SOCIO-ECONOMIC ANALYSIS OF THE USE OF TUBEHELLS FOR DRY SEASON FARMING IN THE NORTHERN ZONE OF SQKOTO AGRICULTURAL AND RURAL DEVELOPMENT AUTHORITY

BY

ALIYU ABDULLAHI GADA

A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL, AHMADU BELLO UNIVERSITY, ZARIA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS

DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY,

FACULTY OF AGRICULTURE, AHMADU BELLO UNIVERSITY, ZARIA.

1994

DEDICATION

This Thesis is dedicated to Sokoto Agricultural and Rural Development Authority (SARDA) for making it a success through the consistent support offered to me during the course of the study.

DECLARATION

I hereby declare that the whole of this thesis was written by me and is a reflection of my research work except where reference is made of published literature. Such references have accordingly been acknowledged. It has also not been part of any presentation for any other qualification.

ALIYU ABDULLAHI GADA

20th August 1994
DATE

The above declaration is confirmed:

PROFESSOR O.A. OGUNBILE
Chairman, supervisory committee

20/8/94
Date

CERTIFICATION

This is to certify that this thesis titled "SOCIO- ECONOMIC ANALYSIS OF THE USE OF TUBEWELLS FOR DRY SEASON FARMING IN THE NORTHERN ZONE OF SOKOTO AGRICULTURAL AND RURAL DEVELOPMENT AUTHORITY" by Aliyu Abdullahi Gada meets the regulations governing the degree of Master of Science of Ahmadu Bello University, Zaria and is, therefore, approved for its contribution to scientific knowledge and literary presentation.

PROF. O.A. OGUNBILE
Chairman, Supervisory
Committee

DR. M.I. KOLAWOLE
Member, Supervisory
Committee

PROF. O.A. OGUNBILE
Head of Department
Department of Agricultural
Economics and Rural Sociology
Ahmadu Bello University, Zaria.

DEAN, POSTGRADUATE SCHOOL
Ahmadu Bello University,
Zaria.

2/5/97

ACKNOWLEDGEMENT

First and foremost I wish to thank the Alminghty God for giving my supporters and myself the ability to successfully support and conclude this M.Sc. programme respectively.

Accordingly, I am grateful to my major supervisor, professor O.A. Ogunbile for squeezing time out of his crowded schedules to thoroughly read through this theeis and make constructive advicee. Similarly, I must express my profound gratitude to my other supervisor, Dr. M.I Kolawole, for the interest he developed in the work and his consequent advice, assistance and guidance throughout the course of this study.

To my other lecturers and staff in the Department of Agricultural Economics and Rural Sociology, Iam very grateful. Specifically among them are Professor J.P. Voh, Dr. D.O.A. Phillip and Dr. A.D. Barau for the assistance rendered in the course of this study.

The list would be incomplete without mentioning the contributions of my colleagues in the office. Specifically, Iam thankful to Alhaji Isa Mohammed Moriki, Late Alh. Muhammad Moyi Shinkafi and Alhassan Abubakar who were infact real source of encouragement for me to go through the programme. The efforts of Alh. yusuf Agayawa, Mr. Jamundo Yohanna and Bello Abubakar at the field level of this study are greatly appreciated. Bello A. Dodo, Muhammed Liman Shinkafi, Aminu J. Guraguri, Bashiru Aliyu

and Abubakar S/Fulani produced quality work out of the manuscript and their efforts are greatly appreciated.

Finally, I must mention that I am greatly indepted to members of my family for the assistance and encouragement rendered in various ways throughout the period of my education. My ability to go through this programme has been possible only because of my parents efforts in initiating my education.

I pray the Almighty God to reward all accordingly.

TABLE OF CONTENTS

LIST OF TABLES

ABSTRACT

For areas with water problem, it is generally believed that dry season farming can increase total agricultural production and consequently agricultural productivity. Intervention in small-scale dry season irrigation farming is also known to favour the small-scale farmers scattered all over an area. However, for a meaningful government intervention to be made, the level of resource use and profitability of the small-scale irrigation farming need to be known.

This study examined the problems, profitability and level of resource use among farmers involved in dry season tubewell irrigation farming. Data for this study were collected from primary sources through personal interview. The questionaire was administered to 42 randomly selected fadama farmers from two purposively selected villages . The descriptive statistics, farm budget and regression analysis were used to determine social characteristics of the farmers, level of resource use and profitability of the irrigation farming.

The results of the study showed that majority of the small scale irrigation tubewell farmers were in the active labour force of 39 years and acquired their fadama lands basically through inheritance. It has also been established that majority of the tubewell farmers got their farm inputs from the open market at prohibitive costs — costs that were as much as three times the official prices.

The results also showed that small-scale tubewell irrigation is profitable. A per-hectare net income analysis showed an average of N18848.88 to have been obtained by the farmers, similarly, the higher net income of N30563 was obtained by the farmers from a hectare of garlic/pepper combination while the lowest net income of =N=4502 was obtained from garlie/onion/pepper/tomatoe/wheat/spinnach combination.

A per farmer net income analysis showed an average of N32,600.14 to have been obtained by the farmers as net income with a range of net income of N8,861 - N12,1702. This high profitability level of the tubewell farming must be responsible for the involvement of the active labour force in the venture.

Accordingly, the study found out that expenditures on all inputs, except chemicals, significantly influenced revenue positively. In other words, the net income could be increased through increasing use of the inputs.

It has also been discovered that capital constraints greatly affected the use of tubewell in dry season irrigation because of the initial investment required for acquiring the tubewells and water pumps.

CHAPTER ONE

INTRODUCTION

1.1 State of Nigerian agriculture and the need for irrigation.

The Nigerian economy, like those of most of the developing countries in the World, is basically agricultural. Agrculture provides the bulk of the employment, income and food for the rapidly growing population as well as raw materials for agro-based industries and feeds for livestock (Yayock, 1990). During colonial period, agricultural production, though oriented towards cash crops production, witnessed a boost. It was the largest generator of national income, government revenue and foreign exchange, contributing about 65 percent of the Gorss National Product (GDP) and employing about 70 percent of the total labour force in the country (Olukosi, 1984). Later, the relative contribution of agriculture to the GDP declined, especially after the discovery and commencement of exploration of mineral oil. The contribution of agriculture to the GDP declined from 43.4 percent in 1966/67 to 31.6 percent in 1971/72 and marginally increased to less than 20% between 1980 and 1985 (Anual abstract of statistics, 1985).

The marginal increases in agricultural production being obtained in recent times have not kept pace with increases in demand resulting from rapid population growth, urbanisation and rising per capita income. Because of the presence of oil revenue and the apparent problem of food deficit, a strategy of large scale food importation was adopted during the second republic. However, this gave rise to high preference for imported food items. Conssequently,

the food import bills for the country continued to escalate since it was not easy to remove food imports once they were established (Floyd, 1984). As contained in Table 1, between 1979 and 1983, the cost of food imports more than trippled. This led to the ban on importation of some food commodities in 1985.

Table 1: *Cost of food imports into Nigeria (million naira)*

Year	Cost of food and animals (N million)
1979	766.50
1980	109.00
1981	1506.80
1982	23366.00
1983	3100.00

Source: Central bank of Nigeria, annual report (1985)
*A. * 1 Naira = $0.65 (1984 conversion rate)*

Similarly, the acceleration of inflation which began around 1974 continued unabated. As can be seen in Table 2, with 1975 as the base year, the consumer price index rose from 185.7 in 1979 to as much as 1146.8 in 1989. This shows about six fold increase in price between 1979 and 1989. Thus, Erhabor (1980) identified a number of factors necessitating the need for improving the food production in the country. The factors included the increasing population vis - a - vis declining food production and the ban on imported food crops. Others were the widening gap between the demand and supply of food crops and the need for self sufficiency in the basic food crops.

Table 2: *Nigeria's food price index*

Year	Index
1977	146.0
1978	171.9
1979	185.7
1980	199.9
1981	250.2
1982	272.4
1983	335.6
1984	479.7
1985	498.5
1986	499.2
1987	541.9
1988	824.7
1989	1146.8

1975 = 100%

Source: Central Bank of Nigeria: Economic and financial reviews Vol 21 No. 3 of September, 1983 and Vol 28, No. 2 of June, 1990.

Agricultural development in Nigeria has been a long struggle for modernisation, establishment and reforms of various organisations with the hope of dramatically improving the welfare of the rural farmers (Yazidu, 1983). Three phases have been identified in the history of agricultural development in Nigeria. The first phase (1893-1959) was the period of foundation of research and infrastructure for development by colonial administration. The second phase (1960 - 1970) was the period of political independence and the expansion of extension efforts. The third phase was the period of concerted efforts to be self sufficient in food production.

From independence to date, various programmes and projects have been conceived, designed and executed for the purpose of achieving self sufficiency in food production. All the programmes are manifestations of the need for

concerted efforts in various aspects of agriculture for the attainment of self sufficiency in food production to meet the domestic need for food by the ever - increasing population, conserve the scarce foreign exchange and provide raw materials for the agro-based industries. All of them emphasized the need for the farmer to substitute the traditional inputs with modern ones like high yielding crop varieties and animal species, fertilizers, agricultural chemicals and improved agronomic practices.

All the efforts were in one way or another constrained by the uncertainties of nature, especially the amount, distribution and seasonality of rainfall. The need for the development of water resources for irrigation and the effect of drought on agricullttural production, though recognised, were taken for granted untill the early seventies when the sahelian drought and the devastation that resulted from it acted as pointers to the government to seek for a way to alleviate this constraint imposed on the agricultutal sector of the economy (Adedzwa, 1987).

Irrigation plays a crucial role in agricultural production especially in countries with some form of water problem as is the case in certain parts of Nigeria. Bagi (1981) noted that in a country with two distinct cropping seasons (wet and dry), irrigation primarily reduces the uncertainty in crop production and consequently increases agricultural productivity by first increasing crop yields even without any increase in the use of other agricutural inputs. Secondly, by lowering risks and uncertainty in crop production, it is likely to encourage greater use of inputs. In the arid and semi arid regions, irrigation, when

properly used and controlled, is considered as one of the essential factors in the war against hunger.

Irrigation makes it possible to grow crops all year round and hence can increase the cropping intensity, and could make cultivation of better quality and high valued crops feasible (Abdullahi and Philip, 1989; Ahmed and Philip, 1988). Irrigation is also found to play very important role in increasing agricultural production by bringing into profitable cultivation vast land areas that would otherwise be unsuitable or only marginally productive (Tyson, 1971). Luning (1968) showed the distributions of yields and revenue to be skewed in favour of farmers with access to irrigation facilities.

The role that irrigation can play in improving the food production situation in the country can not, therefore, be denied. In recognition of this fact, most of the Agricultural development Projects (ADPs) in the country are involved in the contruction and improvement of smalll-scale irrigation facilities thereby encouraging dry season farming. Therefore, a research into its conduct is worthwhile especially in the present time when concerted efforts are being made towards improving food production.

1.2 *Problem statement*

Exploitation of water resource potential of a country for irrigated agriculture can be through large-scale approach, like the river basin development method as has been adopted in Nigeria and elswere in the world. It can also be accomplished through the development of small-scale irrigation facilities like the use of simple water lifting

devices, tubewells, open wells, etc.

A number of problems have been found to be associated with the large-scale approach to irrigation development. According to Otten and Rentlinger (1969) its cost often exceeds forecast levels, implementation of construction and settlement works take longer than anticipated and levels of output are mostly below those predicted. Dams have their specific problems. Salinity and water logging have been identified to be the major threat to irrigated agriculture (Ahmed, 1986). Other problems of the large scale irrigation facilities are their highly localized nature and bureacratic arrangements which are unfavourable to the widely scattered small-scale subsistence farmers.

Consequently, the development of small-scale irrigation facilities is receiving attention in the country. Erhabor (1990) noted that improvement of yield, farmer's income and contribution of agriculture to the Gross Domestic Products (GDP) could be accomplished through the improvement of the existing cultural and agronomic practices and by the encouragement of production of dry season grains and vegetables through the development and strenthening of irrigation facilities particularly for small-scale farmers. Furthermore, it is known that there exist in the country farmers who are participating in irrigation activities through the use of pumps, shadoof and tubewells. They only require some assistance through policy intervention that can make farmer-managed irrigation possible and material inputs available and affordable.

The Sokoto Agricultural and Rural development Authority (SARDA) is involved in the development of small-scale

irrigation system in Sokoto State. Resources are committed by the authority in some cases in form of subsidies for drilling tubewells for fadama farmers, supply of material inputs, pumps and agricultural extension activities in an effort to promote dry season farming and consequently improve farmers income and social welfare. The degree of effectiveness to which this arrangement is working is however not clearly known. It is therefore, necessary to know (i) the effects of of certain inputs on the fadama farmers income, (ii) the problems being encountered by the farmers, (iii) sources of inputs, (iv) profitability or otherwise of the small-scale tubewell irrigation and some social characteristics of the users of the small-scale irrigation facilities.

1.3 *Objectives of the study*

The broad objective of the study is to make a socio-economic analysis of SARDA's tubewell programme in dry season crops production under the tubewell programme of the Sokoto Agricultural and Rural Development Authority.

The specific objectives are:

i) To examine the socio-economic characteristics of the users of tubewell for dry season farming.

ii) To identify the sources of seasonal inputs for this category of farmers.

iii) To determine private returns to the farmer for using tubewell technology in dry season farming.

iv) To assess the relationship between cost of imputs and revenue.

v) To identify the problems associated with the use of tubewell in dry season farming.

vi) To draw policy implications and make appropriate recommendations.

1.4 *Justification for the study*

As a result of the recent high interest in the use of small-scale irrigation facilities for dry season farming in the country and as a strategy for developing small-scale irrigation in Sokoto State, SARDA began drilling of shallow tubewells in 1984 in suitable fadama areas in the state for fermers at subsidized rate. As much as 15,000 hactares were targeted to be covered by this activity of SARDA (Rajakuty, 1989). By 1991, as much as 6280 tubewells have been drilled for fadama farmers in the state (SARDA, 1992). Furthermore, the National Fadama Development Programme (NFDP) which is also a World Bank assisted programme is about to commence through some Agricultural Development Projects (ADPs) in the country (SARDA inclusive). The programme has the main objective of developing small-scale irrigation and the necessary fadama infrastructures (World Bank Mission, 1991).

Based on world bank projections, the use of tubewells in dry season farming was shown to be profitable in Sokoto state (Karam Sighn, 1989). However, since the inception of the tubewell programme in 1984, there has never been a study on its socio-economic elements. For successful irrigation development, it is important to keep track of how effectively resources are employed by farmers in production; what the main problems encountered in the programme are; what improvements are necesary to guard against low production; and availability of inputs to the farmers.

In line with this, therefore, this study was conceived for the purpose of examining the profitability, the relationship between costs and revenue and the problems of using tubewells for dry season farming under the tubewell programme of the Sokoto Agricultural and Rural Development Authority.

CHAPTER TWO

LITERATURE REVIEW

2.1 *Definition and purpose of irrigation*

According to Israelsen (1962) irrigation is defined as the application of water to soil for the purpose of supplying the moisture essential for plant growth. Winstoe (1920) on the other hand defined irrigation as the apllication of water to lands for the purpose of producing large and steady crop yields whenever the rainfall is imsufficient to meet the full water requirements of crops. It may be noted that the definitions point to the fact that irrigated agriculture is given emphasis in areas with shortage of rainfall (arid and semi arid areas) though it has now started gaining ground even in the humid areas.

The application of water to soil serves the purpose of supplying the moisture essential for plant growth; providing crop insurance against short duration drought; cooling the soil and atmosphere, thereby making the environment more favourable for plant growth. It also serves the purpose of washing out or diluting salt in the soil, reducing the hazard of soil piping and softening tillage pans.

A number of methods are used for water application in irrigation. It may be by flooding in different ways; or in furrows which can be large or small; or by applying the water underneath the land surface by sub-irrigation and thus causing the ground water to rise. It can also be done by sprinkling the land surface. The type of irrigation method used is determined by a number of factors which include the

quantity of water available for irrigation, the capital outlay, soil properties and the level of technology (windstoe, 1920).

2.2 *The Nigerian enviroment and the need for irrigation*

Nigeria is a country with two distinct cropping seasons (wet and dry seasons). The lengths of both the wet and dry seasons vary between the two distinct climatic regions in the country. The southern part which consists mainly of tropical areas has up to about five (5) months of little or no rain. The rainfall in this region has a bi-modal distribution having peaks in June and August with a dip in September. The northern part of the country encompassess the aird and semi - arid areas. Most of the parts in this section of the country have more than seven (7) months of little or no rain. The season in the northern apart is categorised into the cool/dry season from October to February; the hot/dry season from March to May; and the warm rainy season from June to September (Nwa, 1980).

Consequent upon the climatic differences between and within the two regions of the country, great variations exist in the amount and distribution of rainfall received in any wet season. For instance, between 1934 and 1963 the average amount of rainfall received in the extreme northern part was 508 mm while in the extreme southern part it was over 2286 mm (Balogun, 1972). Furthermore, between 1988 and 1990 the average amount of rainfall recieved in the extreme northern part was 552.66mm while it was 2471.66mm in the extreme southern part (Federal Ministry of Civil Aviation, 1990). The same record showed an average of 37 rainy days for the northern extreme and 157 for its southern counter

part. Details on the annual rainfall and rainy days in each of the former 21 states and Abuja are contained in Table 3.

Furthermore, the water potential of any area can be measured by the overall quantities of ground and surface water for they represent the most utilisable form of water in the hydrologic cycle. The annual surface water in Nigeria was estimated at about 193 x 10 M (N.E.D.E.C.O, 1959). However, not much is known about the quantity of ground water in the country. Both the surface and ground water in the country are subject to great regional and seasonal variations due to variations in climatic factors as earlier on highlighted.

The above shows some form of water problem in the country and thus the need for irrigation to make agricultural production a year-round business. The problem of seasonality of rainfall and consequently crop production is execerbated by the occurrence of drought. Drought can be defined as a period of abnormal rainfall distribution pattern with the result that normal vegetation growth is retarded because of insufficient amount of rainfall (Adeoye, 1986).

Table 3: Average annual rainfall and rainy days by states, 1989 - 1990

Year	1988		1989		1990	
State	Rainfall (mm)	Rainy days	Rainfall (mm)	Rainy days	Rainfall (mm)	Rainy days
Akwa Ibon	2239	158	1630	106	2252	159
Anambra	1731	130	1759	125	2154	132
Bauchi	921	76	909	65	880	67
Bendel	2328	162	2220	145	2859	152
Benue	841	77	1244	74	1011	66
Borno	661	42	562	43	435	35
Cross River	2027	160	2166	150	2588	165
Gongola	1077	75	886	68	1047	83
Imo	2037	114	1724	108	2235	121
Kaduna	1188	81	832	26	1022	92
Kano	1046	58	700	44	566	44
Katsina	664	52	N.A	N.A	744	41
Kwara	1279	69	1293	89	1080	98
Lagos	2061	110	1522	96	1848	100
Niger	1116	93	1170	98	1101	101
Ogun	1619	127	1405	121	1406	110
Ondo	1623	118	1530	105	1502	115
Oyo	1265	102	1242	101	1197	109
Plateau	1237	113	1211	110	1230	102
Rivers	2336	161	1969	144	2262	162
Sokoto	846	34	719	59	718	58
Abuja	1217	108	1227	91	1400	114

Source: Federal Office of Statistics. 1990 annual report.

In some instances drought is used to denote famine though famine is the end result of chain reactions like widespread crop failure, shortage of drinking water etc. Wide spread crop failures that were experienced in the country in the early seventies were attributed to end of season drought resulting from early ceasation of rains. Drought day probabilities calculated for over a period of 56 years in Nigeria indicated that such end of season drought may be expected in four out of 10 years (Adeoye, 1986). Furthermore, it has been observed that in the last 30 years, drought has assumed an alarming frequency throughout the savanna zone of Nigeria and the development of large-scale irrigation is only a part of the solution to the problem (Owonubi, 1978).

In terms of both the physical and human resources, Nigeria is blessed. These resources can be harnessed to improve agricultural production. The human population in the country has been estimated at about 88 million in 1991. However, the population is unevenly distributed. Just like human resources, Nigeria is blessed with vast land area. The total land area is estimated to be 98.3 million hectares out of which 72.2 million hectares or 73.4 percent is cultivable (FMFED, 1975). Accessibility and availability of land, however, differ among states. The difference is wide between the states in the north and those in the south. The difference in land accessibility is the direct result of the difference in climatic factors like rainfall distribution which influence vegetation growth, making the vegetation thicker in the south.

2.3 *Water resources development in Nigeria - an overview*

The work of water resources development in Nigeria started indirectly in 1709 when a water level gauge was erected at Jebba in connection with the planned railway bridge across the Niger river. This was followed in 1914 by gauges along the Niger at Baro, Lokoja, Idah and Onisha, and along river Benue at Yola, Ibi and Makurdi (NEDECO, 1959).

The first recorded survey of irrigation potential in Nigeria has been traced back to the early 1900's when a military engineer by name colonel Colins undertook work in the Sokoto - Rima and Zamfara valley systems. In 1918 the first attempt to impound water was made and was destroyed by floods in 1928. In 1925 work on canalisation and flood protection by bunding was carried out on shella stream and by 1927, 243 hectares had been developed for perennial irrigation. In addition to the problems that resulted from conflicts between farmers and government objectives on the scheme, later in 1946 this scheme was also flooded (Sighn and Maurya, 1979).

In 1947, the first irrigation division in Nigeria was established in the Ministry of Agriculture of the Northern region of the country. Small-scale irrigation schemes were given priority under the arrangement. In 1957, the division established hydrological stations and orgnised in - field training services (FAO, 1965).

Two reports commissioned by the Federal Government of Nigeria viz: the FAO report (1965) which delt with the perspectives of agricultural development in Nigeria up to 1980, and a report of the study group on irrigation and

drainage are said to be the major catalysts in water resources and irrigation development plan for the country. The federal ministry of water resources which was responsible for irrigation development in Nigeria was established during the period. This resulted into the establishment of large-scale irrigation projects in the country in the name of River Basins Development Authorities (RBDAS).

2.4 *River basin development and irrigated Agriculture in Nigeria*

The case for adopting river basins as planning units has been long established both in the developed and developing countries (Clapp, 1965; Faniran, 1972). Forinstance, the Tennesse Valley Authority (T.V.A.) initiated in the united states of America in 1933 is considered as the first of the modern River Basin Development Authorities (Haxley, 1945). Since then, a number of river valley authorities patterned after the T.V.A have been set up in different parts of the world. An example is the India's experiment with the T.V.A. model (Hamilton, 1969). Other similar attempts were the Domador valley corporation and the ancient development in the Nile valley and in the valley of Tigris.

In Nigeria, although it has long been recognised that the agricultural potential cannot be effectively exploited without the development of the water resources, serious development of the river basins was initaited only in the third national development plan of 1975 - 80 as earlier on mentioned. Thus, Nigerian experience with the river basin development authority which started with the Niger delta development board was set up by the Federal Government in

1960. The board was to prepare plans for the economic and physical development of Delta area. As a result of various studies and activities in the various basins, the Federal Government established two river basins development authorities namely Chad Basin Development Authority and the Sokoto Rima- River Basin Development Authority all in 1973. They were established by decrees number 32 and 33 respectively. In 1976, the river basin development authorities were increased to 11 through decrees number 25 and 37 of 15th June and 3rd August respectively. The mandate states and total proposed area for each of the river basin development authorities are contained in Table 4.

Table 4: *The river basin development authorities (RBDAs) in Nigeria.*

S/No.	RBDA	Mandate States	Area proposed (hectares)
1.	Anambra-Imo	Anambra & Imo	5000
2.	Benin-Owena	Bendel	N.A
3.	Chad-Basin	Borno	157,000
4.	Cross-River	Cross River	724,000
5.	Hadeja-Jama'are	Kano & Bauchi	75,000
6.	Lower Benue	Benue & Plateau	130,750
7.	Niger Delta	Rivers	2,500
8.	Niger River	Kwara & Niger	243,200
9.	Ogun-Oshun	Lagos, Oyo & Ogun	242,300
10.	Sokoto-Rima	Kaduna & SOkoto	108,800
11.	Upper Benue	Bauch & Gongola	309,700
	Total		1,998,250

Source: Irrigation development in Nigeria: Fourth Afro-Asian regional conference of ICID, held in Lagos, Jan. 9 - 14, 1982.

Specifically, the RBDAS were mandated to: (1) construct and maintain dams, dykes, wells, boreholes, and Irrigation and drainage channels; (2) develop iriigation schemes for the production of crops and livestock; (3) lease the developed land to farmers or recognised associations in the locality of the area concerned; (4) develop fisheries; (5) process crops and livestock; (6) resettle persons affected by their works and schemes; (7) develop land for mechanised cultivation of crops including forestry, and (8) establish ranches for cattle and other species of livestock and process livestock for consumption (Okafor, 1985). The RBDAs also showed direct responsibility for aquisition and distribution of agricultural inputs and farming loans; provision of extension services; marketing arrangements; and tractor hire services and machinery maintenance (Abdullahi and Philip, 1990). To perform these functions, the river basins spent a collosal sum of 2.1 billion naira between 1979 and 1983. The details of the disbursement to each of the RBDAs are shown in table 5.

Table 5: *Monetary allocations to the RBDAs (1979 - 1983)*

N'000

S/N	RBDA	1979	1980	1981	1982	1983	Total
1.	Anambra-Imo	5005	9550	4800	35282	20470	75107
2.	Benin-Owena	3200	3000	41400	20772	20449	88821
3.	Chad-Basin	60810	86450	80660	36667	32011	296598
4.	Cross-River	5250	3620	25000	12237	14524	60631
5.	Hadeja-Jama'are	40200	28000	70000	64878	83733	286811
6.	Lower Benue	8970	5625	45000	20330	22398	102323
7.	Niger Delta	4000	12000	28000	13867	18795	76662
8.	Niger River	4190	3100	55000	22596	46230	131116
9.	Ogun-Oshun	4700	51520	60000	38523	27853	182596
10.	Sokoto-Rima	5900	246000	116000	127278	102393	597571
11.	Upper Benue	7290	5390	51000	37419	37419	138518
Total		149515	454255	576860	429849	426227	2036754

Source: Federal ministry of water resources, 1984.

Despite these huge sums of money made available to the RBDAs, the impact of their food production efforts has not been felt. A number of problems and limitations have been identified to be responsible for the failure of the river basin development authorities. As enumerated by Abdullahi et al (1989), the problems and limitations include the following:

i) the pace of land development for irrigation was too slow for any serious hope to be placed on this large-scale approach to solve Nigerias food and raw materials problem. For instance, only 25,754 hectares of land were developed by

1988, four years after the establishement of the RBDAs, a figure which is insignificant when compared with the proposed area to be developed.

ii) being highly capital intensive and considering the dwindling economic fortunes of the country, there is doubt in the ability of the country to sustain the large scale irrigated agriculture.

iii) the number of farmers benefiting directly from the river basin development authorities is considerably low. This is because the large scale irrigation projects are higly location specific, a feature which is at variance with the widely scattered nature of the rural farmers in Nigeria. Furthermore, any attempt to imporve the farmer/project ratio in the context of large-scale approach may prove financially and logistically prohibitive;

iv) even though the activities of the RBDAs seem to be broadly consistent with the intergrated approach to rural development, they appeared to have directly participated in too many activities, so much that their primary role of developing and managing water resources simply became one of the objectives to be met. This made their efforts and recources to be too thinned out for any results to be achieved.

Okafor (1985) identified other problems of the RBDAs to include excessive centralisation of operations, and the attitudes and behaviour of management. Centralization of operations involves bureaucratic processes and delays in action which combine to favour the absentee influential farmers at the expense of small scale ones. Some times farmers ended up leaving the land fallow. For example, in

the Kano River Irrigation Project, only 820 hectares of irrigated land was actually planted in 1980 out of the target figure of 16,400ha. The authority failed to allocate the fallow land to the small farmers because the units of land they demanded and could handle were smaller what the authority had decided should be allocated to each farmers (Wallace, 1982). With regard to attitude and behavior of management, it was argued that the overall cost of irrigation, which is usually escalated by consultants, middle men and politicians, is out of tune with the size of irrigated land and output. For example. the lower Benue irrigation project committed 45 million naira to irrigating a 5000 - hectare rice farm, an expenditure which could not be justified interms of the additional agricultural yield produced. The bulk of this money was believed to have been spent on expensive office buildings, houses and cars for the river basin bureaucrats and not directly on providing food (Okafor, 1985).

In view of the problems and limitations of the large-scale approach to irrigation development in the country, the strategy has been described as inappropriate for covering Nigeria small-scale farmers. It has been recomended that RBDAs restrict their activities, and that government should begin to invest more on the acquisition of simple irrigation technologies which are relatively mobile so that they could be taken closer to a larger number of farmers (Abdullahi et al, 1989).

2.5 *Fadama farming in Sokoto state.*

Sokoto State is blessed with vast fadama land. There are about 206,500, hectares of fadama land in the state-that is the seasonally inundated flood plains spread across the state under the Sokoto rima river basin (SARDA, LUP 1987). As such there is vast recharge of underground shallow water which can be tapped for use during the dry season. Details on local government area wise fadama land distribution are shown in Table 6. However, crop production in the fadama has traditionally depended on rainfal in the wet season and on residual moisture after flood recession in the dry season. In areas with easily accesible shollow grounwater or surface water, traditional water lifting devices, such as shadoof and calabash are used to lift water on to the land. While such devices are low-cost and depend mostly on farmer's labour for construction and operation, their irrigation potential is limited to small plots. In areas with the large scale irrigation facilities, the farmers use such facilities. With the advent of SARDA, the low cost tubewell drilling and use of water pumps were introducted into the fadama farming areas. The main crops grown during the dry season are onion, garlic, pepper, tomato, wheat and some green leafy vegetables.

2.6 *Description of an irrigation tubewell*

An irrigation tubewell is a pipe with strainers inserted in a hole bored to a depth of 10 to 15 metres. Centrifugal water pump draws the water through suction pipe delivering 250 to 1,500 litres of clean water per minute. Because of

the shallow placement of water basin of acquifer, the fadamas are very suitable for boring with simple percussion system and low cost equipment. The rotary mechanical rigs could also be used to expedite drilling. Annex 1 is a sketch of the tubewll.

Table 6: *Local government area-wise distribution of fadama in Sokoto State*

Zone	LGA	Area Ha.
Northern Zone:		
	Sokoto	15,400
	Wurno	44,000
	Gwadabawa	18,000
	Silame	21,600
	Isa	50,800
Sub total		149,800
Eastern Zone:		
	Gusau	1,500
	Anka	6,000
	Kaura Namoda	800
	Talata Mafara	13,000
Sub total		21,300
Central Zone		
	Bodinga	3,600
	Yabo	6,400
	Gummi	25,400
Sub total		35,400
Grand total		206500

Source: Land Use Planning Unit, SARDA, Sokoto

The total area includes both riverine and basin fadamas.

2.7 *Some studies on the economics of irrigation*

This section is a review of some of the studies conducted on the social and economic elements of irrigation in Nigeria and elswhere in the World.

In a study in India, Bagi (1981) found that though irrigation farms underutilize other inputs, except labour, they had higher technical efficiency. He employed the use of Cobb-Douglas production function in its log linear form for the analysis. It was argued that the increased profits can enable farmers to purchase larger quantities of imputs to inprove economic efficeincy of resource use. Also, it is noted that irrigation increases the labour absorption capability of the agricultural sector in a country whose industrial sector is generating the demand for labour at rather slow rate.

In another study on the economic impact of increased water supply on small irrigated farms in Iran, Sadeghi (1967) found that the production function shifted upwards, indicating an increase in productivity coefficients and value of land per farm and more intensive use of seeds and especially chemical fertilizers are possible.

Moorti (1971) compared the use of private and state tubewells in India. He found private tubewells to have yielded higher benefits than state tubewells because of factors like greater reliability and timeliness of irrigation. The extremely high capital cost which caused them to be expanded to a size that would spread cost was identified to be the major source of unreliability of state tubewells.

In an analysis of the costs and benefits of the pump and shadoof systems of irrigation in Nigeria, Nwa (1981) found that for the pump system, irrigation labour accounted for 15 percent of the total production cost. In the case of the shadoof system of irrigation, labour accounted for 30 percent while labour inputs accounted for 88 percent of the total production cost. Similarly, he arrived at N2,886.00 as the annual cost of producing one hectare of tomato with pump while that of the shadoof system was N2,801.00. However, the yield obtained from the field irrigated with the shadoof (77 tonnes/ha) was much higher than that obtained from the field irrigated with pump (46 tonne/ha). The difference was, however, attributed to difference in the fertility of the fields. The analysis showed that the shadoof system was more profitable for the size of farms studied. He used the farm budget technique in his study. In a related study, Orewa (1978) showed that the income was greater for pump irrigated farms than for shadoof irrigated farms.

In a study of the efficiency and profitability of water use in large-scale irrigation in the country, Ahmed (1986) employed the use of regression analysis for the study. He discovered that all the elasticities of production with respect to the individual inputs were less than unity, indicating that they were inelastic. He found water and labour, unlike fertilizer and seed, being inefficiently utilized because of their negative elasticities.

Erhabor (1990) through the use of gross margin analysis found wheat production under irrigation to be profitable. He found a four-year average of N3,733.23 to have been obtained from one hectare of wheat in kano during the 1981/82,

1982/83, 1983/84 and 1984/85 dry seasons under local market conditions. In another study of efficiency of resource use under small-scale irrigation in the country in 1982, he found the returns to irrigation farming with the shadoof and pump irrigation technology to be quite high. He thus concluded that the benefits from promoting these small-scale lift devices are worthy of consideration by policy makers interested in increasing agricultural output. The analytical framework used for the study was the linear programming model.

The farm budget and the regression analysis which were the major analytical techniques adopted by the majority of the researchers in determining the net farm income in irrigated farming was used in this study to determine private return and level of resource use in dry season farming through the use of tubwell under SARDA's fadama development programme.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Study area.

This study was conducted in the northern Zone of the sokoto state Agricultural and Rural Development Authority (SARDA) -a body responsible for the promotion of small-scale tubewell dry season farming in the state. SARDA was established in 1982 as a follow up to the enclave Gusau Agricultural Development Project (GADP) that was successfully implemented between 1975 to 1981. It had four administrative Zones namely: Central, Eastern, Northern and Western Zones with their respective headquarters at Gummi, Bunza, Wurno and Gusau, with its main administrastive headquarters at sokoto. However, with the creation of Kebbi State in 1991, the western zone formed the nucleus of Kebbi State Agricultural and Rural Development Authority (KARDA). Annex II is the administrative map of SARDA before creation of KARDA showing the two villages in which this study was conducted. The Northern zone was selected for the study because since the tubwell programme was launched in 1984, there has never been a study on the economics of using tubwell in the area. Also, a major portion of the fadama land in the state is in the area. When the programme was launched, it was declared profitable by the world bank based on yield projections estimated to accrue from the project activities, the attianment of which was dependent upon a number of assumptions made in the project design (Sighn, 1985). The zone has the major proportion of fadama farmers when compared with the other two zones. Annex III is

a map showing the fadama land distribution in the zone.

The Northern zone of SARDA consists of 14 local government areas namely: Wurno, Gada, Gwadabawa, Silame, Goronyo, Zurmi, Illela, Sokoto, Binji, Wamako, Isa, Sabon Birni, Tangaza and Rabah. The area share common borders with Katsina State and Niger Republic.

The annual raifall in the area is monomodal. The average annual amount of rainnfall from 1984 - 1991 is 452mm. Rains usually get established in the months of May or June in the zone and ends in October and sometimes in September. Table 7 shows the distribution of rains and rainy days according to months from 1984 - 1991. The main dry season crops grown in the area according to importance i.e number of farmers cultivating the crops are garlic, onion, peppers and tomato. Some of the farmers grow potato but on a very small scale.

TABLE 7: Rainfall distribution in northern zone

Month	YEARS 1984	1985	1986	1987	1988	1989	1990	1991
Jan.	-	-	-	-	-	-	-	-
Feb	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-
April	0.25 (1)	7 (2)	0.8 (1)	2.7 (2)	4.5 (1)	-	0.4 (1)	5.4 (1)
May	15 (2)	8.3 (2)	4.9 (1)	23.4 (2)	1.6 (1)	8.1 (2)	19 (2)	63 (4)
June	65.4 (4)	49.5 (4)	29.2 (2)	22.1 (3)	55.8 (4)	61.2 (5)	43 (3)	81.4 (4)
July	57.9 (6)	85.9 (8)	171.1 (9)	65.9 (6)	125.9 (6)	102.4 (7)	208.2 (9)	133.3 (9)
August	54.9 (4)	188.3 (11)	125.3 (10)	145.9 (7)	269.9 (12)	190.2 (10)	116.3 (7)	197.2 (10)
Sept.	83.1 (7)	94.4 (6)	118.6 (9)	54.6 (4)	119.9 (7)	61.9 (5)	40.8 (3)	63.5 (5)
Oct.	4.9 (1)	- -	14.6 (2)	1 (1)	- -	12.4 (1)	3.7 (1)	22.1 (2)
Nov.	-	-	-	-	-	-	-	-
Dec.	-	-	-	-	-	-	-	-
Total	281.5 (25)	432.2 (33)	464 (34)	313.5 (25)	577.6 (31)	436.2 (30)	431.2 (26)	565.9 (35)

Figure in brackets are rainy days.

Source: SARDA, Planning, Monitoring and Evaluation Unit.

3.2 ***Sampling procedure***

Villages where tubewells are predominantly used for dry season farming in the zone were purposively selected. The villages selected are Gidan Modi and Kwargaba. This enable the identification of farmers who used tubewell because tubewell users were not found in all areas in the zone. There were a total of about 97 tubewell farmers in kwargaba and 87 in Gidan modi. A total of 42 dry season farmers who used tubewell were then randomly selected from the selected two villages. The random selection of the farmers from the two villages was done in a stratified manner. That is the list of the farmers in each of the villages was treated separately. Twenty seven (27) of the farmers were in Gidan Modi while 15 were in Kwargaba.

The questionnaires were administered for the 1991/92 dry season period which commenced in November, 1991 and ended in May, 1992.

3.3 ***Data collection***

A structured questionnaire was administered to each of the selected 42 dry season farmers by the researcher with the help of some enumerators of SARDA during the month of May, 1992 which was the harvest period to obtain information on inputs used during the various dry season farming operations. The data collected in this respect was on cost of fertilizer used, seeds, chemicals, labour, fuel, depreciation, pump and tubewell, source of inputs, repairs to the tubewell or pump, or cost of hiring pump, revenue and places where the crops were sold. Similarly, information was sought concerining the socio-economic characteristics of the

dry season farming tubewell - users. Information gathered included source of labour, farm size, eduational level, mode of ownership of tubewell and pump, and age of the farmer.

3.4 *Analytical techniques.*

Simple descriptive statistics, the farm budget analysis and the production function analysis were the analytical tools used in this study.

Descriptive statistics like mean and percentages were used to describe charasteristic such as age of the farmers, educational level and method of land ownership. They were also used to describe the general tubewell dry season farm size distribution and source of inputs. This was done to achieve objectives one and two of the study.

The farm income model is one of the simplest and oldest tools of analysis used in farm management and production economics studies (Olayemi and Oni, 1971; Orewa, 1978). It is used in economic studies for analysing the profitability of farm production practices. Objective three was achieved through determining the net farm income of the farmers by using the farm income model. The use of the model leads to computation of total cost and total revenue for a given production period. The difference between the the total cost and total revenue provides a measure of the net farm income or the financial return to the farmer for the use of his recources in the production process. The net farm income is considered as the surplus resulting from a business operation which could be withdrawn without reducing the future scale of the business (Olukosi and Ernabor, 1988).

In this study, the model was used to determine the costs, returns and profitability or otherwise of the use of

tubewell in dry season crops production. Through this, objective III was achieved.

The model can be stated as follows:

NFI = TR - TVC - TFC

Where,

NFI = Net Farm Income (N)

TR = Total Revenue (N) which is given by the product of total output and its unit price.

TVC = Total Variable Cost (N). This is given by the sum of the products of the quantities of the variable inputs and their respective prices.

TFC = (Total Fixed Costs). These are costs that do not vary with output in the short run. In the case under consideration, they included depreciation on the tubewelll and the pump set and the interest on the money cost of capital items.

The apparent limitations of this model are that it can not be used to define how optimum returns can be obtained from limited resources and that it is useful only if the production inputs and outputs can precisely be valued in monetary terms. However, the costs and returns in dry season farming through the use of tubewell have precise measures and prices.

The production function analysis.

The production function describes the rate at which inputs are transformed into outputs in any production scheme and there are numerous input-output relationships in agriculture because the rate at which inputs are transformed into outputs varies among soil types, animals, technologies, rainfall amounts and so forth (Olayide and Heady, 1982: Doll

and Orazem, 1984).

To achieve objective IV of this study, the data gathered was fitted into a multiple regression model. Some cost elements identified from a priori knowledge of the basic inputs were used as explanatory variables while the value of output was used as the dependent variable. The production function is presented as follows:-

$$Y = B_o + B_1 X_1 + B_2 X_2 + B_3 X_3 + B_4 X_4 + B_5 X_5 + B_6 X_6 + U_o$$

Where Y = Total value of output. (Revenue)

X_1 = Cost of labour for Irrigation and other farm operations

X_2 = Cost of seeds

X_3 = Value of land involved in the production process

X_4 = Cost of fertilizer

X_5 = Charges for the maintenance and repairs on tubewell and pump set or cost of hiring pump.

X_6 = Cost of chemicals.

B_1 to B_6 = Regression coefficients to be estimated

B_o = Intercept, term

U = Stochastic or Random disturbance term.

The criteria used for selecting the function with best fit were the coefficient of multiple determination ($\hat{R}$) and the F-value which measures the significance of the coefficient.

The regression coefficients of the independent variables (cost of inputs) were interpreted as the indicators of the nature relationship between the cost of inputs and revenue. The t-values of the coefficients were also used to describe the significance of each of the cost element in influencing revenue.

3.5 *Operational definition of the variables.*

i) *Total value of output:* This was arrived at by asking the respondent the units of harvest of the output and the number of units harvested to get the total farm output. The total farm output was multiplied by the unit price at which the produce was sold to get the total value of output.

ii) *Cost of labour:* This was arrived at by summing the labour cost incurred for the various farm operations as given by the farmer, family labour inclusive. The family labour cost was determined by asking respondents to estimate proportion of work done by the family.

iii) *Cost of seeds/planting materials:* This was obtained by determining the cost of nursery operation or finding the total cost of seedlings for planting and gap filling for all crops planted in the farm.

iv) *Cost of fertilizer:* This was camputed as the average number of bags used multiplied by the average cost per bag of the fertilizer to the farmer.

v) *Charges for the use of tubewell and pumpset.*

These included depreciation, maintainance and repairs on tubewell and pumpset and/or cost of hiring water pump.

Depreciation charges for the tubewell and pumpset were taken as the average price paid by the farmers for each of the two divided by their respective average life span (Years). A zero salvage value was assumed in this case.

$$\text{Despreciation: } = \frac{Pj}{nj} \quad j = 1, 2, \ldots\ldots\ldots n.$$

Where Pj = Cost of tubewell, the pumpset or any other implement

nj = Expected life of either the tubewell, or the pumpset.

The tubewells and pumps are the only two capital items used. The depreciation for each of the two was divided into two since they are used twice in a dry season.

vi) *Value of land:* This was considered as what the farmer paid for the land or what it would cost him to hire a similar piece of land if it were not his own.

vii) *Age:* This may be defined as the number of years of the farmer from birth. This was taken as the age given by the respondent at the time of the study.

viii) *Household Size:* This was taken as the number of people that eat from the same pot in the family. The family is defined as a kingship group linked by blood and marrige and occupying a common residence.

ix) *Level of literacy:* For the purpose of this study, it was defined as the ability of the farmer to read and write in Hausa, Arabic or English or a combination of some or both.

x) *Source of Inputs:* This was considered as the place where the farmer purchased his inputs.

xi) ***Level of resource use:*** A farmer, like any other businessman who wants his business to survive, has to be mindful of costs of inputs and prices of his outputs. Therefore, a choice indicator based on the assumption of profit maximisation from an enterprise is used in this study to assess the relationship between the cost of inputs used and revenue earned by the farmers. In this case, the farmer will continue to increase the amount of a variable input used in the production process as long as the addition to revenue exceeds the addition to cost. When added returns equal added cost, the optimum is attained.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Socio-Economic characteristics of the tubewell farmers.

4.1.1 Age characteristics of the tubewell farmers

The contribution of a particular segment of a labour force is determined by the age distribution of the individuals in the force. According to this survey, majority of the tubewell farmers are between 30 - 49 years. In fact about 78.6 percent of the farmers interviewed fell within that age group. Table 8 shows the age distribution of the respondents. The average age of the farmers is 39 years. This clearly shows that majority of the tubewell users are within the group of the active labour force contrary to other findings that as a result of the rural - urban migration, the active labour force tend to migrate to the cities in search of higher paying work opportunities. This further shows that the tubewell dry season farming, where available, is holding the members of the active labour force in their respective villages.

Table 8: *Distribution of the 42 tubewell farmers by age categories*

Age group (Yrs)	No. of Resp.	Percentage of Resp.
1. 1 - 39	3	7.1
2. 30 - 39	15	35.7
3. 40 - 49	18	42.9
4. 50 - 59	5	11.9
5. 60	1	2.4
Total	42	100

Average age = 39 years
Standard deviation = 8.4 years

It is important to highlight that women were not found to use tubewells in the area because of the initial investment required for acquiring tubewell and water pump which is substantially high and the pudah system being practised in the area.

4.1.2 *Family characteristics*

The family charactristics specifically looked at in this study are number of wives and number of children per farmer. About 50.25 percent of the respondents had one wife while 40.5 and 7.1 percent had two and three wives respectively. Only 1.4 percent of the farmers were polygamous.

Accordingly, 40.5 percent of the farmers had between 6 - 10 children and 26.2 percent had 3 - 5 children. This confirms the traditional belief among the rural family that security lies in a large number of children who can help with farm work and also take care of the parents at their old age. Also, about 26.2 percent had 2 or less number of children. Table 9 shows the family size characteristics of the farmers.

Table 9: *Family size characteristics of the farmers.*

Family Size	Proportion of respondents %
1. No. of Wives	
0	1.4
1.	50
2.	41.5
3	7.1
Total =	100
2. No. of Children	
1 - 2	26.2
3 - 5	26.2
6 - 9	40.5
10 -15	7.7
Total =	100

Average number of wives = 1.7 wives

Standard Deviation = 0.64 wife

Average number of children = 5.1 children

Standard Deviation = 3.6 children

4.1.3 *Source of inputs*

The fundamental inputs of the tubewell dry season farming are labour, land, pumps, tubewells, fertilizer and agricultural chemicals. The level of productivity and production of the farmers is determined by the availability and level at which the inputs are used. Of the basic material inputs used in the tubewell dry-season crops production, 100 percent of the farmers sampled used hired labour and fertilizer, 80 percent used pesticides (mainly Garmalin 20) for the control of pests which the farmers complained to have caused a lot of damage to their crops.

Two basic sources of fertilizer and agro-chemicals were identified during the survey. The sources are the Sokoto Agricultural and Rural Development Authority (SARDA) which sold the materials at government subsidized prices of N40.00

per bag (50kg) and the open market in which a bag of compound fertilizer sold at about N120 during the season under review. According to the results of the study, 26.2 percent of the farmers sampled obtained their fertilizer from SARDA while 23.8 percent bought it from the open market and 50 percent bought it from SARDA and open market for they could not get sufficient quantities of the input from SARDA. The farmers were found to have applied an average of 206.2kg of NPK, Urea, Calcium ammonium nitrate (CAN) and super phosphiate fertilizers in various combinations per acre of the dry season farms. For agricultural chemicals, majority of the sampled farmers (77.8 percent) bought the chemicals from the open market while 5.6 percent got them from both sources. Table 10 shows the proportion of farmers that obtained the inputs from the various sources during the dry season. All the farmers interviewed used family labour in the farm operations. On the average about 50 percent of work was done by family labour.

Table 10: *Distribution of farmers by sources of inputs during the 1991/92 dry season*

Source of Input	Proportion of Farmers (%)	
	Fertilizer	Agrochemeical
1. SARDA	26.2	16.7
2. Open Market	23.8	77.7
3. SARDA & Open Market	50	5.6
Total	100	100

4.1.4 *Land ownership and farm size distribution among the 42 sampled farmers: 1991/92.*

Land is one of the important physical assets that is owned by all the respondents in the study area. It is in fact an important factor in determining the participation in farming and the level of production of the dry season farmers.

The farmers in the selected area were found to have acquired the land for the dry season tubewell farming through two methods which are private ownership and leasing. The farmers acquired the land as personal property either through direct purcahse or inheritance. Some of the farmers acquired the land through direct purchase and leasing at the same time. In Table 11, 57.1 percent of the farmers acquired their land through direct purchase or inheritance, while 14.3 percent of the farmers leased the land. About 28.6 percent acquired the land through the two methods. The average cost of hiring one hactare of fadama land with tubewell in the study area during the season under study was N1993.02 (farm produce gift included) The average dry season farm holding of the sampled farmers in the study area during the 1991/92 dry season period was 1.7 hectares.

Table 11: *Distribution of the 42 sampled farmers according to method of land ownership, 1991/92*

Ownership Type	Proportion of Farners (%)
1. Private Property	57.1
2. Hiring/Leasing	14.3
3. Private & hiring	28.6
Total	100

Table 12 shows the distribution of the sampled farmers according to farm size. It can be observed from the table that majority (54.8 percent) of the farmers had between 1 to 2 hectares.

Table 12: *Distribution of sampled farmers according to cultivated farm size categories in the 1991/92 dry season*

Farm size Category (ha)	Number of farmers	Proportion (%)
0.01 - 1	8	19.0
1.01 - 2	23	54.8
2.01 - 3	9	21.4
3.01 - 4	2	4.8
Total	42	100

Average farm size = 4.2 acres
Standard deviation = 2.1 acres

An analysis of the number of plots owned by the 42 farmers shows that 71.5 percent of the plots were private possessions while 28.6 percent were rented. Similarly, a major portion of the rented fadama plots fell between 0.01-1 hectare while a major proportion of the privately owned plots fell between 0.01-2 hectares. Details are contained in table 13.

Table 13: Distribution of plots according to size and type of ownership.

Farm size Cagetory (ha)	Private Properly No.	%	Hiring/ Leasing No.	%
0.01-1	20	28.6	14	20.0
1.01-2	21	30.0	6	8.6
2.01-3	6	8.6	-	-
3.01-4	3	4.3	-	-
Total	50	71.5	20	28.6

4.1.5 *Literacy Level of the farmers using tubewell*

The acquisition of western education is expected to enable a farmer be aware of modern and improved agricultural technology from research and extension organisations, which he can adopt to improve his productivity. Through this, he is able to produce enough food for his family consumption and also meet other social obligations.

About 50 percent of the sampled farmers did not attend any formal school.

Table 14 shows the distribution of educational attainment of the farmers. It is, however, interesting to note that 100 percent of the sampled farmers can read and write in arabic. Thus the possibility of writing extension publications in "Ajami" need to be explored besides the use of the conventional methods.

Table 14: *Distribution of literacy level among the 42 selected tubewell irrigation farmers 1991/92.*

Educational level	Proportion of farmers	
	No	%
1. Secondary Education	1	2.4
2. Primary Education	7	16.7
3. Adult Education	5	11.9
4. Quoranic (Arabic) Edc.	42	100

4.2 *Economics of tubewell irrigation*

4.2.1 *Introduction:*

Inputs used in the tubewell dry season farming included seeds, agro-chemicals, fertilizer, fuel and lubricants, jute bags, labour and land.

The farm income model was employed in arriving at the net farm income of one hectare farm enterprise of the tubewell farmers and also according to enterprises.
About 100 percent of the sampled farmers grew garlic while 85.7 percent grew onions. Also 47.6 percent grew peppers and about 14.3 percent grew tomatoes. Some others grew spinnach, wheat and garden egg.

4.2.2 ***Results of the per hectare net farm income analysis***

The costs of production are divided into variable and fixed costs. Table 15 shows that 39.5 percent of the total revenue derivable from a one-hectare farm enterprise in the area was spent as variable costs while 8.4 percent was spent as fixed costs. Accordingly 52.1 percent of the total revenue was the net farm income of the farmers. With a total per- hectare production cost of N17,700.76 and a per hectare net farm income of N19,266.09 as computed in the table, the average return per naira invested per hectare is N1.09.

Table 15: *Cost and returns in tubewell irrigation farming per hectare during the 1991/92 dry season*

Item		Value (N)
1. Total Revenue (N)	=	36,966.85
Variable Costs (N)		
2. Labour	=	4,365.31
3. Seeds/Seedlings	=	3,813.36
4. Agrochemicals	=	255.62
5. Fertilizer (at N120/50kg bag)	=	1,237.39
6. Fuel & Lubricants	=	1,001.55
7. Repairs to Pump & Tubewell	=	714.93
8. Transportation	=	646.02
9. Packaging	=	2,571.52
10. Total Variable cost	=	14,605.69
Fixed Costs (N)		
11. Land Value (one hectare)	=	1,993.02
12. Depreciation	=	
Pump (5yr life span)/2	=	296.36
Tubewell (15 yrs life Span)/2	=	77.83
13. Interest on Capital Investments:		
Pump	=	390.86
Tubewell	=	337
14. Total fixed cost	=	3,095.07
Income (N)		
15. Gross margin (1 - 10)	=	22,361.16
16. Net Income (15-14)	=	19,266.09

It should, however, be noted that because the tubewells and the pumps were used twice during the dry season half their costs were attributed to one production exercise as this analysis is for only one production period. Also, 27 percent was used as the cost of capital during the season as it was the prevailing interest rate as at then.

4.2.2.1 *Variable costs*

4.2.2.1.1 *Labour:*

Labour for the farm operations did not constitute any problem for these farmers, for about half of the farm work was done through the use of family labour and half was hired and demand for labour in the villages was at its lower level since all wet season farm operations had been completed. About N40.00 was paid per manday for hired labour. Labour cost in table 15 included family labour. From the table it can be seen that labour accounted for 29.9 percent of the variable costs.

4.2.2.1.2 *Seeds/Seedlings*

The use of improved seeds is one of the indicators of shift from the traditional to modern agriculture. One of the pre-occupations of SARDA was the delivery of improved seeds to farmers. However, in this study it was discovered that the main source of the seeds used by the dry season farmers was from the farmers previous years harvest. Through discussion with officials of the authority, it was gathered that this revelation was correct and was due to the fact that more emphasis was given by SARDA extension activities to seeds of upland crops. As mentioned earlier the main crops cultivated are garlic, onion, tomato, pepper and some green leafy vegetables as very minor crops. The average cost of a bag of garlic seeds at harvest was N850, while a bag of onion cost about N620.00. For peppers the average cost was N180.00 per bag. From table 15, it can be seen that the cost of seeds/seedlings acounted for about 26.1 percent of the variable cost and 21.5 percent of the total cost of

production.

4.2.2.1.3 *Agricultural chemicals*

One of the fundamental requirements for the production of irrigated crops especially the ones cultivated in the area is the use of agricultural chemicals for the control of pests and diseases. About 85 percent of the farmers interviewed used pesticides for the control of pests and diseases like the garlic leaf curl which the farmers indicated to be reducing yield of their crops greatly. To be specific, majority of the farmers used gamalin - 20 either because it was the only chemical known to them for that purpose or it was the only one they readily had access to. Majority of the farmers got the chemicals from the open market. Through an established Farmers Agricultural Supply Company, and the training and visit system of extension, SARDA promotes the use of both improved seeds and agrochemicals.

From the table also, it can be observed that the cost of agro-chemicals is 0.7 percent of the total revenue derivable from one hectare, 1.4 percent of the total cost of production and 1.8 percent of the variable cost.

4.2.2.1.4 *Fertilizer*

Fertilizer is one of the most improtant inputs for the dry season farmers in the locality. It is important in the sense that it is one of the major production constraints to the farmers. Though some of the farmers interviewed got the fertilizer they used from the government agencies at the subsidized rate of N40.00 per 50kg - bag excluding travelling expenses, majortity of them got it at a very high rate of about N120.00 per bag. None of the farmers

interviewed got all fertilizer required for dry season farming from government agencies at subsidised rates during the season under review. In table 15, a price of N120 per 50kg-bag of a compound fertilizer was used since majority of the farmers paid that much for the commodity during the 1991/92 dry season. Thus, about N1237.39 was spent on fertilizer for irrigating one hectare of the crops. The cost of fettilizer accounted for about 8.5 percent of the variable cost and 7 percent of the total cost of production.

4.2.2.1.5 *Fuel and lubricants*

To be able to run the pump and maintain it for a relatively longer period, fuel and lubricants are purchased and used by the farmers. The quantity used of each of the items depends on the size of land irrigated and the condition of the pump. An average of N1,001.55 was spent per hectare for fuel and lubricants. This was 6.8 percent of the variable cost.

4.2.2.1.6 *Others*

Other variable costs in the venture include repairs of the pumps and tubewells, cost of jute bags and baskets and transporting of the produce to the market. An average of N714.93 was spent for repairs to pump and tubewell while N646.02 was spent on transport. Among the various items constituting the variable cost, empty bags and baskets are third, more than the cost of fertilizer. The cost of the bags accounted for 17.6 percent of the variable cost and 14.5 percent of the total cost of production. This is because of the fact that the bags in which garlic was taken to the market cost about N50 per 100kg - bag.

It can be observed that the total variable cost was N14605.69 while the total fixed cost was N3095.07. Thus 82.5 percent of the total cost of production was variable while 17.5 percent was fixed. The fixed costs here are mainly for land, depreciation and interest on capital investments.

4.2.2.2 *Fixed costs*

4.2.2.2.1 *Land*

Land is an important physical agricultural asset possessed by the farmers in the area. Majority of the farmers using the tubewellls were direct owners of the plots they cultivated though some of them leased other parcels of land in addition. Consequently, in the net farm income table, cost of land was taken as a fixed cost in the sense that whether it was used or not, the value was foregone at that point in time. The average cost of leasing one hectare fadama land with tubewell was N1993.02 as given by the farmers. This cost consists of the amount of money given to the land lord and the produce gift usually given to the land lord also after harvest. Not all farmers possess fadama land thus the high cost of leasing fadama land. From the table developed, 11.2 percent of the total cost of production is attributed to land.

4.2.2.2.2 *Depreciation and interest on capital investments*

Depreciation and cost of money used in acquiring the capital items have been taken into consideration. Zero salvage value was assumed for the pump and tubewell after their presumed life span. Similarly, the 15-year life span assumed for the tubewell could be an underestimation for as at the time of this study, the first tubewell drilled in the

area in 1984 was still perfectly functioning. In fact some of the World bank officials that visited SARDA from Punjab, the source of the technology, expressed the opinion that the life span could be up to 20 years.

From table 15, it can be observed that N374.2 was the depreciation cost of pump and tubewell, while N727.9, comprising interest on capital invested for tubewell and water pump, was the cost of capital investments during the production exercise. The average cost of tubewell was N23349 with a range of N200.00 - N4000.00. Similarly the average cost of water pump was N2963.2 with a range of N250.00 - N4000.00.

4.2.3 *Farmer level net farm income analysis*

4.2.3.1 *Revenue and cost per farmer*

In this part the actual revenue generation capacity of the farmers through the dry season farming business was assessed. It can be observed from table 16 that the average revenue per farmer was N58,897.33 with a gross margin of N37,002.74 and a net farm income of N32,600.14. With the total cost of production of N26,297.18 and a net income of N32,600.14 per hectare, the return per naira invested is N1.24. This is quite a big return.

Table 16: *Cost and returns in tubewells irrigation farming per farmer during 1991/92 dry season*

Item	Value (N)
1. Total Revenue (N)	= 58,897.33
Variable Cost (N)	
2. Labour	= 6,269.05
3. Seeds/Seedlings	= 5,517.14
4. Agrochemicals	= 324.88
5. Fertilizer	= 2,091.43
6. Fuel/Lubricants	= 1,475.09
7. Repairs	= 186.79
8. Transportation	= 1,029.02
9. Empty bags/baskets	= 4,201.88
10.Total variable cots	= 2,1895.28
Fixed cost (N)	
11. Land value	= 3,036.90
12. Depreciation	
-Pump	= 379.29
-Tubewell	= 96.00
13. Interest on Capital Investments.	
-Pump	= 511.93
-Tubewell	= 377.79
14. Total Fixed cost	= 4,401.90
Income (N)	
15. Gross Margin	= 37,002.04
16. Net Income	= 3,2600.14

Similarly, N26,297.18 was the average cost of production amongst the farmers with N21,895.28 as variable cost and N4,401.91 fixed cost.

4.2.3.2 *Variability of the cost and revenue elements among the 42 farmers.*

Cost

The variability of costs and net revenue among the 42 farmers was assessed by using the range and coefficient of variation. As contained in table 17, the highest variable cost was N102,280.00 and the lowest was N6050.00 with a

coefficient of variation of 127.2. For the fixed cost the range was N1,181 - N9,039 with a coefficient of variation of 52.2.

Net revenue

The variability of the net revenue shows the variability in profitability of the business among the farmers. Amongst the 42 farmers the range of the net -income is N8861 - N121,702.00 with a coefficient of variation of 172.1.

Land, Pumps and Tubewells

The scale of operation of the farmers and thus the level of recurrent and fixed costs was determined by the size of the land the farmers cultivated and the number of pumps and tubewells used by the farmers.

The smallest farm size of the farmers was 0.4 hectares cultivated by about 9.5 percent of the farmers while the biggest farm size was 4 hectares cultivated by only 1 respondent amongst the 42 farmers. The distribution of the farm size amongst the 42 farmers has been given earlier own.

For tubewells, the maximum number per farmer was three (3). About 9.5 percent of the 42 farmers owned that much number of tubewells. In the case of pumps, the maximum number owned per farmer was also three (3) with only one (1) farmer having that number. Table 17 shows the variability of the various components of the net farm income table for the farmers as developed earlier on. It may be observed that there exist a very wide variation in costs, revenue and net income among the farmers. A number of factors might have contributed to this wide variation. Among them are the crop enterprises grown, level of material resource use, land quality and scale of operation.

Table 17: *Variability of the cost and revenue elements among the 42 farmers during the 1991/92 dry season.*

Cost/Revenue element	Range	Coefficient of variation
1. Total Revenue (N)	9,238 - 182,000	211.8
Variable Cost (N)		
2. Labour	1,200 - 30,000	73.9
3. Seeds/Seedlings	300 - 15.000	63.1
4. Agrochemicals	0 - 1,500	16.8
5. Fertilizer	240 - 6,000	37.7
6. Fuel/Lubricants	74 - 4.000	35.1
7. Repairs	0 - 3,300	28.8
8. Transportation	170 - 8,500	33.1
9. Empty bags/baskets	850 - 9,150	71.0
10.Total variable sots	6,050 -102,280	127.2
Fixed cost (N)		
11. Land value	700 - 10,000	45.2
12. Depreciation		
-Pump	40 - 900	16.2
-Tubewell	5 - 300	8.1
13. Interest on Capital Investments.		
-Pump	54 - 1,215	18.9
-Tubewell	19 - 1,215	16.3
14. Total Fixed cost	1,181 - 9,029	52.2
Income (N)		
15. Gross Margin	4,050 - 128,425	177
16. Net Income	8,861 - 121,702	172.1

2.2.4 *Enterprise level net farm income analysis*

The farmers were categorised according to the crops they cultivated though in some instances from different plots. A total of 9 enterprises were identified among the 42 sampled farmers. Table 18 contains the list of the enterprises and the proportion of farmers that cultivated them.

An analysis of the cost and revenue elements according to the enterprises shows Garlic/pepper enterprise to have had the highest net farm income per hectare. It was followed by Garlic sole enterprise with

Garlic/Onion/Pepper/Tomato/Wheat/Spinnach having the least. Tabel 20 contains the detailed ánalysis of the enterprises.

A number of factors could have influenced this. Most importantly are the prices of the commondities and the level of resource use by the farmers which inturn is influenced by other factors. Identification of the relationship between the size of operation and net farm income of the various enterprises could be another important area of concern requiring a more detailed study.

Table 18: *Distribution of farm enterprises among the 42 sampled farmers during the 1991/92 dry season.*

Enterprise	Number of farmers	Proportion
1. Garlic/Onion/Pepper	14	33.3
2. Garlic/Onion	13	31
3. Garlic	5	11.9
4. Garlic/Onion/Tomato	3	7.1
5. Garlic/Onion/Pepper/ Garden egg	2	4.8
6. Garlic/Onion/Pepper/ Tomato	2	4.8
7. Garlic/Cassava/Wheat/ Onion/Potato	1	2.4
8. Garlic/Onion/Pepper/ Tomato/Wheat/Spinnach	1	2.4
9. Garlic/Pepper	1	2.4
Total	42	100.1

Further analysis of the 27 dominant enterprises shows that 40.7 percent of farms fell in the 1.01 - 2 hectares category, 29.6 percent were not more than 1 hectare while only 3.7 percent were above 3 hectares. Details are contained in Table 19.

Table 19: Distribution of the 27 farms with the Dominant enterprises according to size

Farm size Category (ha)	No of Farms Garlic/Onion/ Pepper No.	Garlic/Onion	Total	%
0.01-1	2	6	8	29.6
1.01-2	6	5	11	40.7
2.01.3	5	2	7	25.9
3.01-4	1		1	3.7
Total	14	13	27	99.9

Table 20: Costs and returns of tubewell irrigation according to farm enterprises

	Cost/Repairs Elements	ENTERPRISES								
		1	2	3	4	5	6	7	8	9
1.	Total Revenue (N)	32358.85	43934.43	26025	43187.33	42666.5	28580	24942	26666	55833
	Variable Cost (N)									
2.	Labour	5467.97	3159.07	5337.4	3865.66	2646	3400	3846	12500	1541
3.	Seeds/seedlings	4253.15	4114.71	2783.2	3881.66	4296	3000	3762	833	3961
4.	Agrochemicals	362.61	110	520	237.33	312.5	-	154	208	33
5.	Fertilizer	1346.15	1463.93	1403	1966.66	1360	600	923	1000	12500
6.	Fuel/Lubricants	1287	786.93	1162.8	1460.33	646	470	291	416	833
7.	Repairs	864.38	661.79	504	968.66	324.5	730	742	1250	208
8.	Transportation	499.54	984.86	310.6	521.33	579.5	480	438	454	733
9.	Empty bags/Baskets	2246.69	3538.92	1560.2	1919.66	2648	1579.5	2191	1633	3666
10.	Total Variable Cost	16327.46	14620.21	13581.2	14761.33	12812.5	10259.5	12337	18294	23430
	Fixed Costs (N)									
11.	Land Value	2127.46	1912.36	2016.6	2211	1583.5	2100	1461	2500	833
12.	Depreciation									
	Pump	345	258.5	488	50	134	255	275	360	400
	Tubewell	87.69	70.64	86.6	97.66	68.5	73	60	38	13
13.	Interst on Capital* Investments									
	Pumps	433.69	349.07	658.8	67.66	181	344.5	371	513	540
	Tubewell	393.61	293.36	351.2	396.33	277	279	243	459	54
14	Total Fixed Cost Income (N)	3387.46	2883.93	3601.2	2822	2244	3069.5	2410	3870	1840
15.	Gross Margin	16031.38	29114.21	12443.8	28426	29854	18320	22605	8372	23403
16	Net Income	12643.92	26230.29	8842.6	25603.33	27610	15251	20195	4502	30563

1 = Garlic/Onion/Pepper
2 = Garlic/Onion
3 = Garlic/Onion/Cassava/Wheat/Potato
4 = Garlic/Onion/Tomato
5 = Garlic
6 = Garlic/Onion/Pepper/Garden egg
7 = Garlic/Onion/Pepper/Tomato
8 = Garlic/Onion/Pepper/Tomato/Wheat/Spinnach
9 = Garlic/Pepper

4.3 *Resource use and productivity*

4.3.1 *Introduction*

A number of inputs were found to be used by farmers in the dry season crop production in the area. The relationship between the various cost elements in the production exercise and total revenue derived were estimated using a regression model. The linear form of the multiple regression model was employed because it best fitted the data. The results are presented and disccussed in the following sections.

4.3.2 *Results of the Regression Analysis.*

From the result in table 21, the adjusted R for the regression model was found to be 67.9 percent implying that about 67.9 percent of the total revenue was accounted for by the fitted cost elements in the production exercise.

The F - Value of 19.2 which is a measure of the significance of R further shows the stregnth of the combined power of the independent variables, in this case cost of the inputs, in explaining variation in the dependent variable (the revenue) to be significant.. The high significance of the F-ratio indicates the significance of the model entirely. The coefficients further show how the various costs are transformed into revenue. The sign of the coefficients for costs of labour, seeds, land, fertilizer and maintainance and repairs of tubewell and pumpset all show positive relationship between the cost of the inputs and total revenue. This shows that revenue can still be increased by increasing the use of the inputs. In other words, incurring more expenditure on the inputs by way of using more of the inputs increases the revenue.

Table 21: Relationship between revenue and various cost elements in the dry season tubewells farming

Variables		X1	X2	X3	X4	X5	X6
	Constant	Labour	Seeds	Land	Fertilizer	Maint/ Repairs	Chemicals
Coefficients	-12925	1.58	3.33	3.03	11.1	4.64	- 14.2
		*	*	**	*		**
T-Values	-1.39	1.77	2.37	0.91	2.22	1.49	- 1.20

R - sq = 72.6%

R - (Adj) = 67.9%

F - Value = 19.2

* = Significant at 5% level of confidence

** = Significant at 10% level of confidence

However, the effect of using more of each of the inputs on the private return or net farm income depends on the magnitude of the specific coefficients of the cost of the respective inputs. The higher the co-efficient, the higher will be the effect of increasing the input on net farm income.

For labour, a N1 increase in expenditure on it, increases the total revenue by N1.6. In the case of seeds, the relationship between the cost of seeds and total revenue under the prevailing market prices shows that a N1 increase in expenditure on seeds/seedlings could lead to a N3.3 increase in total revenue. The relationship between land cost, total revenue and consequently the net farm income was similar to that of seeds. A N3 increse in total revenue cauld be achieved through a N1 increase in cost of land by way of putting more land into cultivation. Of all the inputs used, fertilizer had the highest return. The result shows that an N11 increase in total revenue could be achieved as result of a N1 increase in expenditure on fertilizer under the market situation that prevailed. Expenditure on maintainance/repairs costs of the irrigation facilities were next to fertilizer in terms of the magnitude of the increase in revenue derivable as a result of increasing it. A N4.6 increase in revenue could be derived as a result of a N1 increase in expenditure on repairs/maintainance provided the increase is a direct result of expansion in production.

A number of reasons can be adduced for the positive effect on revenue as a result of increase in expenditure on the inputs. It is observed that the increase was in form of using more labour to cover more land or perform some of the operations more effectively. For seeds, it was observed that farmers used different seed rates on similar pieces of land. More seeds/seedlings were also used on bigger pieces of land. The increases in seed/seedlings as a result of increase in crop density or land areas all resulted in increased production of the crops and consequently the total revenue. However, what is not known by the farmers is the appropriate combination of the crops to be cultivated in one piece of land or the density of a crop per given area of land where it is planted sole. This is evident from the different expenditures incurred on seeds/seedlings on similar plots with similar crop combination, the variations in sources not withstanding. In the case of land, the possible explanation is that as more land is put into cultivation by the farmers thus incurring more cost on it, more revenue and net farm income are received. Also, the average farm size of 1.7 hectare per farmer with different plots each cultivated with one tubewell as stated earlier may be so small that a N1 increase in the field cost through increase in size, increases the total revenue by N3. Through discussion with the fadama officials of the SARDA it was discovered that the tubewell being drilled for the farmers could irrigate about 2.5 ha when a 3 - inch water pump which was supplied to the farmers was used. In the case of fertilizer, earlier on farmers use an average of 206.2kg

per acre which is more than the recommendations being passed to them for most of the fadama crops.

For irrigation, in terms of intensity and size, a positive relationship has been identified between cost of repairs and income. The high coefficient for this cost element indicates that as production is expanded, the maintainance cost is thinned out and this has a consequent high positive effect on total production and total revenue.

The coefficients for the constant term and chemicals showed a negative relationship. For the negative constant term, it can be linked to the fixed investment on tubewell, pump and land before production could be embarked upon. In the case of chemicals, it showed that as more chemicals are used the revenue decreased. The result shows that a N1 increase in expenditure on chemicals could reduce total revenue by N14.2. This is contrary to the general belief that more yield and consequently more revenue are expected when agricultural chemicals are used to control pests and diseases especially on irrigated crops. This is also in disagreement with the general complaint of serious pests and diseases problems by the farmers. A possible explanation for the negative relationship between expenditure on chemicals and total revenue and net farm income is that either the farmers did not use the right chemicals or did not use the right dosage. This could be due to the fact that majority of the farmers obtained the chemicals from the open market where quality and appropriate recommedations were not guaranteed. High cost of the chemicals might also have contributed to the negative relationship between cost of chemicals and total revenue.

The respective t - values of the inputs show the signficance of the cost of each of the inputs in explaining the variation in total revenue.

The t-values for expenditures on labour, seeds and fertilizer were significant at the five (5) percent level of confidence while that of maintainance/repairs were significant only at 10 percent. For expenditures on chemicals and land the t-values were not significant even at 10 percent confidence level. This shows that except expenditures on land and chemicals, expenditure on each of the other inputs significantly explained variations in total revenue at 10 percent confidence interval.

4.3.3 *Problems of the tubewell farmers*

A number of problems have been advanced by the farmers to be militating against the tubewell dry season farming. They included pests and diseases, unavailability of fertilizer, inadequacy of funds, unavailability and high cost of spareparts, flood, insufficiency of land and scarcity of water pumps. Table 22 shows the degree of each of the problem in terms of the proportion of farmers affected.

Table 22: *Degree of tubewell farming problems according to proportion of farmers affected*

Problem	Number of Farmers Affected	Proportion (%)
1. Inadequency & High cost of fertilizer	36	86
2. Pests and disease problem	18	43
3. Unvailability and high cost of spare parts	13	31
4. Fload from Dam	7	17
5. Lack of Enough capital	6	14
6. High cost and scarcity of water pumps	3	7
7. Lack of land	2	5

Source: Field Survey, 1991/92

It can be observed that fertilizer problem ranked highest among farmers. Eighty six (86) percent of the farmers complained of unavailability of fertilizer at government approved prices and that the open market prices at which they bought the fertilizer were too high. The farmers complained that the high cost of ferilizer greatly limit their size of operation..

About 43 percent of the farmers complained of pests and disease problems. Most of this proportion of farmers mentioned that they bought the chemicals they used for the control of pests and diseases at exhorbitant prices from the open market. It may be recalled that, earlier on it has been reported that 80 percent of the farmers used agricultural chemicals for the control of pests and diseases.

In conection with the maintainance of the irrigation facilities, 31 percent of the farmers indicated that they faced serious problems in procuring the spare-parts for

maintainance of the water pumps and tubewells because the items are scarce and expensive.

Another problem identified to be limiting the level of operation of the tubewell farmers in the area was the sudden flood sometimes experienced from Bakalori Dam in Talata Mafara Local Government Area. This often resulted in washing away of their produce at various stages of development. Thus, the farmers explained that some areas of the fadama are not cultivated because of the fear of flood. This makes the Scope of expansion limited. Another problem that limited the Scope of operation of the farmers was lack of enough capital for the purchase of capital items like pumps and tubewells and also meeting recurrent costs. About 14 percent of the farmers mentioned that lack of enough funds was constraining them in acquiring more tubewells and pumps for the purpose of expanding production.

About 6 percent of the farmers identified land as a constraint in expanding production. They were constrained by the size of their fields that had tubewells because in most cases the holdings were not up to the potential size that the tubewells could irrigate.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION, POLICY IMPLICATIONS AND RECOMMENDATIONS

5.1 Summary of findings

This study was carried out to assess the costs and returns of tubewell dry season farming as well as the influence of each of inputs on revenue.

The data for this study was collected from primary sources using a structured questionnaire that was administered to a total of 42 tubewell farmers in two villages of the Northern zone of Sokoto Agricultural and Rural Development Authority. Discussions were also held with senior officials of SARDA.

The results of the analysis showed that majority of the tubewell farmers were in the range of the active labour force with an average age of 39 years. About 98 percent were illiterates i.e not able to read and write in English. However, all of them could read and write in "Ajami." Also, about half of the farmers interviewed were polygamous, 41.5 percent with two wives and seven percent with three wives. Accordingly, a major portion of the respondents had between 6 - 10 children.

It has also been found in the study that even though there was an established government apparatus for distributing farm inputs at subsidized prices, majority of the farmers did not benefit from it especially in the case of fertilizer and agricultural chemicals. They bought most of the commodities from the open market at higher prices. However, the commodities were readily available in the open market but at prohibitive cost.

In the case of land, it has been discovered that though majority of the farmers acquired their land for the dry season farming through inheritance or direct purchase, some others leased the land they used. The average dry season farm holding irrigated with tubewell in the two villages was 1.7 hectares.

The results of the nmNet farm income analysis showed that about N18,848.88 was obtained as the net farm income for cultivating a hectare with Garlic-Onion and peppers as the major crops. The results also showed that N15,022.90 was spent as variable cost with labour, seeds/seedling, bags and basket as the major variable cost elements. For the fixed cost, about N3095.07 was incurred with land as the major cost element. An initial expenditure on tubewells and pump had to be made before any other activity could be embarked upon in the business. Overall, it has been found that each naira invested by the farmers brought about N1.09 per hecter and N1.24 per farmer within one irrigation period and that farmers can grow the crops twice during one cropping season.

The analysis of costs and returns per farmer showed an average net income of N32600.14 per farmer with a range of N8861 - N121702 and co-efficient of variation of 172.1. About 9.5 percent of the farmers used up to 3 tubewells.

In terms of the enterprise, the farmer's major crops were garlic, onion, peppers and tomatoes. However, majority of the farmers grew garlic because of its high price and ease of storage.

. Among the various enterprises, garlic/pepper had the highest per hectare net income of N30563.00. It was followed by garlic enterprise with a net farm income of N27610.00. However, garlic/onion/pepper enterprise was cultivated by a major proportion of the farmers (33.3 percent) with a net farm income of N12643.92.

Of all the functions tried in the regression analysis, the linear regression model best fitted the data as such its results were used in assessing the profitability and level of resource utilization in the dry season tubewell farming.

The results of the analysis showed that the independent variables explained 67.9 percent of the variation in the revenue. All the expenditures on the inputs (labour, seeds, land, fertilizer and repairs) except that on chemicals and the intercept had a positive relationship with the revenue. However, only variations expenditures on fertilizer, labcur, seeds/seedlings and maintenance/repairs significantly influenced revenue.

All the co-efficients for the independent variables except cost of chemicals are more than 1 indicating the high profitability in the use of resources in the venture. However, revenue and thus the net farm income can be increased through increasing use of the inputs. In the case of chemicals, the co-efficient is negative indicating an inverse relationship. This points to a wrong use of the chemicals. A number of reasons could be responsible for this. Either the dosage is too much or the

chemical being used is not the right type.

5.2 Policy Implications and recommendations

The recommendations based on the findings of the study are for the attention of all the agencies concerned with fadama development in Sokoto State and policy makers in the country.

1- It is clear from the results of the study that tubewell dry season farming is keeping some a reasonable proportion of the productive labour force in their villages gainfully employed. Thus tubewell farming can be used as one of the approaches for preventing rural - urban migration especially in the dry areas with shallow acquifers.

2- It has also been found that though about 98 percent of the tubewell farmers could not read or write in English language, they could all read and write in the "Ajami" form of arabic language. This connotes that the possibility of extending extension messages in "Ajami" pamphlets need to be explored.

3- Even though there is an established government apparatus for distributing farm inputs especially fertilizer and agricultural chemicals at subsidised prices, less than one - third of the farmers got the inputs from the government agencies. Most of the farmers bought all the inputs from the open market at about three (3) times the subsidized prices. This then calls for an overhaul of the government agricultural input distibution system.

4- The inputs should be made available at the right time even at about three (3) times the subsidized price of N40.00 and N30.00 per 50kg - bag of compound and super plosphate fertilizers

respectively. This is in view of the fact that farmers bought all their requirements at very high cost. Majority of the farmers own the land they cultivated but under utilized the tubewells. The farmers explained this was due to cash constraint and the fixed nature of the tubewell. The suggestion here is that farmers should be informed of the capacity of the tubewells being drilled for them and that pieces of land on which a tubewell is to be drilled should possibly be up to the potential capacity of the tubewell.

5- It is clear from the results of the net farm income analysis that net farm income is higher than the overall cost of production. This indicates that tubewell dry season farming is quite profitable with a N1.09 per hectare and N1.24 per farmer return per naira invested. Thus, inview of the vast fadama land area in the state an investment in promoting farmer managed irrigation technique could be a catalyst in raising the standard of living of the rural majority through increase in food production and farm income. It is also noticeable that labour accounted for the highest proportion of the total cost of production though a major portion of it was supplied by the farm family. Also, it has been found that the most profitable farm enterprise was not the enterprise cultivated by the majority of the farmers.

6- It was also brought to light that the total revenue from the venture could be increased through an increasing use of all the inputs studied except chemicals. In other words, except chemicals, all other inputs were used profitably but with room

for expansion.

7- For chemicals, an increase in using them results into a decrease in revenue. This implies that the farmers could be made to increase their net income through increasing the farm size and consequently the quantities of other inputs. The insignificant expenditure on chemicals coupled with its negative effect on the total revenue point to the need for a search into the quality and quantity of the chemicals being used by the farmers.

8- It has also been discoverd in this study that the capacities of the tubewlls and pumps were not fully utilized due to perhaps the problems given by the farmers. The principal problem for this category of farmers was the unavailability of fertilizer from government sources and also its high cost in the open market. The second problem was that of pests and diseases. Others were high cost and scarcity of water pumps and the lack of enough capital especially for making the initial investment in acquiring the pump and tubewell. Therefore, any programme that aims at enhancing irrigation farming should aim at solving these problems. special consideration should be given to this category of farmers in the sale of fertilizer during dry season by the government agencies concerned. Special credit scheme where a government agency would act as intermediary could be arranged for this group of farmers to address the problem of capital. Also, appropriate purchases of chemicals and spare parts and making them available to these farmers by the concerned agency would greatly assist. The extension system in the state is a good channel for passing the information on the inputs availability to these farmers.

5.3 Conclusion

This study has been able to determine some of the socio-economic characteristics of the tubewell farmers in the area. It has also been possible to determine the costs and benefits of the use of tubewells in the production of the combination of garlic, onion, tomatoes and pepper as intercropped by farmers in the first production period during the dry season. The study also estimated the relationship of each of the various cost elements with the total revenue per hactare, according to farmers and according to enterprises cultivated by the farmers.

Majority of the farmers were in the active labour force thus preventing the much talked about rural-urban migration. They were also polygamous. Though they were illitarates in the conventional sense, they coulds read and write in the "Ajami" form of arabic language. Family labour played an important role in the irrigation farming.

Though the use of tubewell in producing the crops has been found to be profitable, there is room for improving the relationhsip between the various cost elements and the revenue derived, and the relationship between marginal revenue and marginal cost. Therefore, it can be concluded that the tubewell dry season farming is holding the active labour force of the populace in the area because of its profitability and is thus preventing rural-urban migration. The net farm income derivable from the venture can be increased by the increasing the use of all the resources assessed in the study except agricultural chemicals used for the control of pests and diseases. It is also

apparent that cash and fertilizer constraints are limiting the size of operation of the tubewell farmers.

REFERENCES

Abdullahi, Y.A and D.O.A.,Phillip (1989). The role of Irrigation in Rural Development in Nigeria. Paper presentated at the National Workshop on Fadama and Irrigation Development in Nigeria held in Bauchi, 23-26 October, 1989.

Adedzwa D.K (1987). The River Basin Development Authority: Another View. A paper read at the Agricultural Extension Research Liason Services seminar on Agricultural Research findings, Policies and Programme Implimentation.

Adeoye K. B. (1986). An Evaluation of Drought incidence and hazard Annual conference of the Agricultural Society of Nigeria, 1 - 3 September, 1986.

Ahmed A., M.M.Ahmed and D.O.A. Phillip (1988). A Comparative Economic Analysis of Irrigated wheat production under Alternative Technologies. In: Mijindadi, N.S., Phillip D.O.A. and Otu, M.F. (eds). Agriculture in Rural Development in Nigeria.

Ahmed M. Makarfi (1986). An Economic Evaluation of Water Use in large Scale Irrigation Projects in Nigeria: A case study of Kano River Project. Paper presented at water management workshop held at AERLS conference hall, ABU Zaria, 13 - 17 October, 1989.

Federal office of statistics Lagos, Nigeria (1985).Annual Abstract of statistics.

Bagi, F.S (1981). Economics of irrigation in crop production in Haryana. In: indian journal of Agricultural Economics No.3 volume XXXV, July - September, 1981 page 15.

Balogun, C. (1972). The Variability of Rainfall in Nigeria. Nigerian Journal of Science 6 (1): 87 - 92.

Clapp, G.R (1965). An Approach to the development of a Region. In Readings in resource management and conservation, pp 298 - 307, kates R.W and Burton I (eds), Chicago, IL.

Erhabor, P.O (1990). Economics of irrigation Farming in Nigeria; The Journey so far. A paper delivered at the National Workshop on Farmer participation in Irrigation development and management organized by Institute for Agricultural Research, ABU, Zaria.

Famoriyo, Segun (1978). Problems relating to agriculture in National Development. Paper presented at the conference on Industrial take-off in Nigeria. ABU, Zaria; page 4.

Faniran, A. (1972). River Bains as plannign units. In: planning for Nigeria pp. 128 - 154, Barbour K.M. (ed). Ibadan.

Floyd B (1984). Nigeria: Economic Austerity and Agricultural crises. Paper presented at a meeting organised by the developing Areas Research Group (IBG) on the International Economic Crises and the Third World, IBG annual conference.

Hamilton, R.E (1968). Domado Valley corporation: India's experiment with the T.V.A model. India Journal of Public Adminstration 15 (1): 86 - 109.

Huxley, J. (1945). T.V.A: Adventure in planning. The Architecturla press, cheam, survey.

Heady, E.O. and J.L. Dilion (1972). Agricultural Production Functions. IOWA state University press, Ames, IOWA.

Imarana Y. (1983). Agrricultural Development and Extension in Nigeria. A paper presented at the seminar on Agro-based Industries held at the adminsitrative staff college of Nigeria, Badagry, Lagos, 14th November - 3rd December, 1983.

James O. Olukosi and Patrick O. Erhabor (1988). Introduction to farm management Economics, principles and applciations, first edition. Agitab publishers, Zaria.

Javad M. Sadeghi (1978). Economic impact of increased water supply on small farms in Iran. In: India journal of Agricultural Economics Vol. XXXVII No. 2 April - June, 1978.

John P. Doll and O. Frank (1984). production Economics, theory with applications, second edition, John Willey and sons, New York.

Karam Sighn (1985). Irrigation tubewells in sokoto State - Nigeria. Financial and Economic viability. SARDA - 1985.

Kowal, J.M. and D.T. Knabe (1972). An agroclimatological atlas of the northern states of Nigeria. Ahmadu Bello University, 1972.

Land use planning department, SARDA (1987): A survey of Agricultural land in Sokoto State.

Moorti, T.V. (1971). A comparative study of wells irrigation in aligarch distric, India. cornell International Agricultural Development Bulletin no. 19.

Federal Ministry of Finance and Economic Development, Lagos (1975): Third National Development Plan 1975 - 1990.

N.E.D.E.C.O. (1957). River studies and recommendations on improvement of Niger and Benue. North Holland publishing company, Amsterdam.

Nwa, E.U (1980). Cropping patterns and environmental factors in kano River Project of Nigeria. subject C paper No. 5, Third Afro - Asian Regional conference of I.C.I.D., New Delhi, India. vol. 11; 59 - 67.

Nwa, E.U (1981). An evaluation of small pump and shadoof systems of irrigation in northern Nigeria. In; Samaru journal of Agricultural Research 1 (2), 1981. IAR/FOA, ABU, Zaria, Nigeria.

Olayemi, J.K and S. A, Oni (1971). Costs and returns in peasant cocoa production: A case study of Western State, Nigeria. Bulletin of rural economics and sociology, 6 (2).

Olayide, S.O. and E.O. Heady (1982). Introduction to agricultural production economics. Ibadan University press, Ibadan.

Olukosi, J.O (1986). Income generation and distribution: A case study of Ipetu and Odo - Ore villages in Omu - Aran area of Kwara State. Samaru miscellaneous paper. No.112, IAR, ABU, Zaria.

Orewa, S.I (1978). The economics of dry season tomatoe production under the Cadbury tamatoe scheme in Zaria area. Unpubliished MSc thesis, Ahmadu Bello University, Zaria.

Orson, A and S. Rentlinger (1969). Performance evaluation of eight on-going irrigation projects. IBRD. Economic department working paper No. 40. Washington.

Owunubi J.J. (1987). Drought and the use of water in Nigerias irrigation projects. A paper presented at the 10th National irrigation and drainage seminar, held at the National Water Resource Institute, Kaduna, 23rd - 26th november, 1987.

Patrick, Osaretin Erhabor (1982). Efficiency of resource use under small scale irrigation technology in Nigeria. Technical report No. 148. Purdue University water resource centre, West Lofayette, Indiana.

Phillip D.O.A (1990). Economic issues in irrigated farming in Nigeria. Invited paper for the national workshop on farmer participation and management, organized by IAR, ABU, Zaria. 7 - 8 May, 1990.

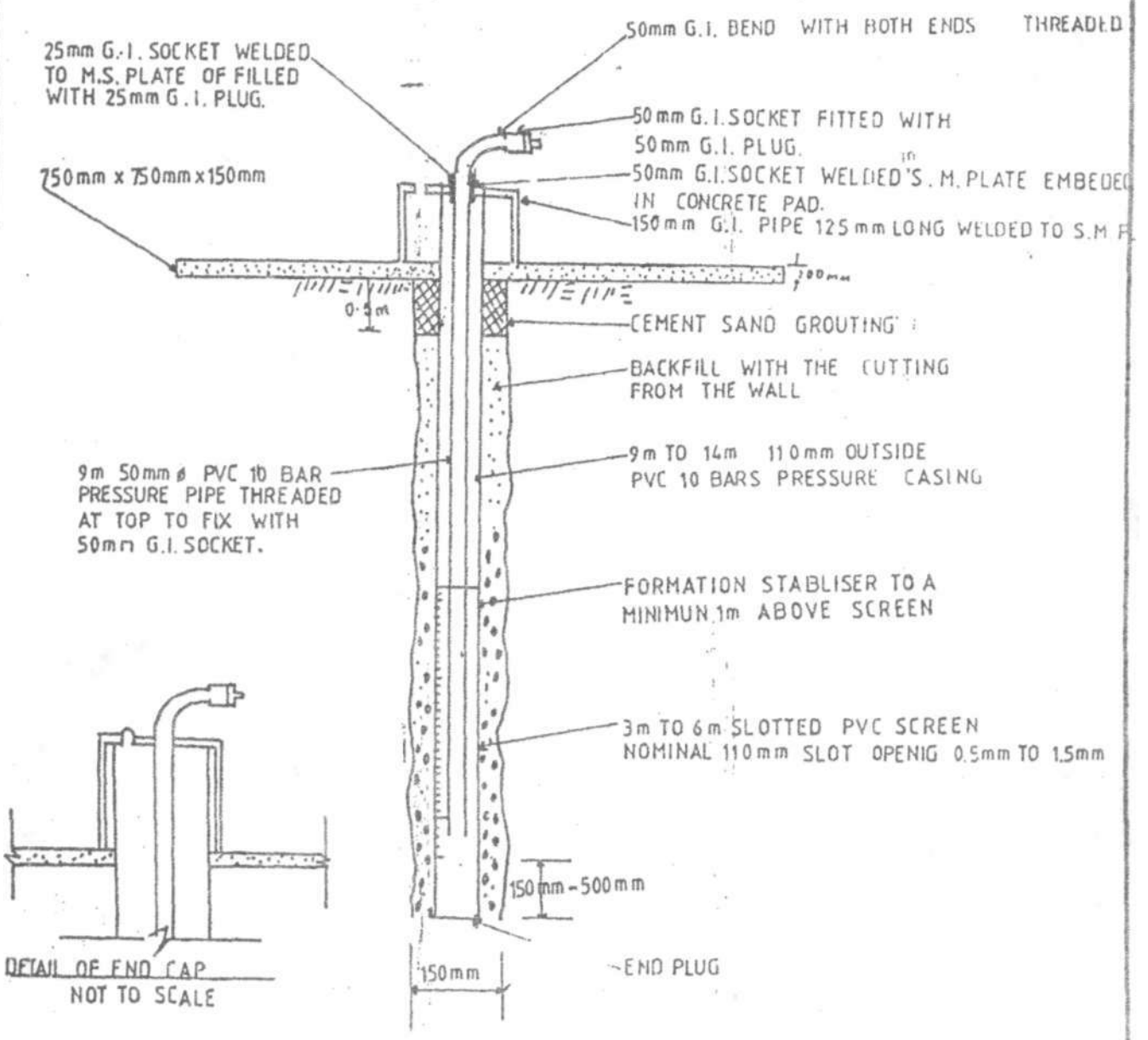
SARDA (1992): Achievements and experiences: March 1984 - Dec. 1991.

Windstoe, B.A. (1920). The principles of irrigation practices. The Macmillan company, New York.

World Bank (1991): Staff Appraisal Report on National Fadama Development Project. Report no. 9618 - UNI.

Yahaya A. Abdullahi(1979). The "New Technology" and agricultural development in Nigeria: A socio political assessment of the green revolution strategy. A paper presented at a political science, seminar organised by the Department of Political Science, ABU, Zaria. November 27, 1990.

Yayock J.Y (1990). National Self - Reliance in Agriculture: A challenge to the technological advancement. A paper presented at 4th annual conference of the Nigeria society of agricultural engineers. University of agriculture, Makurdi, 12 - 15 September, 1990.



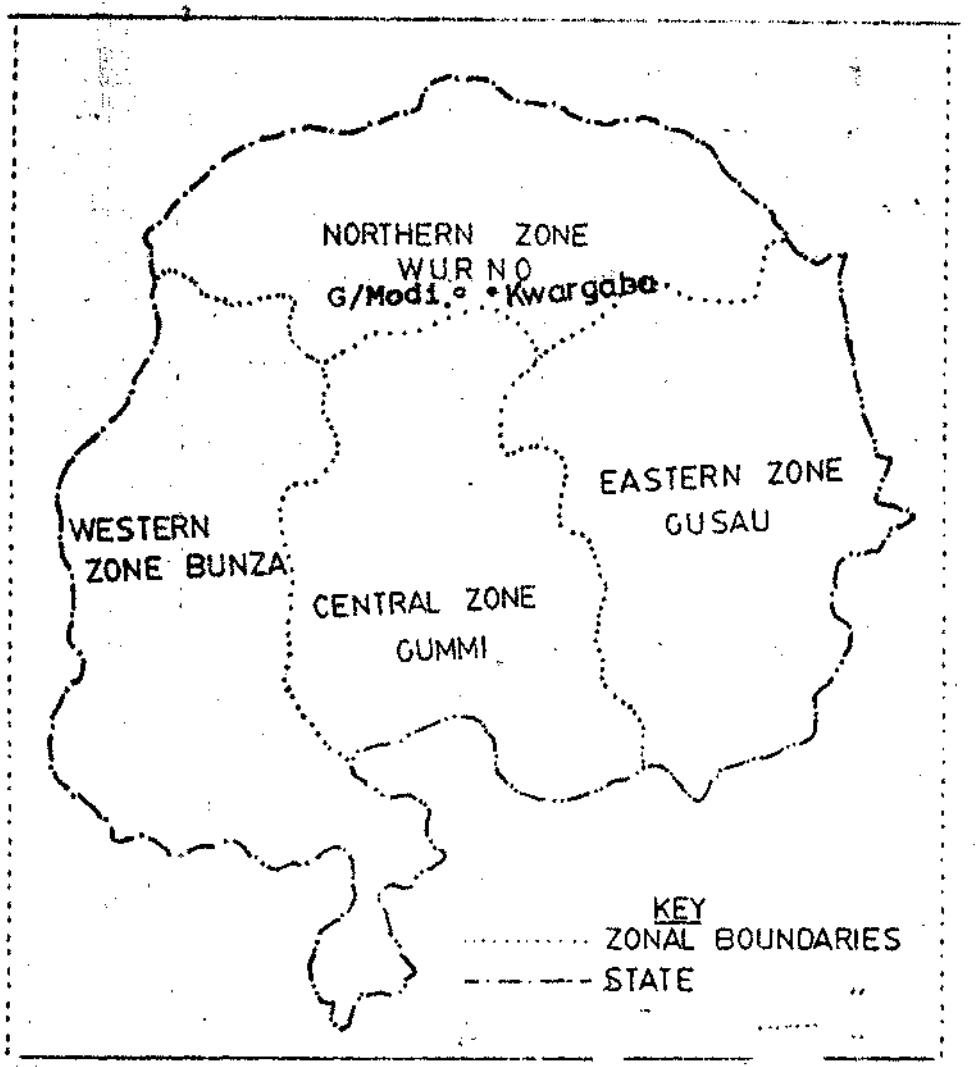
TYPICAL TUBEWELL DRAWING

(NOT TO SCALE)

Annex II

SOKOTO AGRICULTURAL AND RURAL DEVELOPMENT AUTHORITY

ZONAL - BOUNDARIES AND SURVEY VILLAGES



(Source: SARDA)

FADAMA MAP GUIDE SARDA N.Z. WURNO