the EMCOT ploughs, harrows, ridgers and carts were not left to John Holt alone. Some blacksmiths and artisans at Dinya, Awai, Soba, Giwa, Zaria – City, Sabon-gari, Samaru and Gangara (Table 3) were found to be fabricating these IFTE using locally available materials and selling them in local markets. Almost all blacksmiths in the study area could fabricate the plough share for the EMCOT ridger supplementing the production of John Holt. Boftech Precision Engineers located at Samaru was the major fabricator of the planters, weeders, fertilizer applicator, etc, and their spare parts.

5.2: IFTE Dealership

In the design of the study, one of the questionnaire prepared was geared to collecting some relevant information from IFTE dealers. Table 3 gives such compilation obtained from the field.

Table 3: List of Fabricators/dealers, Locations and Types of IFTE

	Name of Fabricator/Dealer	Location	IFTE
1.	Alh. Abdu Na Alli H.	Zaria-city	Ox-drawn plough Ox-drawn weeder
2.	Alh. Bello Ibrahim	S/Gari Zaria	Ox-drawn ploughs Ox-drawn ridger
3.	M. Sani Danladi	S/Gari Zaria	Ox-drawn cart
4.	Baftech Precision Engineers	58 Sokoto Road, Samaru, Zaria.	Ox-drawn weeders Ox-drawn harrow Ox-drawn fert. Application Improved hand weeder Jab planters Ox-drawn cart Water pump for farm use.
5.	Shehu Aliyu	6A Main Street S/Gari, Zaria.	Ox-drawn ridger Ox-drawn plough Ox-drawn weeder
6.	Alh. Sadiku Parki	No. 7 Park Road, S/Gari, Zaria	Ox-drawn ridger
7.	Mercy Agro-Allied (Nig.) Ltd.	2 Sokoto Road, Opp. VIO, Office, Zaria.	Ox-drawn ridger Ox-drawn weeder Sprayers Jab planters Fertilizer Applicator

Table 3 Contd.

	Name of Fabricator/Dealer	Location	IFTE
8.	Gold Agric.	Near Kano Road Junction, Zaroia.	Sprayers Jab planters
9.	M. Sanusi Garba	Hayin dogo, Samaru-Zaria.	Ox-drawn ridger Ox-drawn plough Ox-drawn weeder
10.	Alh. Abdulmumuni Garba	Kowa Street, Hayin Dogo, Samaru, Zaria.	Ox-drawn ridger Ox-drawn plough Ox-drawn weeder
11.	M. Mohd. Sayadi Abdulahi	Shika Market	Ox-drawn plough Ox-drawn ridger Ox-drawn weeder Treadle pump
12.	M. Abdulsalami, Isah	Near Kowa Shopping complex, Samaru	Treadle Pump Ox-drawn cart.
13.	M. Mohammed Sanusi Tanimu	Shika Tsibiri	Ox-drawn plough Ox-drawn ridger Ox-drawn weeder
14.	Alh. Mohd. Nura Gambo	No. 2 Hospital Road, S/Gari, Zaria.	Ox-drawn ridger Ox-drawn weeder
15.	Mohammed Rabiu	Gangara, Giwa	Ox-drawn ridger Ox-drawn plough Ox-drawn weeder

Table 3 Contd.

	Name of Fabricator/Dealer	Location	IFTE
16.	Alh. Dan Raba	Tudun Iya	Ox-drawn ridger Ox-drawn plough Ox-drawn weeder
17.	Mal. Jaáfaru Moh.d	Ung. Shahu, Giwa	Ox-drawn ridger Ox-drawn plough Ox-drawn weeder
18.	M. Musa Yan-ara	S/Giwa	Ox-drawn ridger Ox-drawn plough Ox-drawn weeder
19.	Mal. Salmanu Mohd.	Tudun Iya	Ox-drawn ridger Ox-drawn plough Ox-drawn weeder
20.	Dahiru Mohd. Madaki	Samaru	Ox-drawn ridger Ox-drawn plough Ox-drawn weeder
21.	M. Hassan Sani	Maigana	Ox-drawn ridger Ox-drawn weeder
22.	M. Saidu Makeri	Opp. Soba Market	Ox-drawn ridger Ox-drawn plough Ox-drawn weeder
23.	M. Bawa Musa Makeri	Soba	Ox-drawn ridger Ox-drawn weeder

Table 3 Contd.

	Name of Fabricator/Dealer	Location	IFTE.
24.	M. Yau Umaru	Soba	Ox-drawn ridger Ox-drawn plough Ox-drawn weeder
25.	M. Adamu Abdu	Makarfi	Ox-drawn ridger Ox-drawn weeder
26.	Alh. Sule Hunkuyi	Hunkuyi	Ox-drawn ridger Ox-drawn ridger
27.	M. Abdullahi Adamu	Jama-a Makarfi	Ox-drawn ridger Ox-drawn plough Ox-drawn weeder
28.	`M. Dalhatu Makeri	Gangara Makarfi	Ox-drawn ridger Ox-drawn plough Ox-drawn weeder
29.	M. Hassan Alhaji	Hunkuyi	Ox-drawn ridger
30.	M. Hussaini Alhaji	Hunkuyi	Ox-drawn ridger Ox-drawn weeder
31.	M. Adamu Danwaire Bakin Kasuwa	Bakin Kasuwa, Hunkuyi	Ox-drawn ridger Ox-drawn weeder
32.	John Holt Agric. Eng., Zaria.	Chikaji, S/Gari Zaria	Ox-drawn ridger Ox-drawn cart.

Table 3 Contd.

	Name of Fabricator/Dealer	Location	IFTE
33.	Agric. Mech. Prog. Of I.A.R./ A.B.U., Zaria.	Samaru – Zaria	Straddle row rotary weeder Ox-drawn harrow Fert. Applicator Jab planter Improved Handweeder Herbicide sprayer Water bellow pump (foot operated) for farm use Ox-drawn cart.
34.	College of Agric. ABU, Samaru	Samaru, Zaria.	Fertilizer Applicator Jab planter Improved hand weeder Ox-drawn planter Ox-drawn harrow Ox-drawn weeder Ox-drawn fertilizer Applicator Ox-drawn cart.
35.	NAERLS/ABU, Zaria	Samaru, Zaria	Treadle Pump (foot operated for farm use).

It may be deduced from the table that the local fabrication and commercial availability of IFTE had been attained in the area.

5.3: Description of the IFTE

The Ox-drawn plough

Ploughing is the most important farm operation because it influences all subsequent operations. It determines how good a seedbed can be prepared, how well organic matter are incorporated into the soil, how well initial weed control is achieved, and ultimately affects crop yields. The mouldboard plough (Appendices 8, 9, 10 & 11) was the most common animal drawn plough in the area.

Harrows

These were implements used to break old ridges and soil clods or crush soil particles into finer texture to allow sown grains to be in good contact with soil for water and nutrient intake. It consisted of a collection of discs or series of fingers (Appendix 12) which were made to rotate within the soil. In the process of cutting and turning, soil particles were reduced to finer texture.

Ridgers

The ridger, as the name connotes, was used for making ridges. Unlike manual method where human muscle power was used, the animal-drawn ridger used the energy of animals. The ridger consisted of a frame or beam share, mouldboards, adjustable depth wheel, landside, handles and hitch assembly (Appendices 13, 14 & 15). It was made in such a way that it threw soil to the right and left of a central furrow thereby forming a ridge.

Weeders

Weeding is a very important factor for increased crop production. Weeds directly reduce yields by competing with the crops in respect of space, water and nutrients. They

also adversely affect the micro-climate around the crops, harbour diseases and pests, increase the cost of production and lower the quantity and quality of crop production. In effect, timely weeding is even more important than use of improved varieties, fertilizers, insecticides or timely planting.

Weeders which may be manually operated (Appendices 16 & 17) or animal drawn (Appendices 18 & 19) were available in the study area. Animal-drawn weeders come in different shapes and designs, but only straddle row rotary weeder and the Emcot rotary weeding attachment were more common.

Improved Hand Weeders

The improved hand weeding hoe was developed by NCAM, Ilorin. It enables the user to remain standing while weeding. In this way, it eliminates the fatigue that goes with continuous bending during weeding and because overall fatigue is reduced, the farmer can do more work per day. It consists of a blade, a connecting socket and a handle (Appendix 17).

Emcot Rotary Weeding Attachment

The Emcot rotary weeding attachment comprised two gangs of rotary tines which were mounted on an available Emcot toolbar (Appendix 18). The Emcot ridging share cleared the weeds on the furrow bottom while the gangs rotated on both sides of the furrow, dug up the soil and removed the weeds as they rotate. The implement was powered by two work-bulls and its output ranged from 0.1 – 0.2 ha. per hour on weeds which were at 2 – 3 leaf stage and with soil moisture ranging between 6 – 12%.

Straddle Row Rotary Weeder

The straddle row rotary weeder used a set of four gangs of rotary tines which were mounted on a frame which straddles a ridge (Appendix 19) the tines rotated on either side of the ridge, digging the soil and removed the weeds. The weeder had a high clearance frame

which enables weeding of crops up to one meter high. It was suitable for 76cm and 90cm ridges and was pulled by a pair of work-bulls.

Ox-drawn Carts

The use of animal for transportation provides numerous opportunities for social and economic benefits. For instance, the use of animals for transportation:

i. reduces drudgery for personal transport;

ii. transfers harvested produce to the dwelling;

iii. enhances possibilities for collecting and distributing farm inputs, harvest, farm implements, etc; and

iv. increases marketing opportunities for farm produce.

Much of the transport network in the rural areas of Nigeria consists of footpaths and farm tracks rather than motorable roads. Human portering is the commonest form of transport, with loads carried on the head, shoulder or back, according to the social custom and type of cargo. This is slow and arduous, and the loads that can be carried are generally limited to 35 – 40kg. Animal-drawn cart (Appendices 20 & 21) could carry much greater load on a trailer powered by two work-bulls than by human portering, albeit slowly.

Jab Planters

Precision planting is pre-requisite for mechanical cultivation and is an important factor in efficient land use. It provides acceptable crop stands for efficient production. Labour intensive operations of thinning and weeding can be mechanized easily in a precision planted crop.

The stooping posture during manual planting leads to backache, fatigue and reduces work output. The manual method is slow and tiring due to constant bending. In order to eliminate the negative side effects of the manual method of planting and maintaining

precision planting, planters of various types (Appendices 22, 23 & 24) have been developed for adoption.

Appendices 22 and 23 are jab planters. The jab planter was a device resembling a walking stick. It enables a farmer to plant his seeds in a standing position. Appendix 24 shows an animal-drawn planter. The two systems consist of two main sections, namely; bulk flow seeding device that meters the seeds at constant rages and an electronically controlled check valve system that plants the seeds in a precise manner.

Fertilizer Applicators

The fertilizer applicator is a device which broadcasts fertilizer with a high degree of uniformity and precision. The device reduces the drudgery in traditional fertilizer application that requires much time per unit area. Hand broadcasting lacks the uniformity which results in uneven distribution. Uniformity in distribution can lead to 10 to 12% higher crop yields (Kumwenda and Kunkwenzu, 1988).

The fertilizer applicator (Appendix 25) was developed by the National Centre for Agricultural Mechanization (NCAM), Ilorin. As described here, it comprised a cylindrical hopper with a conical bottom, a circular distributor (spreading) disc with fins; a gear drive mechanism, a hand crank, an agitator, a feed control lever and a strap for mounting the broadcaster on the shoulder (Appendix 26).

Treadle Pump

The most common traditional methods of manual water-lifting are by the swing basket and the bucket or calabash in the hand-dug wells or streams. The capacities of these devices were, however, limited. The treadle pump technology (Appendix 27) was a simple foot-operated water lifting device. It was operated by means of two wooden treadles hooked to two piston rods that reciprocate inside two metal cylinders moved by the human body's strongest

muscles (the foot). It could be used on surface water, tubewells and washbores or on hand-dug well.

5.4: Socio-economic Characteristics of the Respondents

The study probed the personal characteristics of the respondents. Table 4 presents a summary of the findings. It was found that many (64 %) of the adopters were in their productive age group of between 30 and 49 years, while about half (54 %) of the non-adopters were within that age category. The implication of this is that both the adopters and non-adopters would be expected to have the desire to adopt IFTE to increase production due to expected many years of future use. Most (94 %) of the adopters were male, while a little below this proportion(85.8 %) were male non-adopters. Less than one-tenth of the adopters (6%) cultivated less than 1 hectare, while 11 percent of non-adopters cultivated this much. The mean farm size (5.8 ha) cultivated by the adopters was bigger than that of the non-adopters which was 4.3 hectares (Table 4). These results showed that more adopters were operating fairly bigger farms than the non-adopters. The T-test value (2.315; $P<.01$), however, showed that there was no significant difference in the mean size of farms among adopters and non-adopters.

The analysis of years of schooling attained revealed that equally large proportion of respondents (60% for adopters and 83% for the non-adopters) spent less than six years of schooling (Table 4). However, an appreciably larger proportion (40%) of adopter respondents underwent more years of schooling than non-adopters (18%). More significantly, 13 percent of the adopters spent between 15 - 18 years of schooling whereas only about one percent did so among the non-adopters.

Table 4: Socio-economic Characteristics of the Respondents

Variable	Adopters		Non-adopters	
	No.	%	No.	%
Age				
< 29	11	9.2	21	17.5
30-39	34	28.3	30	25.0
40-49	43	35.8	34	29.1
50-59	23	19.2	28	15.0
60 and above	9	7.5	16	13.4
Mean		42.1		39.5 (t=1.945)**
Sex				
Male	113	94.2	103	85.8
Female	7	5.8	17	14.8
Marital Status				
Married	112	93.3	108	90.0
Single	8	6.7	12	10.0

Table 4 Contd.

Household farm labour				
< 5	63	52.5	44	36.7
6-10	44	36.7	52	43.3
11 and above	13	10.8	24	20.0
Mean		6.4		8.1 (t=2.936)**
Years of schooling				
<6	72	60.0	99	82.5
7-10	1	0.8	6	5.0
11-14	27	22.5	10	8.3
15-18	16	13.3	1	0. 8
19-22	1	0.8	3	2.5
23 and above	3	2.5	1	0.8
Mean		5.0		3.1 (t=1.934)**
Year of experience				
< 5	16	13.3	9	7.5
6-10	11	9.2	4	7.3
11-15	11	9.2	4	3.3
16-20	26	21.7	19	15.8
21 and above	52	43.3	74	61.7
Mean		9.0		6.2 (t=1.986)**

Table 4 Contd.

Farm size (cultivated)				
<1	71	5.8	14	11.7
1-3.9	35	29.2	46	38.3
4-6.9	62	51.7	52	43.3
7 and above	16	13.3	8	6.7
Mean		4.8		3.3 (t=2.315)**
Membership of organisations.	87	72.5	96	80.0
None	28	23.3	12	10.0
1-2	5	4.2	12	10.0
3-4	0	0.0	0	0.0
5 and above				
Credit Received				
Yes	31	25.8	12	10.0
No	87	72.5	107	89.2
Extension contact				
None	85	70.8	93	77.5
1-4	23	19.2	19	15.8
5-8	8	6.7	6	5.0
9-12	3	2.5	2	1.7
13 and above	1	0.8	0	0.0
Mean		2.3		1.9 (t=0.124)

t-test significant at p<0.05.

The study also revealed that about 43 percent of the adopters had been farming for over 21 years, while about 62 percent of the non-adopters fall within this category. About 64 percent of the adopters and 73 percent of the non-adopters were engaged in non-farm occupations like carpentry, tailoring, blacksmithing and trading. A large proportion of both adopters (73%) and non-adopters (89%) did not have leadership positions such as ward head, village head, chairman of local farmers' association and contact farmer. Twenty three percent of the adopters had membership of between 3 and 4 rural organizations while 10% of the non-adopters claimed to be members of between 3 and 4 organizations.

Although farmers are expected to have regular contact with extension services to keep abreast with recent production practices, 71 percent of the adopters and 78 percent of the non-adopters did not have contact with extension in terms of visits by extension agents, visits to extension agents, visits to contact farmers, radio listening, television viewing, agricultural publications and so on . Only about 19 percent of the adopters and 16 percent of the non-adopters had had between 1 and 4 contacts with extension services. The major farm enterprise of the majority of both users and non-users identified during this study was crop production. Only about 3 percent and 4 percent of the adopters and non-adopters had either livestock or mixed farming as their major enterprises.

Both adopters and non-adopter households had large farm labour capacity (Table 4). Non- adopter house-holds were, however, larger, with an average of about 8 members compared to 6 in the adopter households (Table 4). When the number of workers was compared, either in terms of adults (defined as persons aged 15 - 55 years) or total labour capacity, non-adopter households had a larger labour force than the adopter households. The total labour capacity of a household was derived by using a weighting system to convert all household members from the age of 15 and above into standard man-working equivalents. The age of 15 and above was conceived as a base from when a child can be said to be

sufficiently prepared within the rural "Hausa" environment to be gainfully involved on the farm. The respective mean differences of household size and number of workers between the two groups of households were highly significant (Table 4). Only 25.8 percent of the adopters and 10 percent of the non-adopters had received some credit.

In summary, an examination of the means of the variables, revealed that there were significant differences between adopters and non-adopters of IFTE. Adopters of IFTE tended to be older, have less farm labour, have more years of schooling and farming experience, bigger farms, and more number had received some credit (Table 4).

5.5: The Total Number of IFTE Available in the Studied Villages.

The total number of IFTE available in the 20 villages surveyed was 4470. In general, the information compiled on the IFTE availability, shows that there were 203 ox-drawn ploughs, 245 ox-drawn harrows, 3436 ox-drawn ridgers, 38 ox-drawn weeders, 500 ox-carts, 23 jab planters, 9 fertilizer applicators, 11 improved hand weeders, while, 5 were treadle pumps. On the whole, the IFTE available were mostly animal drawn implements. The study also shows that as high as 83.53 percent of the total number of these IFTE were in operational condition. The percentage in serviceable and unserviceable conditions were 13.24 and 3.23 percent, respectively.

5.6: Extent of Awareness of the IFTE by the Respondents

For farmers to use new techniques, they must first of all learn about them. The lack of awareness therefore reduces the overall adoption of any new production package. The first part of objective 2 of this study was to identify the extent to which the farmers were aware of the IFTE. In Table 5, "awareness score" represents the number of the 10 IFTE which were known to an individual farmer. Out of the 120 adopters that were studied, 7.5 percent were aware of less than 3 of the farm equipment, while 16.7 percent of the non-adopters were in that category. About 58 percent of the adopters were aware of 3-5 IFTE, while 65.8 percent of the non-adopters were also aware of 3-5 IFTE. The data also shows that IFTE personal ownership was high in all the villages studied, with 91

percent of the adopters owning their IFTE. The remaining adopters used the IFTE on either hired or cooperative ownership basis.

Table 5: The Extent of Awareness of the IFTE

Level of Awareness	Adopters		Non-adopters	
	No	%	No	%
Less than 3	9	7.5	20	16.7
3-5	69	57.5	79	65.8
6-8	28	23.3	16	13.3
9-10	14	11.7	5	4.2
Mean		3.7		3.5 (t=2.730)**

t-test significant at $p < 0.05$.

About 12 percent of the adopters farmers were found to be aware of 9-10 equipment, while 4.2 percent of the non-adopters fall within that. The mean score for adopters and non-adopters were 5.7 and 3.5, respectively. The t-test result shows a significant difference (t=2.730) in the mean scores among the two groups. These data, however, suggest a high awareness of the equipment studied.

This study probed the sources from which the farmers first heard about each of the IFTE. It was found that the most often used source of information was friends/neighbours (55.4%). This was followed by traders, agricultural extension agents, and the radio. Manufacturing companies, village heads, agricultural publications, television and contact were less often used (Table 6). This finding is consistent with Vabi, et. al, (1991) who quote friends/neighbours as the principal source of information on IFTE. Similarly, Mokonnen (1991) and Rach, et. al, (1994) found that the extension agents and radio have proved the most useful sources of initial information about the IFTE.

Table 6: The Adopters and Non-Adopters Sources of Information Regarding IFTE.

S/No.	Sources of Information	No	%
1	Agricultural Extension Workers	40	16.7
2.	Contact farmer	3	1.3
3.	Village head	6	2.5
4.	Manufacturing Company	16	6.7
5.	Traders	48	20.0
6.	Agricultural Publications	2	0.8
7.	Radio	18	7.4
8.	Television	4	1.7
9.	Friends/Neighbours	133	55.4

Based on the evidence presented, it is concluded that farmers used a variety of sources of information from which they first obtained information regarding IFTE studied.

5.7: Level of Adoption of IFTE

The second part of objective 2 was to determine the level of adoption of IFTE by the farmers. This was examined from three major perspectives based on constant use and whether individual ownership, collective ownership or used on hired basis as follows :

i. The number of adopters per IFTE;

ii. The total number of hours an IFTE was used in the previous farming season; and

iii. The total number of IFTE used consistently by an individual farmer.

The IFTE identified were mostly animal drawn and included the ox-drawn ploughs, ox-drawn harrows, ox-drawn ridgers, ox-drawn weeders, ox-drawn carts, Jab planters, fertilizer applicators, improved hand weeders, and treadle pumps (Table 7). The table shows that there were 43 adopters of ox-drawn ploughs, 19 adopters of ox-drawn harrows, 291 adopters of ox-drawn ridgers and 258 adopters of ox-drawn carts.

Table 7: A Breakdown of the number of Adopters by Types of IFTE

Types of IFTE	Number of Adopters	Number in Sample	Sample Percentage
Ox-drawn ploughs	43	16	7.9
Ox-drawn harrows	19	13	10.9
Ox-drawn ridgers	291	28	5.3
Ox-drawn weeders	24	15	62.5
Ox-drawn carts	258	25	4.9
Jab planters	13	8	61.5
Fertilizer. Applicators	9	5	55.6
Improved hand weeders	11	5	45.5
Treadle pumps	5	5	100.0
Total	673	120	9.4

The ox-drawn ridger recorded the highest number of adopters. The least number of adopters was recorded for the treadle pump, followed by the fertilizer applicator and improved hand weeder in ascending order. The low level of usage of these equipment was expected because only very few farmers were aware of them.

Table 8: Adopters and Total annual hours of use of IFTE

S/No.	Types of IFTE	Percentage of total Adopters/No	Total Annual use (Hrs)	Percentage of total hrs.
1.	Ox-drawn plough	7.9 (43)	56	1.2
2.	Ox-drawn harrow	10.9 (19)	45	0.8
3.	Ox-drawn ridger	5.3 (291)	2118	44.3
4.	Ox-drawn weeder	62.5 (24)	39	0.8
5.	Ox-drawn cart.	4.9 (258)	1893	39.6
6.	Jab planter	61.5 (13)	32	0.7
7.	Fertilizer Applicator	55.6 (9)	43	0.9
8.	Improved hand weeder	45.5 (11)	24	0.5
9.	Treadle pump	100.0 (5)	56	1.2

The hours each IFTE was used on the farm during the previous farming season were also investigated and the result is presented in Table 8. The ridger had the highest number of usage (2118 hours) followed by the ox-drawn cart (1983 hours), treadle pump (156 hours). The planter recorded the least number of hours. The hours of use pattern reflected the adoption of a particular equipment and its importance as an agricultural labour saving device (ALSD). Overall, the level of adoption of the equipment studied was very low.

On the number of IFTE adopted by an individual farmer, each respondent was awarded an adoption score based on consistent use of any particular IFTE. studied. One point was scored for each of the IFTE. Thus, the highest level of adoption possible was 10. Table 9 shows that majority of the adopters (82%) had between 1 – 3 points. None of the adopters had above 6 points while the mean was 2.34 per farmer. Six IFTE were adopted by 2, 5 by 4, 4 by 16, 3 by 32, 2 by 39 and 1 by 27 farmers, respectively.

Table 9 : Number of IFTE Adopted by an Individual Farmer

Score	Frequency	Percentage
1	27	22.5
2	39	32.5
3	32	26.7
4	16	13.3
5	4	3.3
6-10	2	1.7
Total	120	100.0

Mean =2.34

Ox-drawn carts were adopted intensively mainly for transporting farm produce, inorganic fertilizers and manure, and conveying farm labourers.

5.8: Factors Affecting the Development, Production and Adoption of IFTE.

The fourth objective of this study was to identify the factors affecting the development, production and adoption of intermediate farm tools and equipment. Data to fulfill this objective were analysed in two ways. The first analysis described the factors affecting the development and production of IFTE from the R and Ds, fabricators' and dealers' point of view. This was followed by the farmers' and KADP officials opinions of the constraints to the adoption of the equipment studied. The second analysis is a test of some selected variables as determinants of the adoption of IFTE.

5.8.1: Constraints to the Development and production of IFTE Proto-type:

An investigation of the constraints to the development and production of IFTE was conducted on the R and D Institutes. The list of constraints identified by the R&Ds is presented in Table 10. The information indicates that financial constraint was the major cause of failure to develop and produce adequate IFTE to meet the needs of the farmers in the study area. Due to financial limitations, the acquisition of important capital items such as universal lathes, milling and shaping machines have been a constraint. A substantial amount of money is required for the acquisition of these capital items. The lack of credit facilities was reported by the R and Ds, as another constraint hindering mass production and wide distribution of the equipment.

Table 10: Distribution of Constraints Perceived by the R&Ds to the Development and Production of IFTE.

Constraint	Ranked according to number of respondents mentioning it
Financial constraints	1
Lack of credit facilities	4
Current agronomic practices (multiple-cropping, ridging, mounding, etc.)	10
Fragmented holdings	16
High –carbon content of steel products	11
Inadequate iron and steel industrial base	3
Inadequate repair and maintenance facilities/supporting industries	12
Lack of good quality steel and high cost	2
Inadequate infrastructure facilities (transportation, communication, water supply, electricity, fuel, etc.)	14
Lack of trained manpower	13
Lack of information on suitability, adaptability and good performance of available IFTE.	8
Inadequate research and demonstration facilities	15
Inability of the steel industry to produce plat sheet	6
Lack of assured market outlets	5
Absence of incentives for indigenous design and manufacture	7
Lack of clear-cut policy of government on development and production	9

The other perceived limiting factors were failure of IFTE to meet uniqueness of the production systems, lack of industrial and engineering base, scarcity and high cost of materials and fragmented holdings, which hinder efficient use of the tools and equipment.

The IFTE were developed and produced without regard to the uniqueness of the agricultural crops and location specificity of the cropping patterns. Most of the designs of IFTE were not made according to the uniqueness of the production systems, as they were fashioned after imported technologies which were often not too relevant to Nigerian agriculture.

As indicated by the officials of the R & D Institutes, the development and production of IFTE. require an adequate iron and steel industrial base. The Nigeria's Iron and Steel Industry, despite the long years of development and huge amounts of investment, still remains grossly defective. Its products were basically rated unsuitable for the production of engineering goods. The high-carbon content of the country's steel products was identified as the major limiting factor for its application. The inability of the Steel Industry to produce flat sheets was identified as another constraint as far as the development of farm machinery was concerned. The development of supporting Industries such as foundries, forges, heat-treatment plants, and inadequate repairs and maintenance facilities, were still slow. Simple tool components such as bearings, pulleys and valves, whose production involved simple metal casting were not easily produced after design had been made. Often, the designers had to import or use cheap available alternatives. The study area, therefore, seriously lacks the strong industrial base necessary to support the development and production of IFTE. Since all good quality steel have to be imported under severe foreign exchange limitations, the past years had witnessed an astronomical increase in their prices. This was possibly responsible for the manufacturers' and fabricators' current substitution of recommended steel materials with cheaper ones without compromising quality and function.

Shortage of proficient technical manpower, market, lack of awareness of the availability of some of the tools and equipment, lack of maintenance culture and government policies were other constraints identified. Trained personnel for the design, development and production of proto-types were limited reported to be and there was little or no effort to constantly upgrade the technical know-how of technical staff. Uncertainties in sales of products was also identified by the R&Ds as a problem. The IFTE had not been oriented to ensuring prompt acceptability by farmers was the cause of the marketing problem from the point of view of the R & D Institutes. The lack of maintenance culture was attributed to the complexity of the tools and equipment on the farm and the lack of understanding of their working principles by farmers which often led to a short useful life span. The lack of clear - cut policy of Government on development and production of IFTE, regarding patronage was identified as a problem. According to the R&Ds, even when a proto-type was developed and ready for mass production, there were no extension services, assured demonstration facilities and market outlets for the products.

5.8.2: Constraints for the Fabricators.

The major constraint for the village blacksmiths and artisans was the availability of materials. They reported that the basic materials available to them were scrap pieces of steel from old cars or abandoned railway lines and had very little opportunity to acquire good quality steel.

Lack of good roads to the villages and high costs of materials was mentioned by 65 percent and 78 percent of the respondents, respectively. The lack of good roads and high costs militated against the efforts of the blacksmiths and artisans in trying to acquire stocks of materials.

Unreliable infrastructure (electricity, fuel, etc) or high costs of toolings were other constraints mentioned. John Holt and Boftech Precision Engineers are just some examples of workshops which were constrained in this way.

Indeed, since most of the Workshops identified in this study were theoretically capable of producing more implements than the farmers demand warranted, there were evidences of an overall over capacity for the production of IFTE. This over capacity was, however, heavily constrained by the high cost of materials as reported by the fabricators.

5.8.3: Constraints for the Dealers

Poor marketing channels exacerbate the situation, so that the dealers complained of lack of market demand. For example, in all the shops studied, the dealers pointed to unsold stocks as a constraint.

5.8.4: Farmer-Identified Problems and Constraints

To ascertain the farmers' problems and constraints, respondents were asked to react to both positive and negative items aimed at revealing how the farmers perceived of the problems of IFTE relative to their situations. These included high cost, non-availability of spare parts, lack of after-sale service, preference for imported ones, frequent breakdown, distant markets, high energy/skill requirement, compatibility and lack of knowledge. Table 11 summarizes the major constraints as perceived by the farmers. High cost of the ox-drawn ridger, and the planter, featured as the major constraint affecting utilization and decreased adoption. The high percentage (72.5%) about non-availability of the improved hand weeder and the ox-drawn planter (65.6%) show that the respondents were also strongly constrained by the non-availability of these equipment.

Table 11: Farmer-Identified Problems and Constraints to the Adoption of IFTE

Major constraints	Tools and equipment										
	Ox-dp	Ox-dh	Ox-rid	Ox-dpt	Ox-wd	Ox-dc	Ox-cart	Fert app.	Imp hw	TP	Jb
	% of Resp.	% of Resp.	% of Resp.	% of Resp.	% of Resp.	% of Resp.	% of Resp.	% of Resp.	% of Resp.	% of Resp.	% of Resp.
High cost	87.1	70.3	89.6	74.2	59.4	63.8	59.1	27.7	36.9	43.4	84.6
Non-availability	40.6	28.4	17.0	65.6	39.2	43.3	24.2	29.3	72.5	22.6	56.8
Non-availability of spare parts	43.4	47.2	39.8	23.2	17.3	28.4	56.6	72.1	19.8	27.5	49.2
Lack of after sale service	38.6	41.8	29.5	63.1	60.3	18.5	73.6	83.2	18.4	20.7	28.6
Preference for imported ones	18.1	20.2	15.7	55.4	63.8	29.4	73.1	67.0	53.4	58.6	56.5
Frequent breakdowns	9.3	6.9	4.2	59.1	71.5	18.6	80.3	76.4	19.6	60.2	49.9
Distant market	54.2	61.6	63.4	73.3	69.1	48.6	71.2	86.5	53.2	61.3	42.2
High energy/skill requirement	18.7	13.5	19.1	11.5	45.8	9.7	21.5	28.9	39.7	84.1	30.4
Incompatibility	0.9	1.1	0.9	0.6	73.4	0.1	1.2	0.8	0.4	63.8	44.1
Lack of knowledge	0.8	0.7	0.1	39.5	31.4	0.0	53.3	42.3	39.6	62.1	0.0

Note:
Ox-dp = 0x-drawn plough, ox-dh=0xdrawn harrow; Ox-rid = oxdrawn ridger,
Ox-dpt = Ox-drawn planter, ox-drawn = Ox-drawn weeder, ox-dc = Ox-drawn cart, jb = Jab planter, Fer. app = Fertilizer applicator, Imp. Hw = Improved hand weeder, TP = Treadle pump.

Availability of spare parts and after-sale service are important factors in the use of any mechanical technology. In investigating these variables, it was revealed by 57% of the respondents that non-availability of the Jab Planter was a constraint. About 72 per cent of the respondents also mentioned non-availability as a constraint to the use of the fertilizers applicator. On the other hand, about 83 and 74 percent of the respondents indicated non-after sale service as a major constraint to the use of the fertilizers applicator and Jab planters, respectively.

Preference for imported ones was not given as important reason for the ox-drawn plough, ox-drawn planter, ox-drawn ridger and the ox-drawn cart. Frequent breakdown was the major constraints for the jab planter (80%), fertilizers applicator (76%) and the ox-drawn weeder (72%); that is that these equipment breakedown too quickly. It was also reported by the farmers that as a result of frequent breakdowns of these equipment, they had to face many problems in repairs as the spare parts and services facilities were not easily available. On the types of breakdowns, about 93 percent of the farmers observed that there were many types of breakdowns in all the tools and equipment in their present form. The most common include breakdowns of leather cups and piston in the treadle pump, gangs and tines in the EMCOT rotary weeder, the gear drive mechanism in the fertilizers applicator and welding failures, were quite frequent. Moreover, the farmers had to go to the same manufacturer or fabricator to effect replacement and repairs of the components. The study also shows that most often, the farmers were compelled to travel from 12 - 50 kilometers, distance for repairs and maintenance. In other villages, they had to travel even up to 100 kilometers or more for service facilities. This may suggest that the lack of easily available service facilities, constrained the use of IFTE in the area even more than high cost and availability of the equipment.

High energy/skill requirement was reported by about 84 percent of the respondents as the major problem to the use of the treadle pump technology. Similarly, high percent (73%) of the farmers mentioned incompatibility with their cropping patterns as the problem inhibiting the use of the ox-

drawn weeding technology.

Further investigations revealed that the ox-drawn weeder did not work well if crops were lodged. In the preceding two or three seasons, the crops had been mostly lodged due to bad weather conditions, hence the weeders were not used for weeding by most of the farmers. With respect to the jab planters, certain operational difficulties were also reported to have been responsible for the low rate of adoption. These include:

i. the jaws of the hand operated planters clogged if the soil was too wet and heavy;

ii. the metering device clogged with seeds frequently;

iii. the plant-hill spacing in some versions were not uniform;

iv. some of the planters had no covering devices for the seeds.

However, they indicated that the jab planters had the advantage of maintaining uniformity in the planting distance(83%), reduction in drudgery (46%) and back-ache(73%) experienced by traditional planting. These advantages made the use of the jab planter indispensable. On the other hand, about 63 percent of the farmers reported that the animal drawn planter performed satisfactorily only in a well prepared dry seedbed that was free of surface trash.

The summary of the overall views of the farmers show that the treadle pump represented an intermediate farm technology appropriate to rural conditions with the following features:

i. it is relatively inexpensive;

ii. it is only manual powered;

iii. it is robust and reliable, and can be maintained and repaired by local artisans using local materials;

iv. it is easy to install and can be moved without trouble or damage from one site to another;

v. It is suitable for very small holdings;

vi. it is extremely labour-intensive, requiring approximately one man-year of labour to irrigate between 0.25-0.3 hectare of dry season crops thereby creating employment at a time of the year when labour is traditionally unemployed, and

vii. it offers a good return on investment by the farmer.

On the other hand, they pointed out that although the treadle pump has several advantages, its disadvantages were that it breakdown too frequently and apparently most serious of all, it has high energy requirement during operation.

Overall, breakdown due to worn-out parts, poor adjustment and operation of equipment, and poor field conditions were considered as the major factors which cause frequent breakdown of the IFTE investigated. But breakdown due to worn-out parts was found to be the most critical factor causing the high frequency of equipment breakdown in the study area.

Knowledge is one of the most powerful variables determining the use of an innovation. To acquire and use an innovation, the farmers necessarily have to know of the existence of the innovation. In this study, the data show that a paltry percentage of the surveyed farmers indicated that lack of knowledge was responsible for their inability to adopt the treadle pump (62.1%) and the jab planter (53.3%). Knowledge of the rest of the IFTE investigated was not a serious constraint.

The study further probed the level of satisfaction of the farmers about after-sale services of the IFTE. As revealed by this study, 71 percent were not satisfied with the after-sale services. Only about five percent were fully satisfied, while 23 percent were partially satisfied. It is therefore, evident from this study, that the interest of the manufacturers and fabricators was simply to sell more tools and equipment and have no concern for caring about those already sold.

5.8.5: Major Reasons Given for Adopting IFTE by the Farmers.

Respondents who reported adopting the use of the various IFTE were asked why they adopted. Results of these responses are summarized in Table 12. These are to (1) increase farm size, (2) improve timeliness of operations, (3) increase productivity, (4) improve precision of farm operations, (5) obtain increase in crop yield, (6) improve quality of crops, (7) reduce the drudgery of farm work, (8) increase dignity of the farmer, (9) increase economic returns to the farmer, and (10) other reasons. Table 12 shows that about 91 percent of the respondent adopted the ox-drawn plough to increase productivity of the land. The ox-drawn harrow was adopted to reduce the drudgery of farm work by about 99 percent of the adopters. The main reasons given for adopting the ox-drawn ridger were to reduce the drudgery of farm work (about 97%), increase farm size (96%) and to improve timeliness of operations by about 94 percent of the adopters. The ox-drawn weeder was adopted to reduce the drudgery of farm work by 98 percent of the adopters and about 94 percent adopted to increase farm size.

Table 12: Major Reasons Given for Adopting IFTE by Farmers

Major Reasons for Using a Practice	I F T E.								
	Ox-dp % of users	Ox-dh % of users	Ox-rid % of users	Ox-dpt % of users	Ox-wd. % of users	Ox-dcart. % of users	Ox-fert. App % of users	Im.hw % of users	Jb % of users
To increase farm size	42.4	38.6	95.6	74.7	93.8	27.8	46.4	89.6	92.7
To increase productivity of the land	90.5	87.7	93.1	23.2	56.8	n.a	n.a	61.5	70.5
To improve timeliness of operations	86.8	89.2	94.3	90.3	89.8	n.a	88.9	94.1	86.8
To improve precision of farm operations.	22.2	16.3	91.3	96.4	5.6	n.a	45.5	6.2	17.0
To obtain increase in crop yields	58.1	73.0	92.8	33.0	87.9	n.a	61.1	72.5	92.2
Improve quality of crops	3.6	2.7	69.6	n.a	28.3	2.1	n.a	46.5	68.4
Reduce the drudgery of farm work	98.3	99.1	96.7	96.4	98.1	97.9	89.8	98.2	69.9
Increase dignity of the farmer	18.6	20.1	38.7	5.9	17.0	33.5	23.7	15.2	49.3
Increase economic returns	48.8	47.0	78.2	4.1	56.3	n.a	18.8	69.8	87.1
Other reasons (e.g. innovation simple to adopt, not risky, not costly, ease of maintenance, etc)	24.9	31.3	40.4	26.5	0.8	49.2	41.3	53.5	12.6

Note: 1. Ox-dp = 0x-drawn plough, ox-dh=0xdrawn harrow; Ox-rid = oxdrawn ridger,
Ox-dpt = Ox-drawn planter, ox-drawn = Ox-drawn weeder, ox-dc = Ox-drawn cart, jb = Jab planter, Fer. app = Fertilizer applicator, Imp. Hw = Improved hand weeder, TP = Treadle pump.
2. n.a = Not applicable
3. Multiple Responses for all IFTE.

The improved hand weeder and the fertilizer applicator were adopted for similar reasons. Most of the respondents, (about 98%) who adopted the improved hand weeder did so to reduce the drudgery of farm work, followed by improve timeliness of operations (94%) and to increase farm size (about 90%). Most of those who adopted the treadle pump, did so to obtain increase in crop yields (93%) and to increase economic returns to the farmer by 87 per cent of the adopters.

5.8.6: The Views of the KADP Officials.

The views of the KADPs staff on the factors encouraging/ hindering the adoption of IFTE. were sought. This information have been pooled together and presented in Table 13. Low cost, multi-purpose usage, simplicity of use and relevance to farmers' needs were the major reasons quoted. On the other hand, the factors hindering adoption included lack of funds, high cost, lack of subsidies, inadequate publicity and complexity of some of the IFTE. These factors are inhibitive to adoption inspite of the benefits implicit in the adoption of IFTE.

Table 13: The KADP Views on Factors Favouring/Hindering Adoption of IFTE in Descending order of Importance.

Factors Favouring	Factors Hindering
Low cost	Lack of funds to purchase
Multi-purpose uses	High cost
Simplicity of usage	Inadequate spare parts
Ease of Maintenance	Non-availability
Subsidization of IFTE	Information rarely comes from Research Centres
Availability	Complexity of some IFTE
Relevance to farmers' needs	Lack of subsidies
Adequate Publicity	Preference for imported types
	Unfavourable government policy/support

5.9: Factors Affecting Level of Adoption of IFTE: Test of Hypotheses

It was hypothesized in this study that there is relationship between personal characteristics of the farmer, institutional factors and attributes of the IFTE and level of adoption of IFTE. The personal characteristics include age of the farmer, years of schooling, years of experience in farming, farm labour, and farm size. The institutional variables are amount of credit received biological/chemical inputs usage and extension contact. The attributes of the IFTE relate to cost, frequent breakdown and energy/skill requirement (Figure 1). The specific hypotheses, however, posited positive associations between age, years of schooling, farm size, biological/chemical inputs, amount of credit received and contact with extension and level of use of IFTE. On the other hand, negative relationships were hypothesized between farm labour, cost, frequent breakdown and energy/skill requirement, and level of use of IFTE. The relationships were tested using correlation and multiple regression procedures. The correlation matrix showing the relationships is presented in Table

14 and the multiple regression analysis is shown in Table 15.

The correlation analysis shows farm size and biological/chemical inputs to be positively and significantly related to level of used of IFTE as hypothesized. The correlation coefficients for these two variables were farm size (r = .73) and biological/chemical inputs (r = .57). Farm size showed a higher positive and significant relationship with level of use of IFTE than did any other variable studied (Table 14). This positive relationship might occur because farmers with larger farms require much more labour to expand the available land resources they have. Similarly, the positive relationship between biological/chemical inputs indicates that farmers who use biological/chemical inputs have the tendency to use IFTE more intensively or vice-versa.

Four variables – high cost, frequent breakdown, family labour capacity and high energy/skill requirement were found to be negatively but significantly correlated with level of adoption of IFTE in the direction predicted in the study. The r values for these relationships were high cost (r = -.68), frequent breakdown (r = -.54), family labour capacity (r = -.51) and high energy/skill requirement (r = .-46). The negative relationship indicate that the more high cost and frequent breakdown are associated with an I.F.T.&E, the favourable the farmer toward their adoption. Similarly, it was expected that households with greater labour capacity would adopt less IFTE because of the availability of manual labour to meet the demands of various farm operations. The more high energy/skill requirement is perceived, the less inclined the farmer is to adoption of IFTE. The significant relationships of the four variable suggest that the high cost, frequent breakdown, availability of household labour and high energy/skill requirement are important considerations in the adoption of IFTE. The hypotheses

that household labour capacity, high cost, frequent breakdowns and high energy/skill requirement are negatively related to level of adoption were therefore supported by the data.

It was hypothesized that amount of credit received, contact with extension service and age of the farmer would be positively related with level of adoption of IFTE. These relationships were confirmed in the correlation analysis. Amount of credit received (r = .38), contact with extension (r = .35) and age (r = .31) were found to be moderately but positively correlated with level of adoption of IFTE. The moderate and positive relationships found with credit and extension contact implies that as a farmer receives credit and more contact with extension services, the more likely the farmer would adopt IFTE. The positive and significant correlation between age and level of adoption of IFTE suggests that older farmers might be more inclined to adopt IFTE than younger farmers. The finding on age, though not consistent with many findings on adoption of new technologies, could be explained from the point of view that older farmers might be weak due to old age and thus need to adopt IFTE more than to reduce the drudgery of farm labour. This finding is also, however, consistent with that of Panin (1992) in Ghana who found positive correlation between age and adopt of animal traction technology. Since the relationships between credit received, contact with extension and age were in the hypothesized direction, support is given to the specific hypotheses.

Years of experience in farming, also, showed a positive relationship with level of adoption of IFTE. This was in agreement with the hypothesized relationship that years of experience in farming would be positively related to level of adoption of IFTE. This hypothesis was, accepted.

The remaining two variables (years of schooling and years of experience in farming),

showed no significant correlation with level of adoption of IFTE (Table 14). Years of schooling was negatively (r = -.16) related to level of use of IFTE. Thus, the hypothesis which predicting a positive and significant relationship was repudiated in this study. This finding is in contrast with normal expectations on adoption of new technologies. A positive relationship was expected since education widens knowledge beyond the traditional village and should accelerate acceptance and adoption of new practices. Education may also make a farmer more enlightened and receptive to advice from an extension agent to adopt a new practice. The negative relationship between years of schooling and level of adoption of IFTE in this study, however, could be attributed to the generally low level of education of farmers in the study area where a majority of the farmers did not go to school.

Table 14: Product- Moment Correlation Coefficient (r) Matrix Showing the Relationship Between some Selected Variables and levels of IFTE adoption.

Variables	(x_1)	(x_2)	(x_3)	(x_4)	(x_5)	(x_6)	(x_7	(x_8)	(x_9)	(x_{10})	(x_{11})	(x_{12})
Age(x_1)	1.00											
Years of Schooling(x_2)	0.25	1.00										
Years of farming experience(x_3)	-0.46	-0.06	1.00									
Family Labour capacity(x_4)	0.59	0.08	-0.30	1.00								
Farm size(x_5)	-0.64	0.30	0.15	0.18	1.00							
Biological/chem. Inputs(x_6)	0.46	0.37	0.26	0.38	0.22	1.00						
Credit received(x_7)	-0.09	0.18	0.06	-0.21	0.14	0.18	1.00					
Extension contact(x_8)	-0.41	0.11	0.01	-0.13	0.16	0.21	0.05	1.00				
Cost(x_9)	0.12	0.16	-0.12	-0.24	0.18	0.31	0.30	0.35	1.00			
Frequent breakdown (x_{10})	0.12	0.21	0.21	0.16	0.19	0.16	0.14	0.63	0.42	1.00		
Energy/skill requirement(x_{11})	0.28	0.11	0.15	0.14	0.11	0.24	0.10	0.24	0.26	0.14	1.00	
Level of adoption(x_{12})	0.31*	-0.16	0.12	0.51*	0.73*	0.57*	0.38*	0.35*	-0.68*	-0..54*	-0.46*	1.00

***Significant at 0.05.**

The foregoing analysis has indicated varying levels of relationships with level of adoption. However, in view of the fact that level of adoption occurs as a function of several variables and not just the independent effect of any one variable, step-wise multiple regression analysis was conducted on the eleven variables which were hypothesized to have an effect on level of adoption to determine the contribution of each independent variable. Table 15 summarizes the results. The coefficient of determination (R^2) is 0.4214 which means that 42 percent of variance in level of adoption of IFTE was explained by the variables included in the model. Furthermore, the F distribution in a statistical table indicates that the probability of getting an F. ratio equals to or greater than 18.08. Table 15, also shows that the standard error of the estimates was 2.5899. This means that, on the average, the level of adoption deviated from the actual by 2.5889.

As indicated in Table 15, eight out of the eleven multiple regression coefficients were consistent at various levels in direction with the hypotheses. When considering the contribution of each variable, farm size and biological/chemical inputs made the greatest contribution toward level of adoption of IFTE. Farm size and biological/chemical inputs variables accounted for about 18 percent of the variability in the level of adoption of IFTE usage. Holding other variables constant, however, farm size made the greatest contribution to level of adoption of IFTE. Dropping this variable from the equation reduced the value of the adjusted coefficient of determination (R^2) from 0.2633 to 0.14. These relatively high magnitudes of farm size and biological/chemical inputs imply that if farmers have large farms and access to biological/chemical inputs, they would be inclined to adopt more IFTE.

The regression coefficient of frequent breakdown, though statistically significant (Table 15) was in the opposite direction (0.6003). It was hypothesized that frequent breakdown of the IFTE would be negatively related to their level of adoption. The positive relationship suggests that frequent breakdowns of the IFTE were not a major factor affecting their level of adoption.

The regression coefficient for age was positive and statistically significant at the 1 percent level. The positive and significant contribution of age, suggests that adoption of IFTE was higher among older farmers than younger ones. Previous research has, however, established that older people are less receptive to accept farm innovations than younger people. Vabi and Williams (1991), observed that rural population which ordinarily have higher concentration of older people were more likely to be conservative owing to the fact that they tend to accept new ideas less rapidly than younger people. The older farmers used more of the IFTE than the younger ones probably because they were weaker and therefore require IFTE to complement their available manual labour input.

The family labour capacity variable, though, significant at the 1 percent level, has a negative coefficient, suggesting that level of adoption was lower among small-sized households with large manual labour capacity. Households with large family labour capacity tend to use the availability of manual labour to perform their farm operations rather than bother about adopting IFTE.

Years of farming experience had a positive coefficient and was statistically significant at the 5 percent level. The hypothesis predicting a positive relationship between years of farming experience and level of adoption of IFTE is therefore supported. This implies that

farmers who have spent many years in farming used more IFTE. This was probably that years in farming might have enhanced the farmers' ability to appreciate the benefits of large scale farming associated with the adoption of IFTE. As the years of a person increased on the job, the degree of perceived benefits also increases.

Though contact with extension made significant contribution in the regression analysis, it had a negative coefficient indicating that farmers having contact with extension adopted less IFTE. This suggest that extension contact was not important factor for determining the level of adoption of IFTE. This might be taken to mean that although the farmers had contact with extension, they did not receive information on IFTE. The farmers seemed to have benefited more in other areas of agricultural innovations from extension services than in IFTE usage. The hypothesis that contact with extension would be positively and significantly related with level of adoption of IFTE was, therefore, not supported.

The amount of credit received, made a positive but insignificant (0.0032) contribution to level of adoption of IFTE. The positive coefficient suggests that farmers who received institutional credit used more IFTE than those who did not, thus implying that availability of credit enhances farmers ability to purchase IFTE. The insignificant contribution of credit to level of adoption may be due to the fact that very few farmers (35.8%) benefited from any sort of credit facilities in the study area. In the context of a small-farmer peasant economy as in Nigeria, the shortage of funds is often emphasized as a constraint to the adoption of new technologies. In this study, the amount of credit received per household was taken as a proxy of the availability of liquid funds, which could facilitate the purchase of IFTE.

Cost of IFTE was posited to negatively affect their level of use. The test of multiple

regression (Table 15) shows that the contribution of cost of IFTE was negative but significant at the 1 per cent level. The explanation for the negative coefficient is that the more costly an equipment is, the less its demand.

The remaining two variables (years of schooling and energy/skill requirement) made insignificant contributions (Table 15). The two variables taken together explained 0.94 per cent of the variance in level of adoption of IFTE. This relates to the generally low level of education of the farmers in the study area. The significance of low level of education among farmers should be a matter of concern by extension workers. Education is usually valued as a means for acquiring knowledge about farm technology. Research has shown that a low level of education tends to foster unfavourable attitudes towards the adoption of improved farm practices. Havens (1965) and Gatrill, et. al, (1973), found that more years of schooling were associated with higher adoption rate than fewer years of schooling. It seems, therefore, that extension efforts among the farmers of the area, would be adversely affected by the low levels of education of the farmers.

In general, it can be concluded that the most important variables in the adoption of IFTE were farm size followed by the use of biological/chemical inputs and frequent breakdowns. The least important factors were years of experience in farming, extension contact and energy/skill requirement.

Table 15: Step-wise Multiple Regression Model on Factors Affecting the Adoption of IFTE.

Independent Variable	Coefficient.	St. Error	T-Values
Age(x_1)	0.1180	0.0327	3.613***
Farm labour capacity(x_2)	0.0081	0.0037	-2.213**
Years of schooling(x_3)	-0.0379	7.5800	-0.005
Years of farming experience(x_4)	0.1036	4.7523	2.081**
Farm size(x_5)	0.6928	0.1278	5.421***
Biological/chemical inputs(x_6)	0.6693	0.1608	4.163***
Credit received(x_7)	0.0032	0.0109	0.291
Extension contact(x_8)	-0.0245	0.0095	-2.569**
Cost(x_9)	-0.3804	0.1526	-2.493**
Breakdown (x_{10})	0.6003	0.1830	-3.281***
Energy/skill req.(x_{11})	0.0037	0.0261	0.142
Constant	0.1238		
R^2	0.4214		
Adjusted R^2	0.2633		
Standard Error	2.5899		
F-ratio	18.0800***		

***** Coefficients statistically significant at 1% level .**
****Coefficients statistically significant at 5% level.**

5.10: Consequences Of Adopting IFTE.

The consequences of adopting IFTE were assessed in terms of area cultivated, crop yields and income. The relative importance of the crops was based on area planted, its importance in subsistence farming and income generation, and the crops that the farmer in his views considered the most important. In this regard, maize, sorghum, millet, cowpea, rice, groundnut, yams, and tomatoes in that order were considered the most important crops. The impact of the IFTE on land under cultivation and crop yields were analyzed from two perspectives: (i) a comparative analysis of the adopters and non-adopters, and (ii) an analysis of the perception of the adopters. Also, the impact of IFTE on household income was investigated.

5.10.1: Impact on Cultivated Areas

Food crop cultivation was dominated by maize, sorghum, millet, rice, cowpea, groundnut, yams and tomatoes. Table 16 compares the mean area cultivated between the adopters and non-adopters. The mean area under maize, sorghum, millet, cowpea and tomatoes cultivation was slightly higher for the adopters than the non-adopters. On the other hand, the non-adopters recorded larger land area for rice, groundnut and yams.

Table 16: Means and Standard Deviations of Cultivated Areas of Major Crops among Adopters and Non-adopters of IFTE.

Crops	Area Cultivated				
	Adopters		Non-adopters		t-test
	X	Std	X	Std	
Maize	1.40	1.32	1.23	0.99	0.541
Sorghum	1.25	1.02	1.70	0.95	0.338
Millet	0.43	0.44	0.35	0.75	0.144
Rice	0.33	0.61	0.86	1.14	0.003
Cowpea	0.48	0.71	0.31	0.56	0.128
Groundnut	0.19	0.51	0.22	0.69	0.106
Yams	0.11	0.76	0.15	0.42	0.019
Tomatoes	0.24	0.85	0.13	0.43	0.270

Std = Standard deviation
t - test significant at P<0.05

The data in Table 16, however, show that the area cultivated by the adopters and non-adopters were generally low. Except for yams, the t-test shows that the mean cultivated areas did not differ significantly among adopters and non-adopters. Incidentally this was the crop which only few operations could be performed with the IFTE investigated due to its prevalent agronomic practices.

Any major difference in average cultivated area was assumed to have been caused by the adoption of IFTE. This was confirmed by the opinions of the respondents with respect to whether the adoption of IFTE caused significant changes in the area cultivated (Table 17).

Table 17: Perception of Adopters on Level of increase in Farm Size owing to adoption of IFTE.

Perceived level of increase in farm size.	**Respondents**	
%	**No**	**%**
1 – 10	17	14.2
11 – 20	16	13.4
21 – 30	19	15.9
31 – 40	24	20.0
41 – 50	16	13.3
51 – 60	13	10.8
61 – 70	10	8.3
71 – 80	3	2.5
81 – 90	1	0.8
91 – 100	1	0.8
Total	120	100.0

Table 17 shows that about 14 percent of the adopters felt that their farm sizes had increased between 1 – 10 percent as compared to what they used to cultivate before, while 13 percent felt that they had increase of between 11 – 20 percent. Twenty percent of the adopters indicated increases of between 31 - 40 percent, while only 0.8 percent reported farm size increases of between 91 – 100 percent.

5.10.2: Impact on Crop Yields

Table 18 depicts the yields by crops for the two groups surveyed. With regard to the average yields in kilogram per hectare, significant differences were found between adopters and non-adopters. Averages of all crops, except millet were higher for the adopters. This relates to the average larger size of the fields of the adopters, as shown in Table 16.

Table 18: Means and Standard Deviations of Yields of Major Crops among Adopters and Non-adopters of IFTE

Crops	Yields (kg/ha)				
	Adopters		Non-adopters		t-test
	X	Std	X	Std	
Maize	2094.2	1643.4	1867.9	971.8	0.167
Sorghum	1362.6	1556.0	1167.8	1461.5	0.184
Millet	1091.9	366.3	1137.5	807.5	0.119
Rice	4272.3	975.1	4026.1	880.2	0.086
Cowpea	870.9	1404.3	798.1	438.1	0.169
Groundnut	2148.0	287.8	2127.2	281.4	0.118
Yams	6114.6	726.1	6245.4	994.2	0.194
Tomatoes	6464.1	1261.5	6199.6	788.0	0.188

Std = Standard deviation
t - test significant at P<0.05

Except for rice, the t-test shows that the mean yields of all the crops did not differ significantly among adopters and non-adopters of IFTE.

The adopters were also asked to evaluate the impact of the IFTE on their crop yields. Most of them evaluated the impact on their crop yields in favourable terms, with about 6 percent of them reporting increases of between 1 – 10 percent, while 13 percent reported increases of between 11 – 20 percent. About 20 percent of them indicated increases in crop yields of between 41 – 50 percent, and about 3 percent reported increases of between 91 – 100 percent over what used to prevail before the adoption of the IFTE (Table 19)

Table 19: Perception of Adopters on Crop Yields increase due to Adoption of IFTE

Perceived Level of increase in crop yields %	Respondents No	%
1 – 10	7	5.7
11 – 20	11	9.2
21 – 30	12	10.0
31 – 40	17	14.2
41 – 50	24	20.0
51 – 60	20	16.6
61 – 70	16	13.4
71 – 80	5	4.2
81 – 90	5	4.2
91– 100	3	2.5
Total	120	100.0

However, although the adopters indicated crop yield increases, and the data also show that the crop yields of some of the crops of the adopters were higher than those of the non-adopters, they were nowhere near the genetic potentials quoted by research stations (of 7840kg for maize, 3920kg for sorghum, 2800kg for millet, 2500kg for cowpea and 3360kg for rice, 2240kg for groundnut, 20700kg for yam and 22,580 for cassava, per hectare) (Yayock and Misari,1991). This indicates that the research experience had not been replicated under actual farm conditions in this area where the labour bottlenecks had been reduced. This could be due to some other factors like weather, soil fertility, pests and diseases still constituting production constraints in the area.

5.10.3: Impact of IFTE on Household Income from Crops Production

The estimates of income obtained by adopters and non-adopters are presented in Tables 20 and 21. It was found that nearly one percent of adopters and the same percent of non-adopters obtained income of less than N20000. About 2.5 percent of the adopters generated between N20000 – N30000, while only 0.8 percent of the non-adopters fall within this category. Majority of the adopters (95.0%) had income greater than N50000, while a similarly large

number(93.3%) of the non-adopters fall within this category (Table 20).

Table 20: Farm Income of Adopters and Non-adopters of IFTE.

Income Categories	Adopters		Non-adopters	
	No	%	No	%
Less than N20000	1	0.8	1	0.8
N20000-30000	3	2.5	1	0.8
N30001-40000	1	0.8	3	2.5
N40001-50000	1	0.8	3	2.5
Above N50000	114	95.0	112	93.3
Mean		23,500		19,850 (t=3.350)**

t- Significant at .05

Table 21, however, shows that total gross monetary value of crops was higher (2,987,002.0) among adopters than among non-adopters (N1,911,203.3), and income per household member was also higher for the adopter than for the non-adopter households.

Table21: Summary of Annual Household Income from Crop production for Adopters and Non-adopters of I FTE.

S/No	Item	Adopters	Non-adopters
		Amount(N)	Amount (N)
1.	Gross value of crop production	2,987,002.0	1,911,203.3
2.	Income per household member	3,986	1,912

It was assumed that differences in income would be as a result of adoption of IFTE. This study confirmed this assumption (Tables 20 & 21) as the adopters obtained substantial increases in income from crop production due to the adoption of IFTE. However, though the adopters' income was relatively higher than those of the non-adopters, the income of both groups were generally very low, compared with those of non-agricultural occupations.

CHAPTER SIX

6.0 : SUMMARY, POLICY IMPLICATIONS AND RECOMMENDATIONS, AND CONCLUSIONS

6.1: Summary

In this chapter, the thesis is summarized. The Chapter also presents the implications of the findings regarding the development, level of adoption, constraints and consequences of IFTE.

This thesis started on the note that Nigeria is blessed with abundant agricultural land area. Besides, agriculture provides livelihood directly or indirectly, for nearly 80 percent of the population. Currently, however, the farming population is constrained with labour bottleneck attributed to the use of traditional back- breaking and arduous hand tool technology. This has happened inspite of over 70 years of efforts on popularizing the adoption of IFTE for agricultural production to raise the level of living of the subsistence farmers.

This study was designed to provide information and data on the development, level of adoption, factors affecting adoption and the consequences of adopting IFTE on land under cultivation, crop yields and income. The Kaduna State government had accepted the use of IFTE as a means of enhancing farm productivity. Thus, substantial amounts of money had been expended on procurement of several kinds of IFTE. The particular concern of this study was to provide data for analytical guidance for understanding the development, production, problems and consequences of IFTE in Kaduna State.

The theoretical perspective which guided this study was the theory of social change and the factors studied were based largely on adoption studies and personal experience. It was then postulated that certain socio-economic characteristics of the farmers, institutional factors, and some attribute of the innovations affect the adoption of agricultural innovations. Theoretical variables were operationalized and eleven empirical hypotheses were derived concerning the relationships between the independent and dependent variables. The relevant data were collected from secondary and primary sources. The primary data were gathered by the use of four sets of questionnaire. Two hundred and forty farmers comprising 120 adopters and 120 non-adopters selected using a combination of stratified and simple random sampling techniques served as respondents. The data were analyzed using descriptive, correlation and step-wise regression statistics and t-tests.

Findings

Introduction and development of IFT E for Crops Production

The first objective of this study was to identify the level of introduction and production of IFTE for crop production and make an inventory. The reason for this objective was to provide background knowledge of the efforts made by research and development agencies situated in the area and that of the KADP.

It was found that the adoption of IFTE in the study area started in the 1930s with the introduction of animal traction. The conservative estimate indicates that there were at least 641 animal traction implements adopters in the villages studied.

The National Animal Production Research Institute (NAPRI), Faculty of Veterinary Medicine were found to be focusing on the biological aspect as well as work

efficiency of the work-bulls used for animal traction. The College of Agriculture and the National Agricultural Extension and Research Liaison Services offered special extension training programmes on animal traction. Soft loans were also made by the NLPD and commercial banks to farmers for the purchase of work oxen and implements. The KADP had established an animal traction training centre at Maigana where about 112 farmers had been trained.

Some non-governmental organizations (NGOs) and private extension agencies such as the SG-2000, UNICEF, the NTC and the UAC had provided some credit facilities to purchase some IFTE. On the whole, majority (86%) of the farmers used mostly animal drawn implements.

The John Holt Agricultural Engineers Company, the Agricultural Mechanization Programme of I.A.R/ ABU, Zaria were found involved in the development and production of the IFTE, investigated. Other IFTE development and production efforts were based in the College of Agriculture and the NAERLS. Some blacksmiths and artisans were also found to be fabricating most of the animal drawn implements using locally available materials. Almost all blacksmiths in the study area could produce the plough share for the animal drawn ridger. Therefore, the development and local fabrication of some of the IFTE had been attained locally to ensure availability and adoption.

Extent of Awareness and Level of Adoption of IFTE

The second objective of this study was to identify the extent to which the farmers were aware of the availability of the IFTE. This thesis provide the data which show that farmers in Zaria area had a high degree of knowledge of the IFTE. The data show that

over half of the farmers (123) were aware of all the 10 IFTE studied. This awareness can certainly help farmers to accept and adopt recommended improved practices.

The objective was also to determine the level of adoption of the IFTE by the farmers. As indicated by the data the ox-drawn ridger recorded the highest number of adopters across the villages studied. The least number of adopters was recorded for the treadle pump. A majority (82%) adopted between 1 - 3 and none adopted above 7 IFTE for agricultural production. The data also show that the ridger had the highest (2118) hours of usage and the planter recorded the least number of hours.

Ox-drawn carts were used intensively for transportation of inorganic fertilizers, manure, farm labourers and farm produce. The other animal drawn implements were used mainly for ploughing, harrowing, ridging and weeding.

Factors Affecting the Adoption of IFTE.

The third objective of the study was to identify the factors affecting the development, production and adoption of IFTE. The perceived factors were identified from four major categories of respondents - from the R & D institutions, fabricators and dealers, the KADP and the farmers' perceptions, while the personal characteristics of the farmers, institutional factors, and some selected attributes of the IFTE were additional factors investigated. Information from the R & D institutions indicated that financial constraint was the major cause of failures to develop and produce adequate IFTE. to meet the needs of the farmers. Other constraints identified include lack of credit facilities and subsidies, lack of industrial base, scarcity and high cost of materials, fragmented holdings and the cropping patterns which hinder efficient adoption of some IFTE, shortage of

proficient technical staff, lack of awareness and lack of clear cut policy of government on the development and production of IFTE.

The major constraint reported by the fabricators was the none - availability of raw materials. The basic materials available were scrap from abandoned cars and railway lines. Unreliable infrastructure such as electricity and fuel, and high cost of toolings were other constraints affecting mass production by the fabricators. Poor marketing channels and lack of market demands were major problems identified by both the fabricators and the dealers.

High cost of the animal drawn implements featured as the major constraint affecting utilization of IFTE by the farmers. None availability of IFTE was mentioned by 73 and 76% as the constraint affecting the adoption of the improved hand weeder and the ox-drawn planter, respectively. About 83 per cent and 74 percent of the respondents indicated lack of after sale service as a major constraint to the adoption of the fertilizer applicator and jap planter, respectively. On the other hand, low cost, multipurpose usage, simplicity and relevance to farmers' needs were the major reasons favouring the adoption of the IFTE, identified by the KADP.

The data show that farm size and adoption of biological/chemical inputs were positively correlated with adoption of IFTE Both the correlation and regression coefficients were significant with regards to these variables.

Years of schooling, amount of credit and contact with various sources of extension services were not significantly correlated with the adoption of IFTE. The lack of significance of these variables suggests that the variables had little or no effect on the adoption of IFTE by farmers.

The Consequences of adopting IFTE.

The fourth objective of the study, investigated the impact of IFTE on land under cultivation, crop yields and household income from crops production. In this study, the relative importance of crops was based on area planted, its importance in subsistence farming and income generation, and the crops that the farmer considered the most important. In this regard, maize, sorghum, millet, cowpea, rice, groundnut, yams and tomatoes in that order were considered the most important crops. It was found that more adopters of IFTE cultivated fairly bigger farms than the non-adopters. The difference in average area cultivated was assumed to be the effect of IFTE technology. This was confirmed by t-test analysis.

Data were collected on crop outputs measured in head pans, baskets, wheel barrows, ox-carts and pick-up loads and converted into kilograms per hectare to determine differences in productivity between adopters and non-adopters. The data gathered show that even where the adopters cultivated smaller hectarages, they obtained higher yields per hectare of sorghum, rice and groundnuts - the crops which IFTE were intensively used. The t-test analysis show that IFTE had a positive impact on some crop yields. In general, the use of IFTE made some significant positive impact on crop yield per hectare.

Crop production was by far the largest source of household income in both farming systems, accounting for 88 percent in the adopter households and 81 percent in the non-adopters. Total net income was higher (4%) for the adopter than the non-adopter households. On gross value of crops and per capita income, adopter households had more gross values and income than the non-adopters.

6.2 :Policy Implications and Recommendations

The findings of this study provide a useful basis for discussing policy implications and recommendations. These policy implications and recommendations include the following:

1. Financial constraints was identified as the most critical constraints affecting the design and production of IFTE by the R&D and the fabricators. The capacity of the Government to accelerate investment in development and to support research and fabrication of IFTE will depend on the availability of finance. So far, the government has largely depended on external resources (foreign aid and loans) for financing such investment. The present political pressure from foreign countries suggests that it will be increasingly difficult to mobilize foreign aid for programmes that promote the development and use of IFTE. Uncertainty about the future availability of foreign aid and the increased cost of debt servicing suggest that it is advisable for the government to seek out internal resources. Advantage should therefore be taken of available funds such as the Petroleum Trust Fund (PTF) and the withdrawn fertilizer subsidy to put money to support research and extension in IFTE Modalities should also be put in place to involve the private sector in funding research and fabrication of IFTE.

The Government should also take steps to mobilize additional resources from the agricultural sector. A move in that direction could be made by recovering the cost of public investment from the beneficiaries

2. The lack of good quality raw materials was identified as a constraint by the researchers and fabricators. For the development and production of IFTE to thrive,

sustainable local good quality raw materials must be available and relevant infrastructures must be put in place. Good materials and suitable designs may increase costs, but the use of good materials and suitable designs may result in lower costs to the farmers in the long run because repairs should be fewer and IFTE can be used more effectively.

3. The study shows that R&Ds were plagued with a serious lack of trained manpower at all relevant levels -operational/artisans/technical as well as managerial levels. Without this critical mass of personnel for effective mechanization, the hope of an agricultural revolution for this country will remain a dream. The establishment of the Rural Agro-Industrial Development Scheme (RAIDS), the Rural Artisans Training and Support Unit (RATSU), The Agricultural Machinery Mechanics Operators Training Centres (AMMOTRACs) at Misau and Akure, and agricultural engineering departments of the Universities and Polytechnics are commendable efforts. It is however, necessary that the Government of this country should establish more farm machinery training institutes in strategic areas of the country to develop the needed technical manpower. The following courses can be taught in such training centres. Regular course on:

i. Agricultural machinery utilization;

ii. Refresher courses on agricultural mechanization fabrication;

iii. Technician's course on IFTE;

iv. Agro-service centre training course;

v. Training for rural youth for self-employment, and

vi. Train the trainers course.

The need for improving the training and career prospects of IFTE designers and producers cannot therefore be over-emphasized.

4. The KADP was the statutory agency which provided extension services in Kaduna State. The KADP indicated severe funding problems. All levels of field extension staff especially the frontline staff were underpaid, ill-equipped and under-motivated as occasioned by the poor service conditions caused by government under-funding. Salaries were not just poor but remain unpaid for months and allowances hardly ever paid. Transportation facilities (vehicles and motorcycles) have been grounded due to lack of fund. The KADP had also carried out mass retrenchment of staff so as to cope with the technical problems. These have a negative effect on the morale and consequently the output of extension workers. In such a circumstance, extension activities directed at IFTE become disrupted. A complete review and overhaul of the conditions of service of the extension services therefore, is needed to increase effectiveness and efficiency in extension activities geared towards promoting the use of IFTE.

5 The study shows that the farmers adopted a variety of sources of information. Extensive efforts are, however, still needed for further demonstrations and popularization of IFTE. One way of doing this is through radio and television. However, the cost of air-time is very expensive. Government should therefore intervene by directing broadcasting stations to subsidies or allocate some free air-time for agricultural radio and television programmes specifically on IFTE.

6 High cost has been identified as crucial problem limiting the adoption of IFTE by farmers. Dealers also complained of lack of market demand. The adoption of ox-

traction for example, represents an important capital investment mainly due to the present high cost of bulls and ploughs which averaged N30,000.00 for a set (2 bulls and one plough) at the time of this study. Considering the average annual income of farmers from crops production which was N28,195.9, one could easily infer that ox-traction technology was already beyond the buying capacity of the farmers since their income is mostly through sale of crop produce. So, it is recommended that rural saving schemes be established to effectively harness rural resources and provide the type of credit facilities needed. In addition, a greater emphasis on farm mechanization policy based on affordable IFTE, such as Oxen and Ox-drawn implements is recommended. Appropriate policy measures necessary to render this effective should be put in place. In the alternative, IFTE cooperative ownership should be encouraged. Membership should be based on size of holding, financial base and experience. Members should collectively pay and use the equipment. For example, if the cost of an equipment is N30000.00, for a cooperative group made up of 5 members, each member will be required to contribute N6000.00. This amount is affordable by most rural farmers.

Emphasis on subsidy as a means of inducing farmers to adopt IFTE should be discouraged. Rather, comprehensive policies should be put in place to ensure that the overall costs and returns to crop production can guarantee adequate profit for farmers. If, however, subsidy is to be applied at all, the macro-economic environment should be thoroughly reviewed to ensure that the subsidy will go to the intended beneficiaries. Efficient marketing and distribution networks for IFTE should be evolved.

7 This study shows that the current agronomic practices set constraints for the rapid development and production of IFTE. In this connection, it is suggested that Government

should, with the help of the Universities and Technical Colleges, formulate and implement an engineering strategy aimed at the production of IFTE. adapted to the farmers' farming systems. A gradual process involving one or two crops should be tackled for a start and blacksmiths and fabricators trained in the production of such tools, covering cultivation, planting, weeding and fertilizers application.

8 The study found that farm size and biological/chemical inputs were the most important determinants of level of adoption of IFTE. The study shows that the average farm cultivated by the farmers was some fragmented 3 - 5 hectares. Experience has also shown that there are often considerable differences in the amount of agricultural land available for each household. While some may have plenty of land in reserve, others have none. This is buttress by the fact that literature shows that Nigeria is blessed with abundant land area of 98.3 million hectares, out of which 72 percent is considered as potentially cultivatable but only 40 percent is currently under actual cultivation. It is therefore recommended that government should focus attention on land consolidation in view of the remarkable fragmented holdings. The advantages to be gained in land consolidation are many and include maximization of IFTE usage and provision of holdings that are amenable to mechanical application. In order to ensure accessibility, a ceiling on holding size should be instituted by government, and land fallow and bad crop husbandry should be taken as indications of excess land. In such cases, land should be expropriated and redistributed to less privileged farmers. This has been done in Japan, with very great success.

Biological/chemical inputs should be abundantly available to farmers. It is obvious that the private sector is better suited to the supply and distribution of crop

production inputs. Government should, however, provide the enabling environment and the regulatory framework that will make the private sector function efficiently in making agricultural inputs available to farmers at the right time and place, and at affordable prices. Adequate infrastructure should also be provided in the rural areas to ensure that private dealers are not discouraged from reaching out to the hinterlands. New feeder roads should be constructed and existing ones maintained to ensure that they are in good conditions all the year round. The availability of good roads will reduce the cost of inputs procurement and distribution.

9 High cost and non-availability of IFTE were identified as critical problems affecting the usage. To ameliorate the problem of non-availability, the R and D organizations should copy, adapt and reproduce any I.FTE imported into this country. They must not be deterred by the so-called patent rights. Many developed countries of the world used this strategy to develop their industrial base. The Government should therefore formulate a policy to indigenise any IFTE once imported. By indigenising and copying foreign designs the country can gradually expand its technical competence. Such tools must be simple and affordable and can be made readily available in villages and local markets. This implies the internalization of the production capacities for such tools within the village or local millieu. Because of the enormity of the problem and the need to alleviate the tedium and drudgery presently experienced by farmers in using traditional farm tools, farmers should identify trustworthy local blacksmiths and fabricators for training who will produce them enmasse in their communities. The cost of training such local blacksmith should be borne by the trainees.

10 Frequent breakdowns resulting in low demand was also a factor affecting the use of IFTE. The establishment of the National Centre for Agricultural Mechanization (NCAM), the Nigerian Society of Agricultural Engineers (NSAE), the Standard Organization of Nigeria (SON), the National Technical Committee on Agricultural Engineering Standards (NTCAES) and some of the equipped units of Agricultural Mechanization Programme are commendable efforts. However, to facilitate effective checking of standards, government should provide appropriate regulations concerning quality control standards and official testing centres established at National, State and Local Government levels. The lack of effective checking allows fabricators and dealers to have a field day sending in all types of equipment as the most suitable for farmers. The Federal Government should establish these centres and adequately fund them.

Because of the high frequencies of IFTE break-down, non-after sale service and the difficulties usually encountered in obtaining spare parts for effective maintenance, this study strongly recommends that as the R&Ds develop a proto-type, there is the need to consider timely provisions of adequate spare parts. The systematic development of guidelines for the encouragement of indigenous small-scale engineering establishments to specialize in the fabrication of spare parts should be the responsibility of the Government and be more vigorously pursued.

Further more, the Government pursuance of mechanized farming, must be backed by a comprehensive IFTE policy which will involve:

i. Establishment of mobile repair facilities and central repair workshops to service the equipment used by farmers, and

ii. Encouragement of private sector investment in IFTE hiring and servicing through provision of loans.

11. Research has shown that low level of education tends to foster unfavourable attitudes towards the adoption of improved farm practices. Education in this study made insignificant contribution to level of adoption of IFTE. The insignificant contribution of the level of education variable can be attributed to the generally low levels of education of the farmers. It is, therefore, recommended that since the educational levels of the farmers were generally low, government should provide a means of raising the literacy levels of the farmers. For too long the solution to this problem has been left in the hands of the Federal and State governments. The Local Government Councils (LGCs) are the closest to the farmers and should perform this role through organizing mass literacy programmes.

12. Though contact with extension made significant contribution in the regression analysis, it had a negative coefficient indicating that extension contact did not lead to IFTE adoption. This may be due to the quality of the delivery systems or apparently due to low credibility of the extension agents. It is obvious that private NGOs often provide better extension services than the government. For some time, however, IFTE dissemination have been more closely associated with governments than NGOs. Given the ever increasing commitments of the government, NGOs should be encouraged with incentives to effectively participate in implementing extension programmes that focus specifically on the

production and dissemination of IFTE. However, government should remove the bureaucratic red tape often endemic to the private and NGOs extension systems.

13. The present financial predicaments of the government call for the participation of all, in funding programmes aimed at encouraging the adoption of IFTE. In this regard, it is recommended that farmers should be made to pay a token fee to support extension activities on IFTE. The money so collected can be used to pay for such activities as air-time and allowances of village extension agents (VEAs) for visits to farmers with information on IFTE, and teachers for mass literacy programmes. It is further suggested that farmers' representatives should be part of the teams to decide the nature of the programmes.

14. This study has some theoretical implications. For example, most of the socio-economic characteristics such as farm size, extension contact, age, family labour capacity and credit were found to be significantly related to the adoption of IFTE which corroborates findings of previous studies such as those of Atala (1980), Voh (1982) and Rogers (1983).

15. There are also practical implications. The primary objective of this study was to obtain data necessary to identify the factors affecting the adoption of IFTE in Kaduna State. The factors affecting the adoption of IFTE identified in this study can be used by the extension agencies as criteria for the selection of farmers who can serve as innovators for the diffusion and dissemination of IFTE.

16. There are also methodological implications. The results of this study show that users achieved higher area under cultivation, crop yields, and higher net farm incomes than their hoe counterparts. It may be emphasized that a study such as

this, serves as a basis for replicating the inquiry in other parts of the country. Further detailed and systematic study on the effects of IFTE on labour use patterns is also important. Such information is very vital in the development of appropriate strategies for popularizing as well as providing a systematic basis for the efficient adoption of IFTE. It is further suggested that this should form a future post- graduate research. These may generate the necessary data on which a specific theory of IFTE can be built.

17. Government fiscal, monetary, trade and other macro-economic policies are very important factors in the development process. These have not been adequately explored in this study. One would wish to suggest, however, that the scope of future studies should be widened and more time allowed for in-depth studies and analyses of the role of policies on IFTE development and utilization in Nigeria as these were the major limitations of this study.

6.3: Conclusions

This study was designed to achieve four specific research objectives, all aimed at improving the adoption of IFTE and the living standard of rural people. Viewed as social change, the contention of the study was that similar factors affecting the adoption of improved practices, found in prior literature will be found for the use of IFTE. Support was found for some of the hypotheses of this study. Factors affecting the adoption of IFTE were found to be essentially those that concern the personal characteristics of the farmer, institutional factors and the attributes of the IFTE. In terms of relative magnitude, farm size and biological/chemical inputs were the most important variables in explaining variation in the level of adoption of IFTE. It was also

found that the age, farm labour, years of schooling, years of farming experience, credit, extension contact, cost, break-down and energy/skill requirement exhibited some effects on the adoption of IFTE but years of schooling and high energy/skill requirement exhibited very weak and statistically insignificant effects on the adoption of IFTE.

The implications of the study are viewed at four levels. First, there are implications for government policy planning purposes. The study suggests that government should provide amenities basic to the development and introduction of IFTE. The need for government policy makers to take certain factors into consideration when planning IFTE programme was also emphasized.

Secondly, there are theoretical implications. To some extent, the findings are similar to past studies, leading to the conclusion that certain factors affect the adoption of any new technology. From a theoretical point of view then, it means we have to understand more of these factors that affect the adoption of new technologies. In this regard, further studies should be undertaken to generate more tenable and empirically powerful hypotheses that can enable the development of theoretical models which will go a long way to improve the explanation of adoption of IFTE or adoption of improve technologies in general.

Thirdly, there are methodological implications. It was evident that certain important variables were not included and that some of the variables investigated did not relate to the dependent variables as hypothesized. Additional variables need to be included in the model in future studies. It can be concluded, therefore, that when the recommendations made are implemented, the adoption of IFTE among farmers will increase, and consequently, the living standard of small holders will improve in Nigeria.

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Appendix 1: QUESTIONNAIRE FOR FARMERS

A. BACKGROUND INFORMATION

1. Local Government Area: ----------
2. Town/Village: ----------

B. FARMER'S CHARACTERISTICS

3. Age: ----------
4. Sex: ----------
5. What is the total population of your household? ----------

---

6. Fill in the table below for your household composition.

Age groups(yrs)	No. of Male	No. of Female
< 30		
30 – 39		
40 - 49		
50 – 59		
60 and above		

7. Level of education (write the years of formal education).
   i. No. education: ----------
   ii. Quoranic education: ----------
   iii. Adult education: ----------
   iv. Secondary education: ----------
   v. Primary education: ----------
   vi. Post secondary education: ----------

8. For how many years have been farming? ----------
9. What is the total size of farm land owned by you?
   ---------- (ha)

10. What is the total size of farm land under cultivation during the last cropping season? --- ----------(ha)

11. How did you acquire your lands (e.g. inheritance, purchase, lease/rent, gift, pledge, etc).

Field	Hectarage
i.	----------
ii.	----------

iii. ----------
iv. ----------
v. ----------
vi. ----------

12. Do you belong to any voluntary organization? Yes: ---------- No:----------

13. If yes, how many of such organizations do you belongs?

_____

14. Are you a holder of any leadership position? Yes: ---------- No: ----------

15. If yes, how many leadership position (s) do you hold? ----------

C AWARENESS/USE OF IFTE

16. Which of the following IFTE are you aware?

Awareness and consistent usage

		Yes	Consistently	Not aware
i.	Ox-drawn ploughs			
ii.	Ox-drawn harrows			
iii.	Ox-drawn ridgers			
iv.	Ox-drawn weeders			
v.	Ox-drawn carts			
vi.	Jap planters			
vii.	Fertilizer applicators			
viii.	Improved hand weeders			
ix.	Treadle pumps			
x.	Sprayers.			

17. Which of these IFTE did you use on your farms in the last cropping season?

	Adoption		If yes, hours adopted
	Yes	No	
i. Ox-drawn ploughs			
ii. Ox-drawn harrows			
iii. Ox-drawn ridgers			
iv. Ox-drawn weeders			
v. Ox-drawn carts			
vi. Jap planters			
vii. Fertilizer applicators			
viii. Improved hand weeders			
ix. Treadle pumps			
x. Sprayers.			

18. Which of the following farm operations do you perform consistently with IFTE.

Operation	Yes	No	Name Equip Used (if yes)	Years Equip have been in used.
i. Land clearing				
ii. Land preparation				
iii. Planting				
iv. Fertilizers application				
v. Weeding				
vi. Irrigation				
vii. Transportation				

19. Please, indicate type of ownership of the IFTE you adopt.

IFTE.		Individual	Hired	As group
i.	Ox-drawn ploughs			
ii.	Ox-drawn harrows			
iii.	Ox-drawn ridges			
iv.	Ox-drawn weeders			
v.	Ox-drawn carts			
vi.	Jap nplanters			
vii.	Fertilizer applicator			
viii.	Improved hand weeders			
ix.	Treadle pumps			
x.	Sprayers			

20. Which of the following factors do you consider responsible for your non-adoption or discontinued adoption of the IFTE indicated in this table (multiple responses)

		Frequent break down		Non Availability		Non Availability of spare parts		High Cost		Non after sale service	
		Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
i.	Ox-drawn ploughs										
ii.	Ox-drawn harrows										
iii.	Ox-drawn ridgers										
iv.	Ox-drawn carts										
v.	Ox-drawn weeders										
vi.	Jap planters										
vii.	Fertilizer applicators										
viii.	Improved hand weeders.										
ix.	Treadle pumps										
x.	Sprayers.										

21. Please, indicate any of the following production inputs quantity used during the last season and cost.

Inputs		Quantity	Cost
i.	Improved seeds		
ii.	Insecticides		
iii.	Herbicides		
iv.	Fertilizers		
v.	Seed dressing		
vi.	Fungicides		
vii.	Other (specify)		

D. CREDIT

22. Did you borrow money for the purchase of the IFTE you are currently adopting? Yes ------ No --------
23. If yes, how much did you borrow? ----------
24. What was the source? ----------
25. Did you borrow money for the hiring of the IFTE you indicated in question 25? Yes -------- No _____---
26. If yes, how much did you borrow? ----------
27. What was the source? ----------

E. EXTENSION CONTACT

28. Did you have frequent contact with extension services last year? Yes --------- No ---------
29. If yes, give the total number of:

    i. Visits by extension agents ----------
    ii. Visits to extension agents ----------
    iii. Visits by contact farmers ----------
    iv. Visits to contact farmers : ----------
    v. Radio programs listened ----------
    vi. Television programs viewed ----------
    vii. Agricultural publications read ----------
    viii. Other (specify) ----------

30. List all your sources of information on IFTE

	IFTE.	Sources of information
i.	Ox-drawn ploughs	
ii.	Ox-drawn harrows	
iii.	Ox-drawn ridgers	
iv.	Ox-drawnweeders	
v.	Ox-drawn carts	

vi. Jap planters
vii. Fertilizer applica.
viii. Improved hand weeders
ix. Treadle pumps
x. Sprayers.

- friends/neighbours, village head, Agricultural Publications, Radio, Television, Extension workers, NGOs, sale's men, farmers' cooperative society; others.

F. CROPS GROWN, LAND CULTIVATED, YIELDS AND INCOME

31. Give the types of crops IFTE. is used.

IFTE.		Crops Grown
i.	Ox-drawn ploughs	
ii.	Ox-drawn harrows	
iii.	Ox-drawn ridgers	
iv.	Ox-drawn weeders	
v.	Ox-drawn cart	
vi.	Jap planters	
vii.	Fertilizer applicators	
viii.	Improved hand weeders	
ix.	Treadle pumps	
x.	Sprayers.	

32. Give estimated area cultivated, output, yield and income for the important crops grown in the last cropping season.

Crops/mixture	Area(ha) cultivated	*Output (100kg/bag)	Yield (kg/ha)	Estimated value (N)
i.				
ii.				
iii.				
iv.				
v.				
vi.				

- Output include crops consumed, sold, gifts and what remains.

33. In your opinion, is there a difference in the area of land you now cultivate as a result of the IFTE you have adopted? Yes ---------- No ----------

34. If yes, how?
i. Decreased.
ii. Increased.
iii. By how much percent?

35. In your assessment, is there any difference in your crops' output as a result of the IFTE you have adopted? Yes ---------- No ----------

36. If yes, how? I) decreased---------- ii) increased ---------- iii) by how much percent? ----------

37.

38. In your assessment, is there any difference in the money you now earn from the sale of crops as a result of the IFTE you have adopted? Yes ---------- No ------

39. If yes how? I) decreased ii) increased ---- iii) by how much percent? ----------

40. Indicate the livestock/fisheries you own and prices per unit if to be sold.

Livestock/fisheries/pets	Number	Unit price
Cattle		
Sheep		
Goats		
Rabbits		
Horses		
Donkeys		
Camels		
Chickens		
Swine		
Bush fowls		
Pigeons		
Ducks		
Turkeys		
Dogs		
Fishes		
Other		

41 Indicate the total annual income from sources other than farming:

42 From the following, indicate the ones you own.

Item	Quantity	Acquired price	Year acquired	Current market price per unit	Total value (₦)
1. Radio					
2. T.V set					
3. Motor-cycle					
4. Bicycle					
5. Car					
6. Fridge					
7. House					
8. Cushion chairs					

9. Traction implement 10. Calf (2 – 3 years old for traction)					

43. What suggestions would you like to give to Research Institutes that can assist in reducing the bottleneck in agriculture?

Appendix 2: RESEACH AND DEVELOPMENT INSTITUTIONS QUESTIONNAIRE

A. Background Information

1. Name of Institution/Agency:..... 2. Location:.....

3. Name of Respondent:..... 4. Rank:.....

B. Production of farm tools and equipment

1. For how long have you been researching into the development of farm tools and equipment? Equipment?
.....

2. Please, complete this table for proto types.

Farm tools and equipment ready for extension to fabricators or manufacturers	Year(s) since has been ready
i. ii. iii. iv. v. vi. vii. viii. ix. x. xi. xii.	

3. Please, complete this table for farm tools and equipment being fabricated or manufactured by your Institution/Agency.

Farm tools and equipment being fabricated or manufacture	Year(s) since started	Category of customers e.g (Govt., private, etc.	Locations of customers and users
i. ii. iii. iv.			

B. Adoption of Intermediate Farm Tools and Equipment

3. Since you started developing agricultural equipment, which of your products have been widely adopted?

Products	Years of first adoption
i. ii. iii. iv. v.	

4. What factors do you think have favoured its/their adoption?

Products	Factors favouring adoption
i. ii. iii. iv. v.	

5. Are there others that have not been widely adopted? Please list:

Products	Reasons for non-adoption
i. ii. iii. iv. v.	

6. What extension channels do you consider very appropriate for information dissemination on your innovations?

i. _____
ii. _____
iii. _____
iv. _____

7. What suggestions do you have for the general improvement of intermediate farm tools and equipment extension delivery in the country?

i. _____
ii. _____
iii. _____
iv. _____

8. What other comments/suggestions on issues covered/not covered in this questionnaire do you have? Please state in the space below:

i. _____
ii. _____
iii. _____
iv. _____

Appendix 3: ADP's QUESTIONNAIRE:

A. 1. Interviewee ..... 2) rank: ..... 3) years in service.....

B. Participation in IFTE. Extension Services

1. Has the ADP in the past participated in Extending IFTE. to Farmers?

   Yes ..... No .....

2. If yes, please indicate the IFTE extended in the past.

   .....
   .....

Type of IFTE	Source of Acquisition	Year Extension Commenced	Status
a. b. c. d. e. f. g.			

3. Please indicate the pre-dominant locations of IFTE users in Kaduna state.

Type of IFTE	Locations (L.G.As)
a. b. c. d. e.	

4. Indicate the channels of disseminating IFTE. to end-users by your organization:

   a) Personal contacts with farmers through VEWS: ----------
   b) Extension publications .....
   c) Radio/Television .....
   d) Other (specify) .....

Appendix 4: QUESTIONNAIRE FOR LOCAL FABRICATORS AND DEALERS OF IFTE.

1. Village/Town:.....
2. Name and Address:
   .....
   .....
   .....
3. Fabricator or Dealer?
   .....
4. Date established:
   .....
5. Give names and addresses of your major branches (if any):

   a) .....
   b) .....
   c) .....

6. List the IFTE. you fabricate or sell:
7.

IFTE.	Fabricates	Sales
i.		
ii.		
iii.		
iv.		
v.		
vi.		

7. Give types and total number of IFTE sold to users since established:

IFTE	Number Sold
i.	
ii.	
iii.	
iv.	
v.	
vi.	

8. List the category of customers that purchase IFTE. from your company (e.g individuals, cooperative groups, parastatals, institutions, State government, private organizations, Federal government)

.....
.....
.....
.....

9. Please, indicate the predominant locations of your customers.

IFTE.	**Location(s) L. G. As)**
i. ii. iii. Iv .v. vii.	

10. Please, indicate the problems with your business.

.....
.....
.....
.....

11. Please, indicate what you consider necessary to improved the use of IFTE by farmers.

.....
.....
.....
.....

Appendix 5: Conversion Ratios (Approximations).

A. Output of Crops (cereals and tomatoes)

1. Standard Football Field	=	1 hectare
1. Bundle of Sorghum	=	16 kilograms
1. Bundle of Millet	=	15 kilograms
1 Sack of Beans	=	100 kilograms
1 sack of Maize	=	100 kilograms
1 Sack of Groundnuts (unshelled)	=	28 kilograms
1 Sack of Rice (unhusked)	=	28 kilograms
1 Basket of Tomatoes	=	30 kilograms.

B. Output of tuber crops (yams, cassava, cocoyams, sweet potatoes and irish potatoes).

1 Headpan (Kwanun-Kaya)	=	50 kilograms
1 Wheet Barow	=	50 kilograms
1 Ox-drawn cart	=	350 kilograms
1 pick-up	=	1000 kilogram.

C. Livestock

Cattle/Horses/Donkeys/Camels

Calf	=	1 month to 1 year
Heifer	=	1 – 3 years
Cow	=	Above 3 years
Bull	=	Above 3 years

Sheep/Goats/Rabbits/Dogs

Kids	=	1 – 6 months
Adults	=	Above 6 months

Poultry (chicken, ducks, turkeys, pigeons, quail and bush fowls).

Chicks	=	1 day – 6 months
Adults	=	Above 6 months

Appendix 6: Current Market Prices

Sorghum:	100kg bag	=	N1800.00
Millet	100kg bag	=	N2400.00
Beans:	100kg bag	=	N3000.00
Maize	100kg bag	=	N2000.00
G/nut (shelled)	100 kg bag	=	N3200.00
Rice (husked):	100 kg bag	=	N5000.00
Tomatoes:	1 kilogram	=	N50.00
Tuber crops;	1 kilogram	=	N22.00

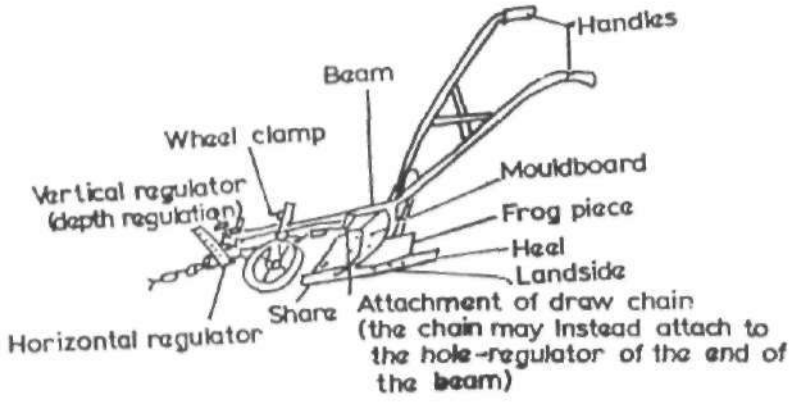
For vegetables, farmers gave information on the revenue they received for the 1996/97 cropping season.

Appendix 7: Potential Working Hours of the IFTE Per Hectare

Ox-drawn ploughing	27.8*
Ox-drawn harrowing	8.9*
Ox-drawn ridging	5.7*
Ox-drawn cart	18.9*
Ox-drawn weeder	11.3*
Ox-drawn moulding	8.6 *
Improved hand hoe	21.6 **
Jap planter	13.4**
Fertilizer applicator	15.9**
Treadle pump	384 ***

*Musa, H. L. (1996)
**Fashina, A.B. (1999)
***NAERLS (1997)

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Appendix 8: Principal parts of Mouldboard Plough.



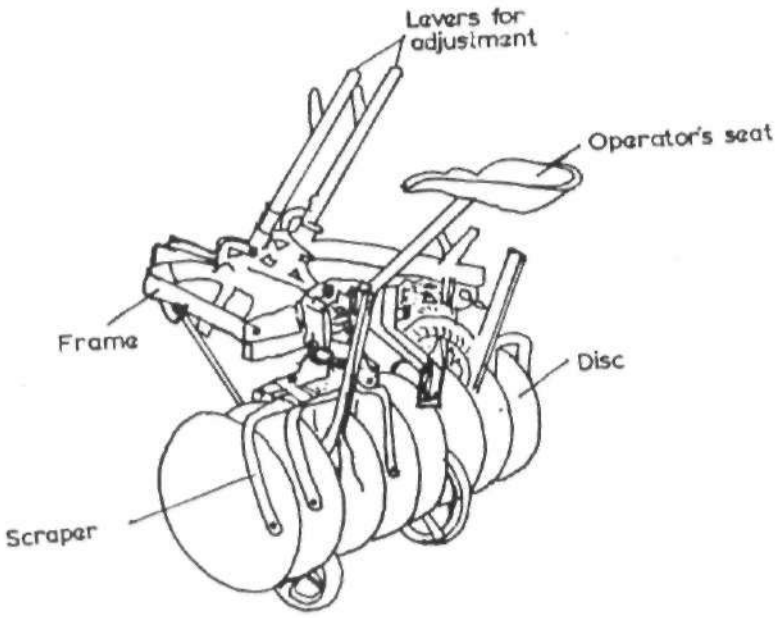
Appendix 9: Ox-drawn Plough in Operation.



Appendix 10: Ox-drawn Plough in Operation.



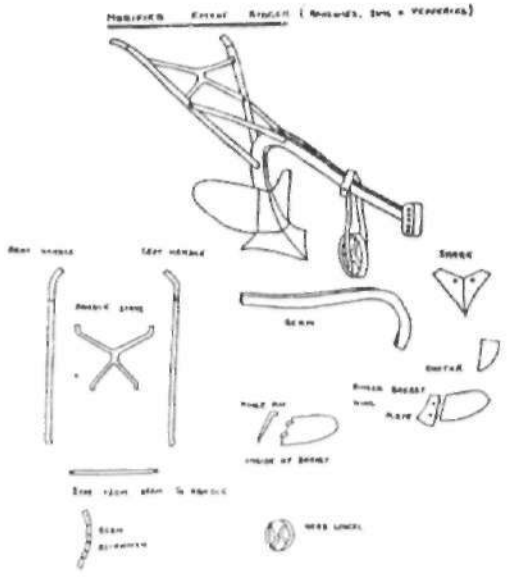
Appendix 11: Ox-drawn Plough in Operation.



Appendix 12: View of a Disc Harrow.



Appendix 13: An Ox-drawn Ridger

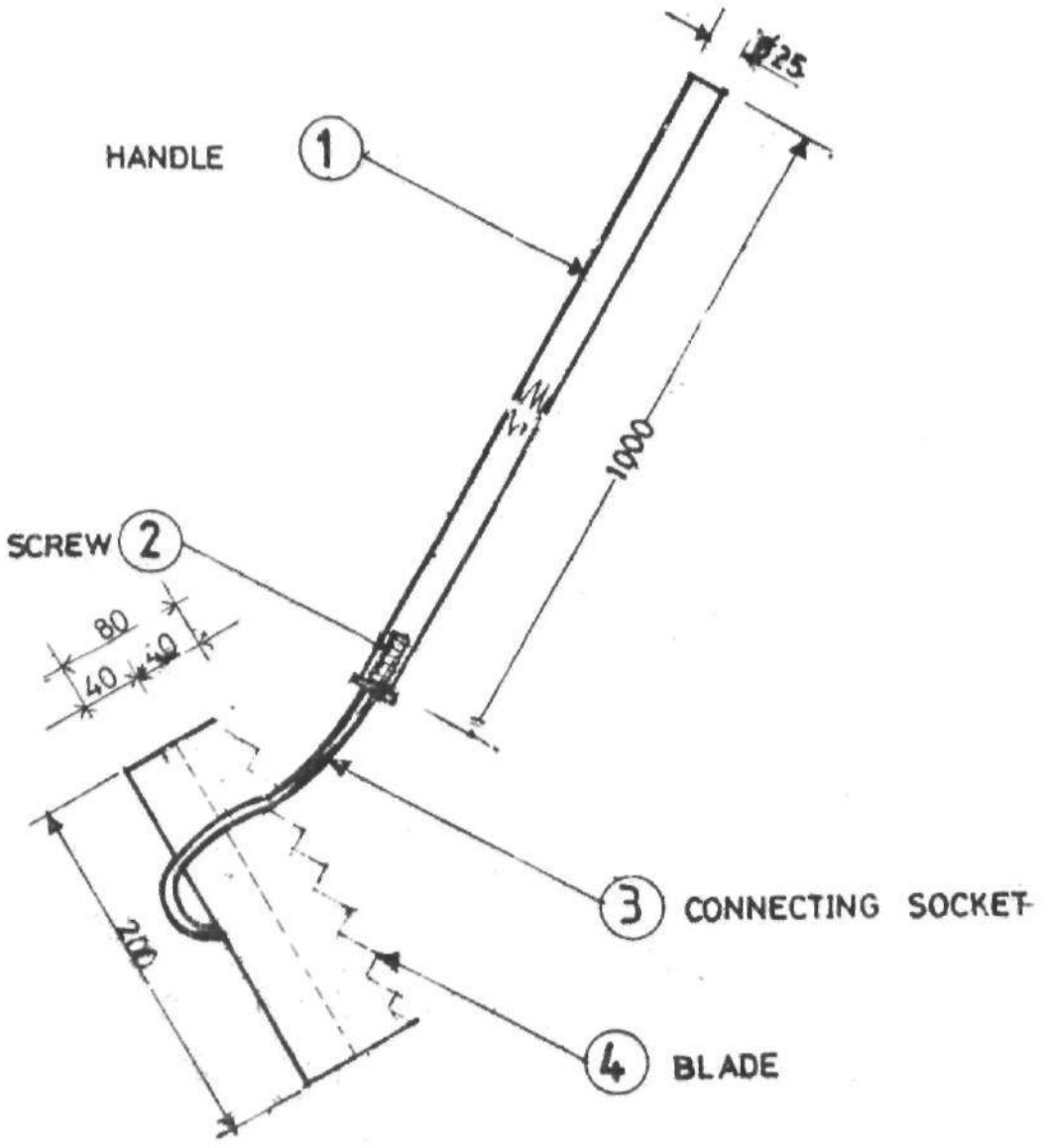


1. Right handle
2. Handle stays
3. Left handle
4. Beam
5. Share
6. Cutter
7. Ringed breast
8. Plate
9. Stay from beam to handle
10. Beam Re
11. Head wheel
12. Hinger pin
13. Inside of breast

Appendix 14: Principal Parts of Emcot Ridger.



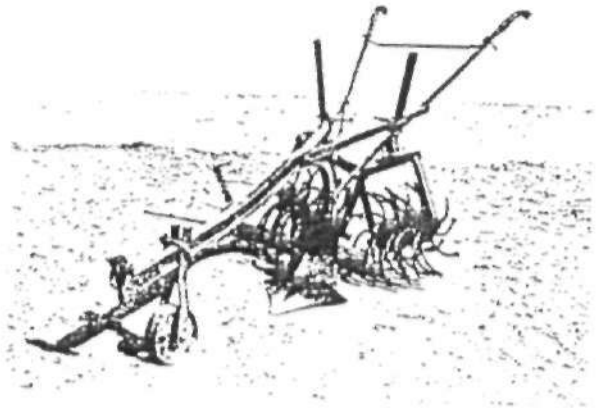
Appendix 15: An Ox-drawn Ridger in Operation.



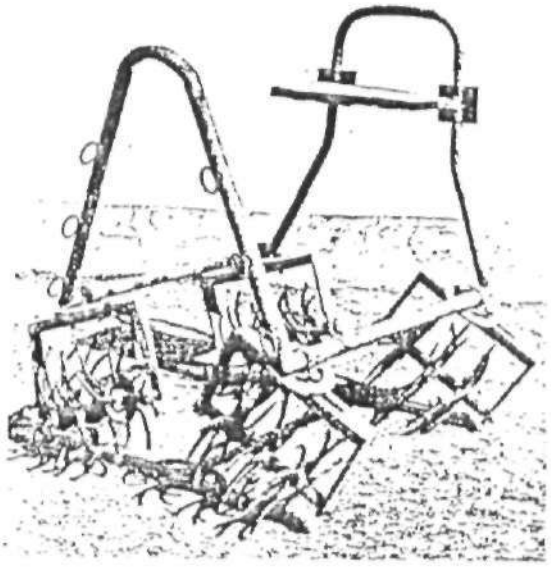
Appendix 15: Improved Hand Weeding Hoe.



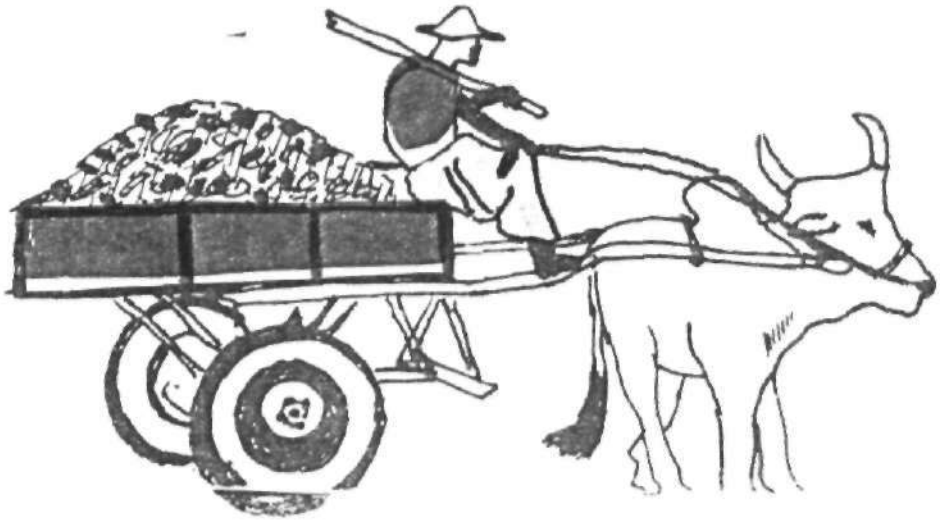
Appendix 17: Improved Hand Weeding Hoe in Operation.



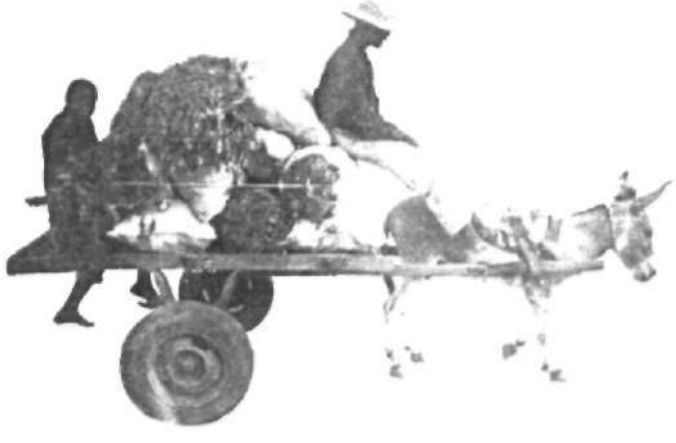
Appendix 18: Emcot-rotary Weeding Attachment



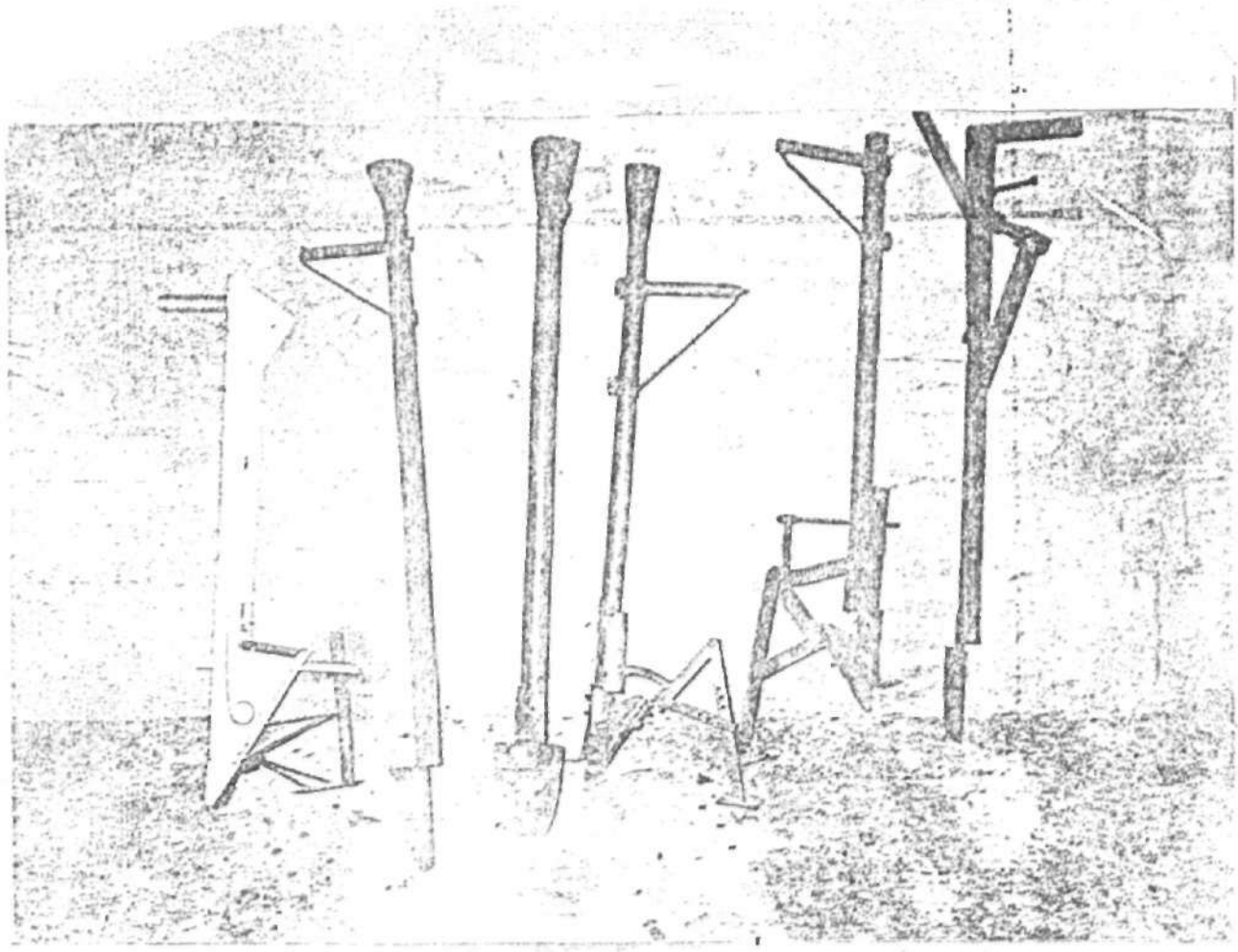
Appendix 19: IAR Straddle-row Weeder.



Appendix 20: Ox-drawn Cart Carrying Manure to the Farm.



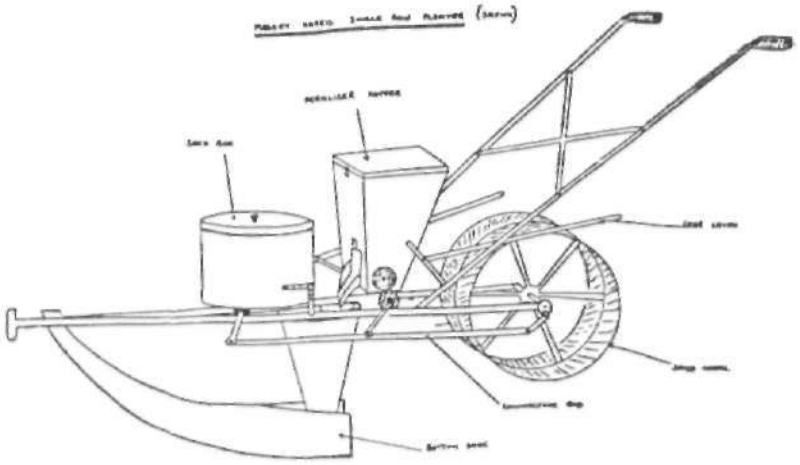
Appendix 21: Ox-drawn Cart Carrying Harvested Groundnut Home.



Appendix 22: Various Types of Hand-held Planters.

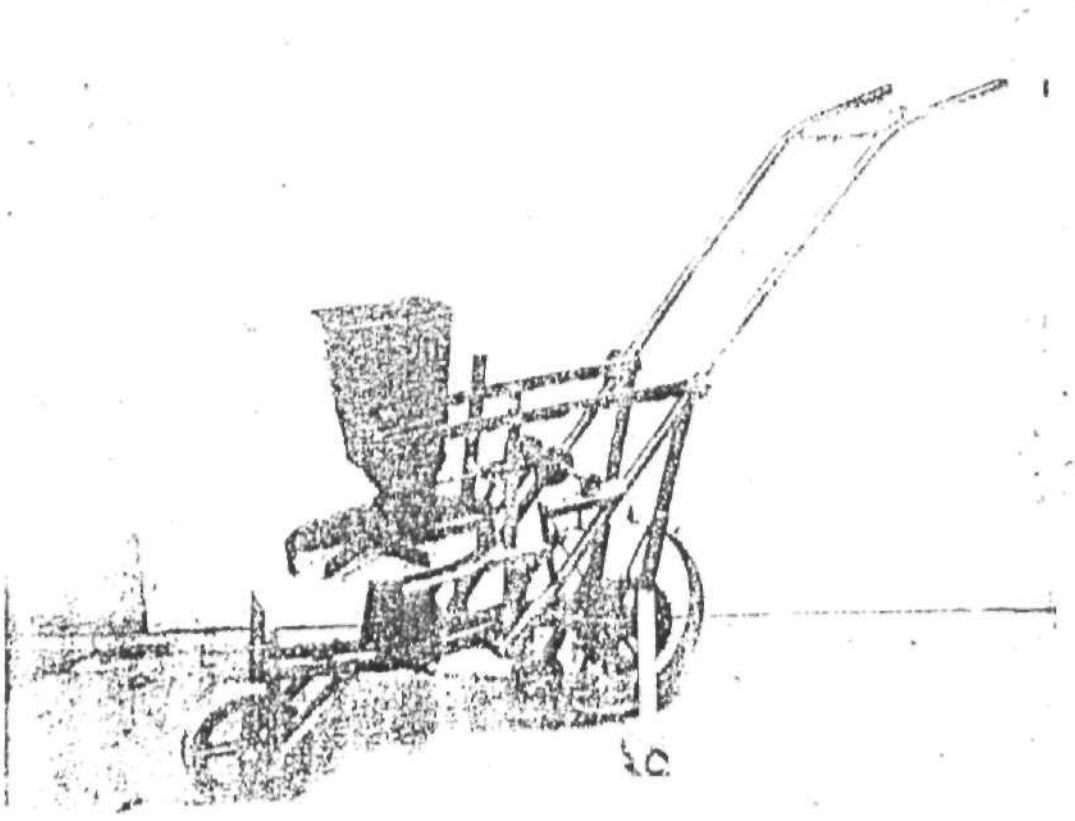


Appendix 23: Jap Planter in Operation.



1. Seed Box
2. Fertilizer Hopper
3. Bottom Shear
4. Connecting Rod
5. Wheel
6. Gear Lever
7. Massey Hamis Single Row-Planter

Appendix 24: Principal Parts of typical Planting Equipment.



Appendix 25: Fertilizer/Grain Distributor and Broadcaster.



Appendix 26: Manual Broadcaster in Mounted Position.