AN APPRAISAL OF THE DIRECTORATE OF FOOD, ROADS AND RURAL INFRASTRUCTURES, RURAL WATER SCHEMES IN SOBA AND MAKARFI LOCAL GOVERNMENT AREAS OF KADUNA STATE

BY

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DEPARTMENT OF GEOGRAPHY
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D E C L A R A T I O N

I declare that this thesis is based on the result of research carried out by me; that it is my own composition and that is has not been previously presented for a higher degree at any university or institution.

Information derived from published and unpublished work has been duly acknowledged.

SIGNATURE

DATE

C E R T I F I C A T I O N

This thesis by Emmanuel D. Attah, meets the regulations of the Post Graduate School, Ahmadu Bello University, Zaria governing the award of Master of Science Degree in Rural Development. It is hereby approved for its contribution to knowledge and literary presentation.

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D E D I C A T I O N

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A B S T R A C T

This study evaluates the effectiveness of DFRRI's rural water Schemes in the Makarfi and Soba Local Government Areas of Kaduna State. To this end, primary and secondary data were gathered and analysed. Twenty sampled villages were selected and from each village, 15 respondents were sampled. The village heads and community development officers were also interviewed.

The results obtained from the data show that the DFRRI, water projects have not attained the desired success, especially in Soba Local Government, where most of the boreholes are not functioning. There is also the problem of poor planning which has resulted in poor distribution of the wells. This forces some people to travel long distances to got water, especially during the dry season, while others have the wells behind their residences. Other problems militating against the water scheme include shortages of funds and lack of man-power.

Various government agencies that are involved in water supply development in the study area tend to work independently of one another, resulting in poor coordination. Projects are also imposed on the people without consultation. The non-participation of the people in the planning and execution of the water projects, has contributed to the failure of some boreholes.

In view of this, a model based on appropriate organisation, that incorporates the input of the rural communities is proposed; it is argued that if this model is adopted in its comprehensive form, the deplorable situation in the study areas will improve. For the model to be really successful government efforts should be coordinated and unwarranted interference with the village components of the model should be avoided.

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CHAPTER ONE

INTRODUCTION

Water is a natural resource of paramount importance to human beings. It constitutes the most essential need after air. Its significance can be seen in the case of early settlers who in most cases settled along the banks of rivers and streams (Adekayi, 1991). The amount of renewable water available to a country is an important determinant and natural constraint to societal development unless large scale technology is available to transfer water from neighbouring regions that are better endowed (Falkenmark, 1989). Adequate both water supply in quantity and quality is a prerequisite in the development of many sectors of the Nigerian Economy such as industrial activities and agriculture.

Despite the fact that water is an inevitable necessity of life, it is a scarce resource in some parts of Nigeria, especially in the Northern sector.

In many communities, clean water is not available, and where available in urban areas, its supply is erratic. Because of the poor availability of good water supply in Nigeria, many people, especially in the rural areas, have to resort to getting water from unhealthy sources such as polluted streams, shallow wells and ponds. These sources have resulted in the prevalence of water-borne diseses,sometimes

on epidemic scale. Such diseases include cholera,dysentry, typhoid fever, schisosomiasis, etc.

To solve the problem of poor water supply in many areas of Nigeria, the Federal Government has within the last fifteen years taken some giant steps towards developing the water resources of the country. One approach was the establishment of the Directorate of Food, Roads and Rural Infrastructure (DFRRI) in 1986.

One of the main objectives of DFRRI is the provision of portable drinking water in the rural communities of the country, especially through the construction of bore-holes. This study is undertaken to investigate the extent to which the Directorate has succeeded in the provision of portable water using the Makarfi and Soba Local Government Areas (LGAS) of Kaduna State as case studies.

1.1 THE RESEARCH PROBLEM

Rural dwellers in Nigeria have been variously referred to as the "neglected rural majority" (Olatunbusu , 1975) "the stagnant sector" (Anthanio 1976) and "victims of collective underdevelopment" (Ijere, 1978). This is because the rural population collectively lack the purchasing power to enable them acquire the basic necessities of life. They are victims to the official government policies which disproportionately favour the urban areas to the detriment of the rural majority.

The provision of portable water is too important for the rural communities. The pains, trauma and occasional loss of life inherent in drinking filthy water is better imagined than told. This is beside the enormous amount of time and energy wasted in searching for, and conveying clean water, usually through human porterage, to various homes.

The Directorate of Food, Roads and Rural Infrastructures is saddled with the responsibility of providing water to rural communities in Nigeria. While some progress has been made, there are still a number of problems. For example, there have been several reports of DFRRI well projects becoming non-operational after a few months of their construction. Notable examples include the boreholes in Likoro, Racifa, Nasarawa, Gimba etc. (field work, 1992). This peculiar problem could be traumatic for the rural dwellers, particularly when every hope of getting fresh water through such wells suddenly fissles into thin air.

Besides, there are also reports of non-optimal location of the wells. This has tended to create dissaffection among the communities because of accusations of influenced siting of wells. The focus of the study is to

examine the magnitudes of these problems in the Makarfi and Soba L.G.As with a view to suggesting possible solutions.

1.2 AIMS AND OBJECTIVES

The aim of this study is to evaluate the success of DFRRI's water scheme in making portable water readily available to the study area. Within this general aim, the specific objectives are:

(i) To examine the spatial distribution of DFRRI borehole projects in these two Local Government Areas;

(ii) To assess the extent to which water supply from the DFRRI wells meet the water needs of the people;

(iii) To determine the level of community participation in the projects;

(iv) To evaluate the magnitude of the failure of the DFRRI wells and identify causes for failures; and

(v) To make recommendation for ways to improving portable water supply in the study area.

1.3 SCOPE OF STUDY

The study covers the Soba and Makarfi Local Government Areas of Kaduna State.

It focuses on the provision of portable water to the communities by DFRRI. It also tries to establish the effect of water projects on the people and the degree of community participation in water supply in the areas.

1.4 JUSTIFICATION OF THE STUDY

DFRRI has been inexistence for six years. It is thus pertinent to appraise it's water resource development programme in the rural areas.

The area of study is located in a semi-arid environment where rainfall and surface streams are seasonal. In view of the desperate nature of portable water supply to these semi-arid communities, it is relevant to examine the functionality of water schemes especially the provision of boreholes to utilize underground water resources of the area of study.

1.5 ORGANISATION OF WORK

This thesis is presented in six chapters. The first chapter introduces the work and specifices its focus.

Chapter two reviews the literature on water resources development for rural communities, water demand and supply situation in Nigeria and the utilization of Groundwater resources, problems and prospects.

The study area and methodology is discussed in chapter three. Analysis of the research findings is presented in chapter four.

Chapter five proposes an organisational model for improving rural water supply. The final chapter summarises and conclude the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Water Resources Development For Rural Communities

Wright (1963), suggested that the following factors should be of primary consideration in the development of water sources for domestic supply. These are:

(i) the amount and quality of water needed;

(ii) the source for the supply and

(iii) the sanitary measures to be employed.

The quantity of water will however depend on factors such as the nature and size of project, size of population to be served and nature of demand.

Smith (1966), on the other hand concludes that the need to purify and treat water, depends upon the quality at the source and the demand of the community to be served. According to him, water should be safe to drink, attractive in appearance, taste and odour and usuable in a variety of household and industrial purposes. He further maintains that the waters from surface and ground sources are satisfactory for all ordinary uses and may not need purification even though for domestic purposes, they may however be chlorinated against contamination.

The standards for drinking water prescribed by the World Health Organisation (W.H.O) in 1979 is shown in Table 2.1. The standards for bacteriological quality, for example, require that in 90% of the samples examined, throughout the year, the average number of coliform bacteria should be less than 1 per 100 millitres (ml.) in treated waters and less than 10 per ml. in untreated water. By proper selection, protection and treatment of water sources, some societies have been able to wipe out epidemics of water borne diseases (Smith, 1966).

Source is the second consideration in water resource consideration. According to Wright (1963) only an adequate source that will fulfill requirements should be located and developed. Such sources include streams, ponds, springs and wells. Underground waters, he maintains, are more feasible as sources for domestic water supplies for small communities.

The method of development of sources to produce dependable yield varies with the type of source (Burn, 1966). In the case of underground water such as wells and springs, reserviors may be used; even though for developing countries, such as Nigeria, hand pumps may be important. In developing a well, the factors to be taken into consideration will include location, suitability and measures to be taken against contaminations and pollution.

Table 2.1

WORLD HEALTH ORGANISATION STANDARDS FOR DRINKING WATER (1)

Characteristics	Limit of general acceptability Mg.L	Maximum permissible level Mg/L	undesirable effects at higher level
Physical & colour (platinum cobalt)	5	50	Stains
Odour	unobjectionable	unobject-ionable	Odour
Taste	"	"	Tastes
Total hardness	50	100	Scale deposits
Suspended solids	5	25	Turbidity
Total solids			
Chemical	500	1.500	Taste and intestinal irritation
Arsenic	0.01	0.05	Toxic liver damage
Cadmium	0.005	0.01	Toxic
Calcium	75	200	Scale for-mation
Chloride	200	600	Taste & corrossion
Copper	0.05	1.5	Taste, emesis or liver damage
Cyanide	0.05	1.20	Higher toxic and affects nervous system.
Detergents	0.2	1.0	Frothing gastrointe-stinal problems
Fluoride		0.6-1.7 at 33 - 10°C	FLUOROSIS

Table 2.1 (Contd)

Iron	0.1	1.0	Stains, tastes
Lead	0.05	0.10	Severe and permanent rain damage
Maganese	0.05	0.5	Stain and taste problems, deposits in water lines.
Magnesium	30	150	Scales, taste
Mercury		1.001	Lack of muscle control, kidney damage, personality changes with permanent brain damage.
Oil & grease	0.01	0.30	Taste and potential danger to aquatic life.
P^H	7.0 - 8.5	6.5-9.2	Taste, corrosion
Phenol	0.001	0.002	Taste and odour
Selenium		0.01	Highly toxic, dental carries and cancer
Sulfate	200	400	Catharic a action
Zinc	5.0	15	Bitter taste gastrointestinal problems and opa lescenil of alkaline

Source: W.H.O. (1979)

Rain and storm water have also been harvested for improved utilization since ancient times. This involves a delibrate collection of rain water from a surface (catchment) and its storage to provide a supply of water. After rainfall, the excess water from the fields is trapped to increase it's utilization, to raise soil moisture. Also storm run off into perennial rivers is controlled and stored in reserviors behind dams for irrigation, hydroelectricity, fishing and improved navigation, and for domestic and industrial water supplies. Rain and storm harvesting is mosly associated with marginal environments water where there are no permanent sources of water that could permit irrigated agriculture (UNEP, 1983).

Rain and storm water harvesting techniques includes collection from roofs, directed into surface or underground tanks (cisterns). From ground catchments, methods like barring run-off, contour terracing and many others are employed, mostly for agriculture. The technique used require only a modest amount of labour and without any sophisticated machinery for construction and for operation and maintenance. These can be constructed incrementally and by individual families and communities.

There has been a remarkable improvement in present day technology for water development. Rain and run-off catchment are better,using corrugated sheets, concrete and other impermeable materials like plastics. Mathematical calculation of rainfall, the volume of Harvestable water over a catchment and the demand, size and life span of storages are now effectively undertaken (Nace, 1967; UNEP, 1983; Adekayi, 1991).

2.2 THE PLACE OF GROUNDWATER IN THE HYDROLOGIC CYCLE

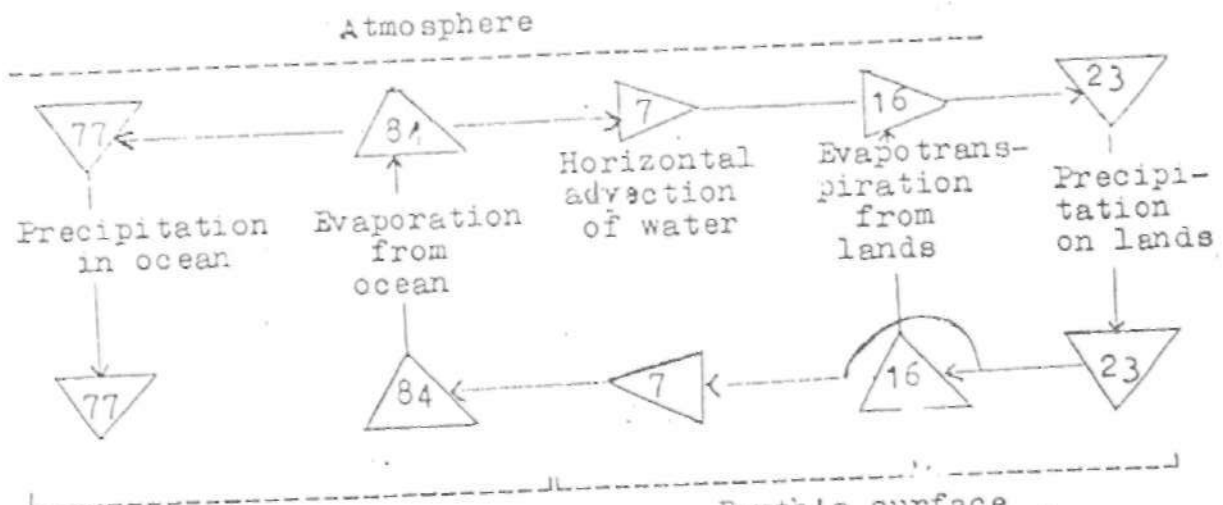
The hydrological cycle starts when energy from the sun rays evaporate water from the sea, from open water on land and from leaves of vegetation. The water vapour thus formed rises and collects into clouds which are carried by winds to the point where they precipitate as rain or snow as a result of meteorological conditions. Precipitation may take place either near the point of evaporation or hundreds of kilometres away.

When the rain falls over land, part soaks into the ground and part run off into streams or rivers to return eventually to the sea, part of the water absorbed by the ground is used by vegetation, part sinks below root level through soils that are porous until it gets to the bedrock or other impermeable layer. At this stage with the force of gravity operating, the water will through time run downhill to either emerge as springs or return below ground to be reevaporated. A schematic representation of the process is shown in figure 2.1.

The stage of the hydrological cycle in which the water first sinks into the ground and its reemergence in springs, rivers or sea itself is known as 'groundwater'. The saturated soil layer containing it is the 'aquifer'.

Only a small fraction of the earth's water content is available for human comsumption. 97% of all the earth's water is held in the oceans, 0.75% of the total fresh water is locked up in glaciers and ice sheets; at any instant the rivers and lakes hold only 0.33% of all the fresh water, the atmosphere

Figure 2.1: The Hydrologic Cycle



Figures represent percentages of cyculating water content which is equal to a mean annual precipation of 857mm.

Source: Barry, 1969

a mere 0.035% and almost all the remainder is groundwater (Barry, 1969).

The distribution of fresh water for human consumption is not even both in time and space. The precipitation input surface run off and groundwater storage constitute the water resource potential in terms of development for the area under study, being in the northern savannah region. However, of this potential, rainfall is small and seasonal; occuring between the months of April - September. As a result of this short precipitation period, surface run off is, therefore, scanty. Thus the importance of groundwater in the area cannot be over emphasised.

Groundwater is that water which occurs beneath the saturated zones where the hydrostatic pressure is greater than, or equal to the atmospheric pressure (Waltz, 1969). Ground water occurrence and distribution are controlled by the physical properties of the earth material which affects the amount of water that can be stored beneath the ground and the ease with which it can be extrated from the ground. Geologic factors involved here include lithology, texture and structure of rocks; while hydrological and meteorological factors are stream flow and rainfall.

Water can be extracted from geological formations termed aquifers'. Aquifers are water bearing strata and found in them are unconsolidated and consolidated materials. They may be

confined or unconfined; the former is water held under pressure by an overlying impervious substratum except at the intakes (Shuval, 1980). The surface to which confined aquifer will rise in non pumping wells which pierce a common aquifer is termed the pressure surface or the piezometric surface, that is the surface which joins all the water table (Dupreez and Barber, 1965). Where a confined aquifer is pierced by a borehole and the water rises to a level above the ground surface, the well is artesian; if it rises only to a certain level, it is then known as sub artesian. An unconfined aquifer on the other hand is that which is exposed to the atmosphere or possesses a free surface. The movement of groundwater here is not restricted by overlying impervious bed (De Preez and Barber, 1965). Water table aquifer is usually connoted to denote unconfined aquifer. This means that the upper limit of the aquifer is determined by the water table. The hydraulic head at any level within a water table aquifer is equal to the depth from the water table point in question (Shuval, 1980).

An impervious bedlying above the water-table may support a body of groundwater and thus separate it from the main water-table. The upper limit of such a body of ground water is known as the perched water-table (Du Preez and Barber, 1965). Clay or loam lenses in sedimentary deposits have shallow perched

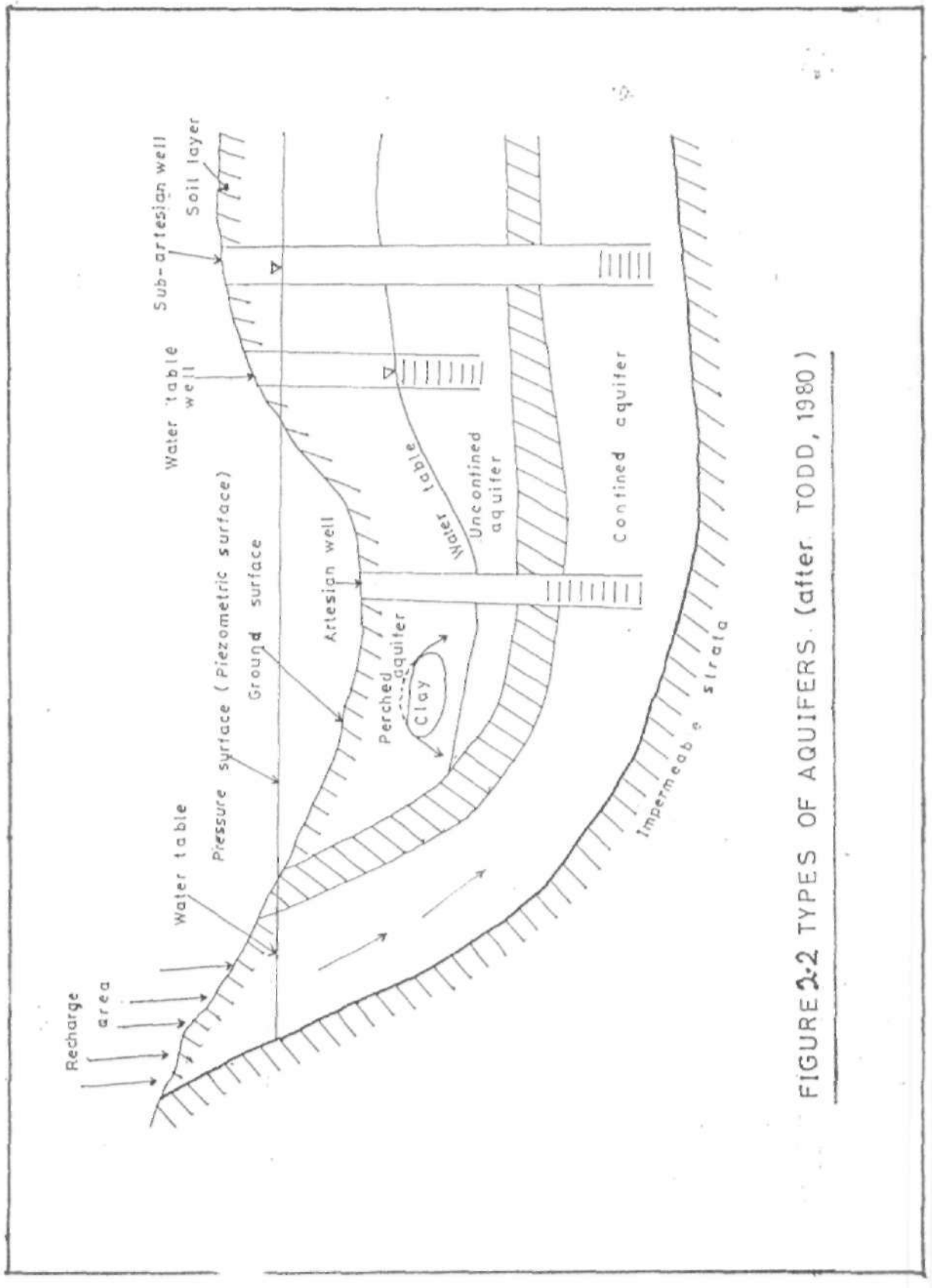


FIGURE 2.2 TYPES OF AQUIFERS. (after TODD, 1980)

aquifers above them. Illustrated in figure 2.2 are the various types of aquifers.

Ground water is recharged by precipitation input. Thus the amount of groundwater in a place will be subjected to climatic influence. Climatic conditions coupled with soil type greatly influence the moisture balance and ground water recharge; the net water income being determined by a higher precipitation input than is required for evapotranspiration losses. As a result of this there is progressive shift in the conditions of groundwater replenishment, from continous state in humid zones to periodical and then completely discontinuous recharge in arid zones (Schoeller, 1959).

Thus because the area of study is in the semi and zone where rainfall is seasonal, it's aquifers are only endogenously recharged. Therefore there is the need to properly manage its groundwater resources.

2.3 WATER RESOURCES DEVELOPMENT IN NIGERIA

Water resources development was an exclusive preserve of the private individuals and groups, prior to 1960. The government major intervention came during the first National Development Plan period (1962-1968) through the establishment of the River Niger and Lake Chad Basin Commissions (Handidu, 1990). The Commissions were mandated to produce hydrological maps of the country's water resources, use the map to fashion out a comprehensive development of agriculture,

fisheries, animal husbandry and navigation (particularly the river Niger). Following this was the establishment of the Sokoto-Rima and Chad Basin Authorities in 1973 and 1974 respectively. In 1976 the number of the River Basin Development Authorities was increased to eleven to cover the whole country. The River Basin Development Authorities (RBDAs) were charged with the responsibility of a comprehensive water resources (surface and groundwater) development of Nigeria for multipurpose uses such as through dam construction and provision of irrigation infrastructure, exploration and development of underground water, hydrological investigation and water supply for human and livestock consumption. They are also to develop land resources for agricultural production on a national basis throughout Nigeria (Anderson, 1984). In 1984, the RBDAS were increased to 18 and redesignated River Basin and Rural Development Authorities (RBRDAs). However, in 1985, the number was scaled down to 11 and retained the name RBRDA, and its function limited to purely water resources development. Salau (1986) points out that the need for this development was quite obvious for areas where the rainfall is in adequate or concentrated within a short season and where high evapotranspiration results in water deficit during a substantial part of the year.

Regretably however, the impact of the RBDAs is not much felt. According to Salau (1986) their objectives could not

be said to have been met. 'Enclave' economics are formed within the rural areas they operate. General problems of the RBRDAs pointed out by Adams (1984) was that of concentrating on single-purpose large-scale projects. Conflicts arise with state Government over projects as a result of duplication of functions. For examples there was an attempt to take over the Idere Gorge Dam planned by the Oyo State Government by the Ogun-Osun River Bain Development Authority. Other problems bedevilling the RBDAs include lack of political delimitation (of States) resulting in coordination problems, incomprehensive basin ecology studies and non integrated basin planning to include the socio physical equilibrium reached over time. Poor resettlement planning also results in human suffering.

As the best alternative, Salau (1986), suggested the construction of small scale dams and barrages across rivers; boreholse and tube wells; appropriate intermediate technology and sequential introduction of innovations which can be mastered and manage by the local people within a short period. He stated that this strategy wad adopted by the Kano State Agricultural and Rural Development Authority (KNARAD) and has been successful.

As part of its water resources effort the Federal Government in 1979, re-establish the ministry of water resources (hitherto created in 1975-1977) which was merged with the Federal Ministry of Agriculture, Water Resources and Rural Development in 1987. It was however, distintegrated in 1989 w

to reconstitute the ministry of water resources and charged with the sole responsibility of water resources development (Hassan, 1991). In 1991 the ministry was again merged into that of Agriculture, Water Resources and Rural Development.

The latest reconstitution of the ministry was informed by the need to broaden it's scope of operation in order to overcome the structural, administrative and operational weakness witnessed in earlier attempts of the ministry of water resources. Despite this, the solution of the latter problems according to Hassan (1991) is aimed at using expensive technologies by the new ministry. The implication is that the government might not be prepared to invest in the rural areas due to high costs. It is pertinent to note that among the problems of installation and maintenance of such sophisticated systems are lack of funds, spare parts and technical expertise (Anderson, 1984). Moreover attaining food self sufficiency is the major objective of the new ministry; developing water for irrigation will therefore be its main focus.

Among the ministry's programmes are direct labour design and construction of small earth dams to supplement efforts of water supply to rural communities, especially where borehole construction is uneconomical. Such dams also supply water for small scale village level irrigation projects. The ministry's domestic water supply programme is generally geared more towards urban and semi-urban areas.

Parastatals for water supply development, were also established at both the state and local government level. There was the establishment of state water boards or corporations, ministries of water resources with or without Rural Development depending on the state.

Despite all these efforts, water supply problem still persists. This could be due to heavy reliance on expensive western technologies and neglect of the communities in the planning, implementation and maintenance of the schemes. In order to ameliorate maintenance problem, the Directorate of Food, Roads and Rural Infrastructures (DFRRI) was established in 1986. One of the main aim of DFRRI was the mobilization of the people and local resources for grassroot development in conjunction with government.

The creation of DFRRI has however been strongly criticised for the duplication of functions of state and local governments and other parastatals. It is also believed that DFRRI in it's present operational structure, is not he best solution for the development of our rural areas. There are still intractible problems including water scarcity.

Thus, although DFRRI has made some impact, despite the involvement of numerous organisations in water provision, the majority of the rural areas continue to be neglected.

In general, inspite of the various efforts by the Federal and state government to improve the water supply situation in the country, a lot is still required especially in the rural areas. This is because most of the projects do not have enough community input.

2.4 WATER DEMAND AND SUPPLY SITUATION IN NIGERIA

Nigeria has abundant surface water and groundwater resources. But the geography and geology of the country has resulted in the uneven distribution of the water resources. While some areas have perenial surface water, others do not, and while some are under lain by thick aquifers that receive ample inflitration, other areas are underlain by aquitards, aquicludes and even aquifuges (Ezeigbo, 1990). Nigeria's large population requires adequate quantity water to maintain and increase industrial and agricultural growth, reduce infant mortality and morbidity rates and check the alarming rates of (poor quality) water related diseases like typhoid, cholera, guinea worm infection and diarrhoea.

For a modern home the average percapita requirement of water per day is 115 litres. Out of this figure only about 2.5 litres is used for drinking, though more will be used in hot climates. The rest is for cooking and sanitation purposes. The actual water used may be greater depending on availability (Ayoade and Oyebande, 1978).

In developed countries portable water supplies are considered an essential commodity and are relatively inexpensive

(representing only a small fraction of the disposable income). Accordingly local government generally require that public water supplies be of sufficient quality and quantity to satisfy the requirements of the population (Babalola, 1990). Thus the provision of water supply of sufficient quality and quantity is not left to the discretion of individual engineers or politicians but are mandated by statutory regulations.

To determine the water demand of any community, it is very necessary to know the population. This is because an under estimation could result into inadequacy of the project; making designing reconstruction and refinancing necessary. Like wise gross over estimation could lead to excessive capacity that must be financed by smaller population by a considerable high unit cost.

It is clear from the above that demand for water in any country is a function of its population. In Nigeria for example, this vital parameter for estimation of water demand and eventually its rate of growth from time to time is not readily available for any town or village (Babalola, 1990).

It is estimated that almost 1.4 billion (18%) of the people in the developing countries will be living in the rural areas (Ogunrombi, 1988). Where as at present there seems to be great inbalance in water supply between the urban and rural communities of those countries. While there are a number of existing urban water supply schemes with varrying degrees of performance; the rural dwellers, especially women and children are busy trekking

several kilometers daily in search for portable water. Out of Nigeria's population of 88.5 million (1991 provisional census) less than 50% have access to portable water and in most cases of questionable quality and quantity. Urban dwellers do not enjoy more than 32 litres per capital per day. Further more it is also believed that about 70% of the entire population reside in the rural areas and water supply to the fortunate among them is understood to be grossly inadequate and often fall as below as 4 litres/capital/day (Mustapha, 1984).

Compared with some other developing countries the above figures are discouraging. For example, in Sierra Leone, Bah (1978) gives the per capital water use in two communities to be 45.7 and 41.2 litres respectively. These are rural communities that depend on local shallow wells.

The government of Nigeria in the Third National Development (1875-80), recognises the fact that "the supply of portable water in adequate quality and quantity is a vital factor in the determination of health, welfare and productivity of the population". (Federal Ministry of National Planning p.297). Despite this, the present situation in both the urban and rural areas in the country is that of inadequacy. All over the country there are sizeable communities without pipe borne water. In the rural areas no more than 10 percent of the population have access to pipe-borne water. This means that majority of the people depend on unhygienic sources for their water supply such as shallow wells and streams. Dependance on

these sources of water especially by the rural dwellers has been recognised by government to have adverse effect on the health of the people.

In recognising that Nigeria is endowed with natural water resources spanning considerable sections of river basins, a catchment area of many streams and receives at least 1500mm of rainfall a year (Elabi, 1987), the government believes that the water supply situation can be remedied with proper planning.

The good intentions of government in trying to make portable water available to all is however being hindered by certain factors. According to Anderson (1984), the basic problems inhibiting this progress is that while "a basic foundation exist for providing urban water supply,no such foundation is available for rural water supply". Despite the formation of DFRRI and it's laudable water supply programme the above argument still holds. This is because for the rural areas, the issue is the absence of a uniform or co-ordinated scheme for water supply by the different agencies concerned e.g. the local government and the DFRRI. To minimise conflicts, there should be clear assignment of responsibilities so as to attain an effective supply system.

Even though some progress has been made, the water supply situation, particularly as it affects the rural areas is yet to achieve the objectives set out in the plans 12 years after its pronouncement.

In a summary of existing water supply for both urban and rural communities as at early 1985, Oyebande (1990), states that the total urban water supply is 1800 MLD for a population of some 28 million. The production capacity thus gives an average consumption of 63 litres per capita per day. In the rural areas, the total water supply amounted to 350 MLD. Only 14 million had access to this supply thus obtaining an average per capita consumption of 25 L/d.

Oyebande (1990), further said that the variation in the level of water supply from one state to another is great. For example urban centres which accounted for nearly 30% of the country's population, the daily per capita consumption varies from 18 litres in Ondo, 38 litres in Imo and 40 litres in Ogun to 107, 117, 182 and 244 litres in Bauchi, Kano, Kaduna and Benue State respectively. Even within these states spatial variations are significantly high.

From the above discussion the national average per capita water supplies of 63 litres per day for urban centes and 25 litres per day for rural communities are certainly very much short of the national target of 112 litres for 1980. So is the overall average of 49 litres for both communities. Oyebande (1990) noted that in some states, average daily per capita water use is as low as 18 litres though rarely so, for urban areas; and 2 to 5 litres for the rural areas. The intra-state short-falls are even greater for both urban and rural communities.

The consequences of water supply shortage are well krown. As such, water should be accorded the priority it deserves. The DFRRI rural water supply programme is a step in the right direction. However, there have been discrepancies in plan implementation in some states such that while some states have taken giant strides in their efforts, others are yet to find their feet. This problem cannot be divorced from what Anderson (1984) said stem from lack of proper coordination of the efforts of development agencies within the water resources development sector and which is one of the many problems Nigeria is yet to resolve alongside bureaucratization and politicization of programmes even the laudable programme of DFRRI.

2.5 UTILIZING GROUNDWATER RESOURCE

Problems and Prospects

Groundwater, being an important source of water supply, has many advantages for water supply development over other sources of water supply. The aquifers underlies geographically large areas and can frequently be tapped close to the water demand at least for smaller supplies thus maintaining reticulation requirements. Also there is a nature protection from evaporation for water stored in aquifer and the drainable storage is substantial. In areas prone to drought, security in terms of large volume of water supply is usually from ground water resources. Given adequate protection of the aquifer, ground water is of high microbiological and organic quality requiring minimal treatment (Foster, 1984).

In developing groundwater, its capital cost is relatively modest and with minimal land requirements, ground water resource thus lends itself to flexible development capable of being phased out without rising demand.

Because of these advantages, groundwater is an attractive source of portable water supply, even in relatively humid climates. Despite the numerous stated advantages of groundwater, there are some hydrogeological problems. Some of these problems include:

(i) Goehydrological inhomogeneity of many minor aquifers which may hamper successful drilling of wells;

(ii) Difficulty in estimating the recharge rate and exploitable storage, available for large scale development in major aquifers, and

(iii) The occurence of bodies of groundwater with unacceptable inorganic characteristics in some aquifers (Foster, 1984).

Other problems that affect groundwater harnessing viz-a-viz well (bore hole) construction are related to economic factors. According to Foster (1984) these constraints are determined by:

(i) the size, location and quantity of projected water demand which defines the required knowledge of the local or regional groundwater system, and

(ii) the economic value (opportunity cost) of the proposed resource utilization, which in general will dictate the viable level of associated investigation.

Although public water-supply cannot be subjected to intensive economic analysis financial constraints however are a major factor retarding its development in Nigeria.

Borehole maintenance and reactivation is becoming an increasing problem of water supply in many areas of Nigeria (Akuyam, 1990). The frequent burning of pumps and the rampant cases of fallen pump in some boreholes is an issue of concern to the government. These problems result from inadequate data or the use of unskilled man power to man the schemes. Another problem associated with borehole projects is that there is no standing rule for pump installation and poor borehole records. For example, it was noted by Akuyam (1990) that an average of one pump gets burnt or falls ito into a borehole every week in Bauchi State. All these point to the problem of technology transfer without adequate attention being paid to maximum utilization of local resources and low capital investiment to attain the goal. It also emphasizes the need to adopt small scale application that is suitable for village and local control.

In addition to the problems of failure and poor maintenance, the cost of borehole construction is very exhorbitant. Average cost of drilling a borehole was estimated by Adekayi (1991) to be between ₦100,000 to ₦250,000. The system of distributing and other accessories will bring an additional cost of ₦100,000 per boreholes. Additional costs are incurred in the maintenance and operation of the wells, on the whole a borehole

system will cost between ₦500,000 - ₦1,000 000.

Such a cost is obviously beyond the economic capability of many rural communities. Consequently, borehole construction has become the sole responsibility of the governments at different levels.

Other factors that usually result in decrease in borehole yield or borehole failure include: (i) small aquifer, (ii) limited recharge (iii) improper screening of the borehole (iv) incompactibility of the openings (slots) or holes of the screen with hydrological properties of the aquifer material, (v) short screen and (vi) high rate of pumping. Inflow of fine sand, silt and muddy water could also result in borehole failures if the screen is improperly selected to suit the aquifer and/or if the well is poorly developed and parked (Michael, 1978).

In general improper design of a well, assembly and use of unsuitable screens could result in low discharge. Further more, the use of fine screens against coarse sand or gravel formations will restrict the inflow of water through fine screens resulting in higher drawdown in the well.

Well failures could also be caused by incrustation and corrosion. Incrustation is the building up of material around the screen or perforated well section, even on the metal itself to form a hard impervious well through which water cannot pass. This is usually due to the precipitation of carbonates principally of calcium from the ground water in the proximity

of the well screen. Other substances, such as aluminium silicate and iron compounds, may also be entrapped in the scale like carbonates which cement the sand grains together around the screen. The deposit fill the voids, and the flow of water into the well is reduced proportionately.

Geophysical investigation is important in the siting of boreholes. Geophysical methods provide indirect evidence of subsurface formations that indicates whether the formations may possibly be aquifers. Geophysical methods however do not directly measure type of rock, porosity, permeability or density of any formation. They do measure some other properties of the materials that vary with the factors which determine whether a formation may be sufficiently porous and permeable to serve as an aquifer.

The Directorate of Food, Roads and Rural Infrastructure (DFRRI) is saddled with the responsibility of utilizing Groundwater resources to provide portable drinking water to the rural communities in Nigeria. This is being done through the construction of boreholes/wells. Incidentally, there are reports that some of these wells are failing. This situation is pathetic because the rural dweller would then have to go back to streams and brooks for their domestic water supply. This therefore, has become a serious problem area for rural development experts, who feel deeply concerned about the plight of these rural dwellers.

CHAPTER THREE

THE STUDY AREA AND METHODOLOGY

The area under study constitutes the Makarfi and Soba Local Government Areas (LGAs) of Kaduna state. It is located approximately between latitudes 11° 27° and 11° 00'N and longitudes 7°37'E and 8° 00'E. Located in the Northern part of Kaduna State, the study area is bounded in the North by Kano State, in the Western side by Sabongari, Zaria and Igabi LGAs, in the eastern side by Ikara LGA and on the Southern edged by Kauru LGA (figure 3.1).

3.1 CLIMATE

The study area falls within the tropical savannah climate. Temperatures vary between less than 20°C around January and over 30°C in April. Diurnal and annual variations are fairly large (Annex 1). The area experiences two distinct seasons: rainy season which extends from April/May to October, and a dry season between November and April. The annual rainfall ranges from a minimum of 768.5mm to a maximum of 1188.3mm. Average annual rainfall for a ten year (1976-1985) record from the meteorological station Zaria is about 950mm (figure 3.2). The low and seasonal character of rainfall makes it's mark on the vegetation of the study area which assumes various shades of green in the wet season and turns brown pale of yellow in the dry season. According to



FIG. 2.1 Location of Study Area in Kaduna State
Source: Ministry Of Information Kaduna State

Thornthwaite's moisture index described by Adedeji (1982), the climate of the study area is dry sub-humid.

Early rains in May - June are marked by line squalls resulting from the invasion of two distinct air masses,one from the north (dry and continental in origin, the saharan airmass) and the other from over the Atlantic in the South (moist, cool and equatorial maritime in nature). The weather depends, to a large extent, on the airmass which covers the area and it's depth. These two airmasses form a discontinuity zone of their boundary. In West Africa this quasi-stationary boundary zone between the moist equatorial air (M^E) of mostly Southern Hemisphere origin and the dry tropical continental air (cTs) of the Northern Hemisphere origin is usually refered to as the Inter Tropical Discontinuity (ITD). The surface position of the ITD runs north to south across the country. It is the location of a place in relation to the surface position of the ITD that determines its weather (Hore, 1970).

Evapotranspiration occurs all the year round but is generally highest during the months of March to May. When the amount of rainfall exceeds the evapotranspiration a surplus of water occurs which goes into the reserve, but when the reverse is the case, some water from the storage is lost to evapotranspiration.

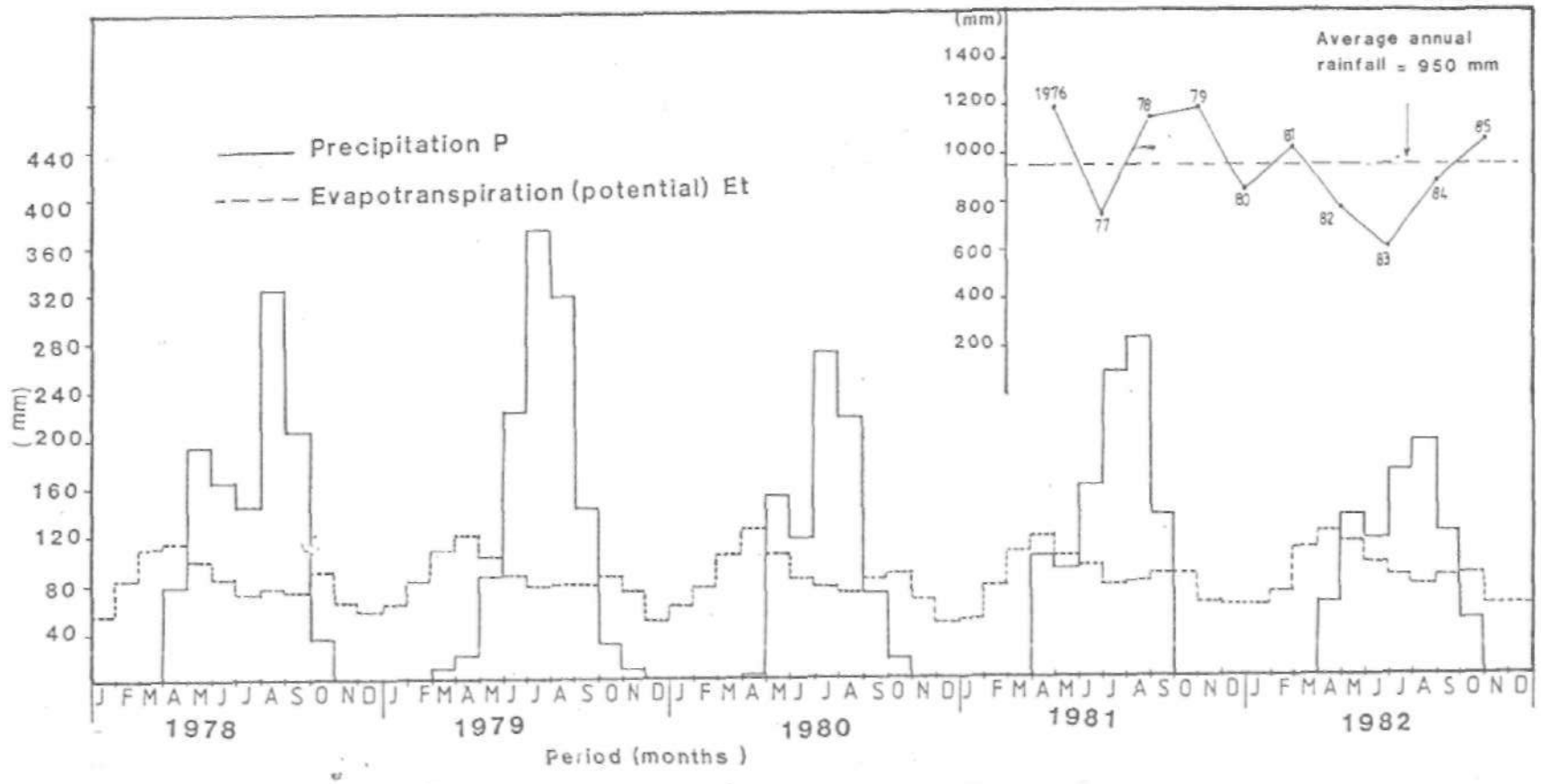


Fig-3.1: Relarionship between rainfall (P) and evapotranspiration (Et) in the study area.

The soil in the study area remain dry for about six months within a hydrological year, especially between November and April. At the onset of the rains, because evapotranspiration, (ET) rate is generally still higher than precipitation, the first rains are lost directly through ET, hence, there is no positive rise of water reserves.

Between July and September, the temperature drops and there is considerable surplus of rainfall over ET. Some of this surplus is used to recharge the soil moisture until this reaches its maximum capacity. Some of the remaining water after the soil had been saturated, drains down to the ground water table. Hence the water in the soil is first lost to evapotranspiration (ET) and there after some water reserve is also lost to ET which result in a progressive decrease in the amount of water left in reserve.

Inadequate knowledge of the groundwater reserve in areas designated for borehole construction can lead to well failures. For optimum advantage of taping water from various depths, it is important to estimate the ground water reserve to enable proper water management. This is to avoid over draft of the available groundwater reserve.

Lack of data however, did not permit the estimation of the ground reserve in this study.

3.2 GEOLOGY AND GEOMORPHOLOGY

It is very important to know the nature of the geological formation of an area, because some are water bearing while others are not. We have, for example, the aquifuge, aquitad and aquiclude. These are various geological formations which may or may not contain water. It is thus important to know the geology of a place to ascertain if water will flow from a well constructed there or not.

A summary of the geology of the study area was given by McCurry (1973). The area is underlain by crystalline metamorphic and igneous rocks of precambrain to lower paleozoic age.

A major part of the rock is of high grade metamorphosis, mainly gneisses which suffered intense folding and granitisation and have remain stable for millions of years.

Sediments of late proterozoic age are found folded and metamorphosed mainly into schists. Intrusive rocks of late proterozoic to cambrain age, including synorogenic to late orogenic granites, minor basic and ultra-basic rock dykes and pegmatites, are also found. Figure 3.3 shows the geological map of the project area. Prolonged weathering under tropical conditions has produced a characteristic topography of peneplain and inselbergs and domes of resistant basement rocks. A combination of topography and geology more or less control the groundwater occurence in this area.

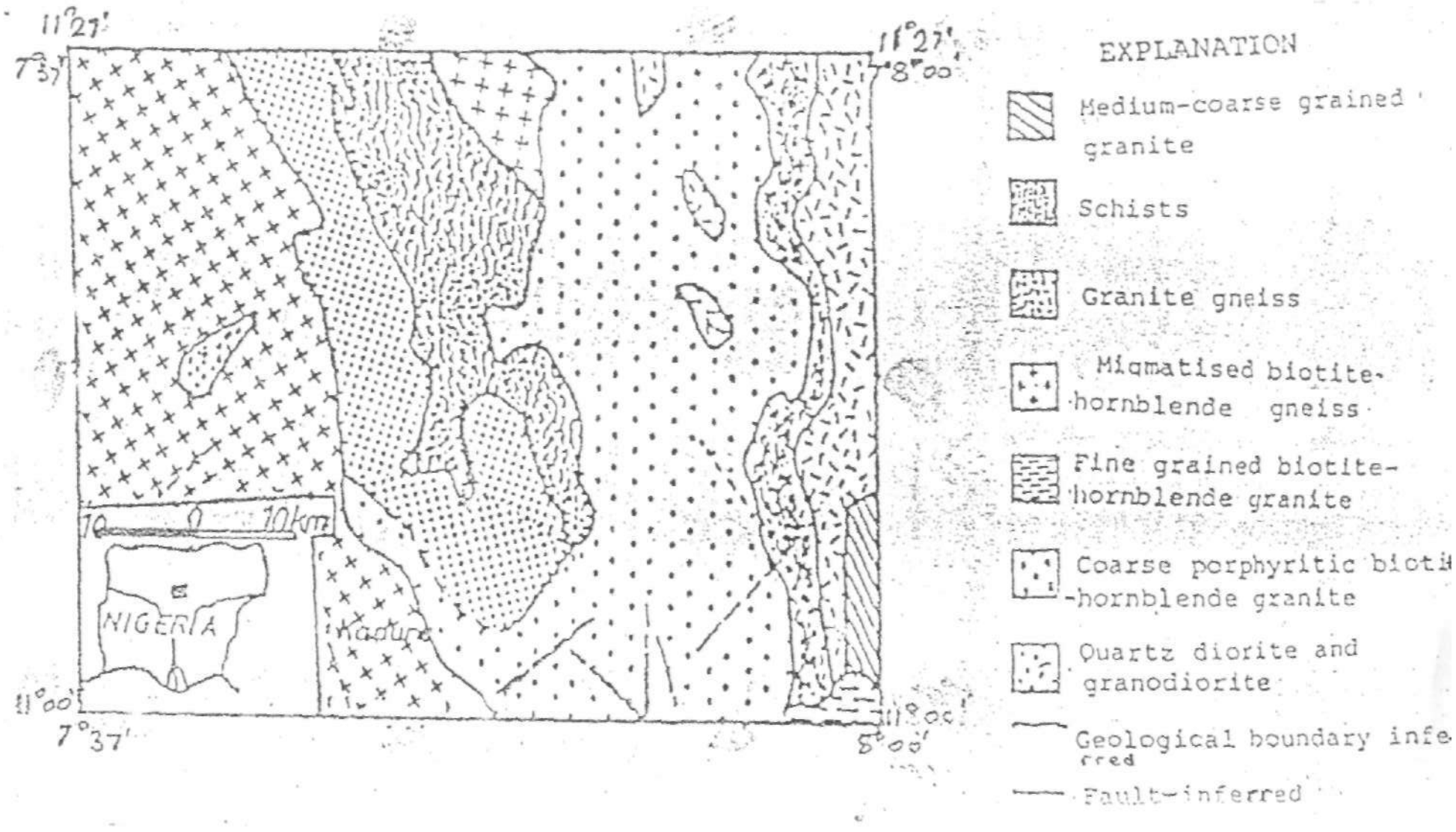


Figure 3.3 Geological map of study area **(After Adanu 1987)**

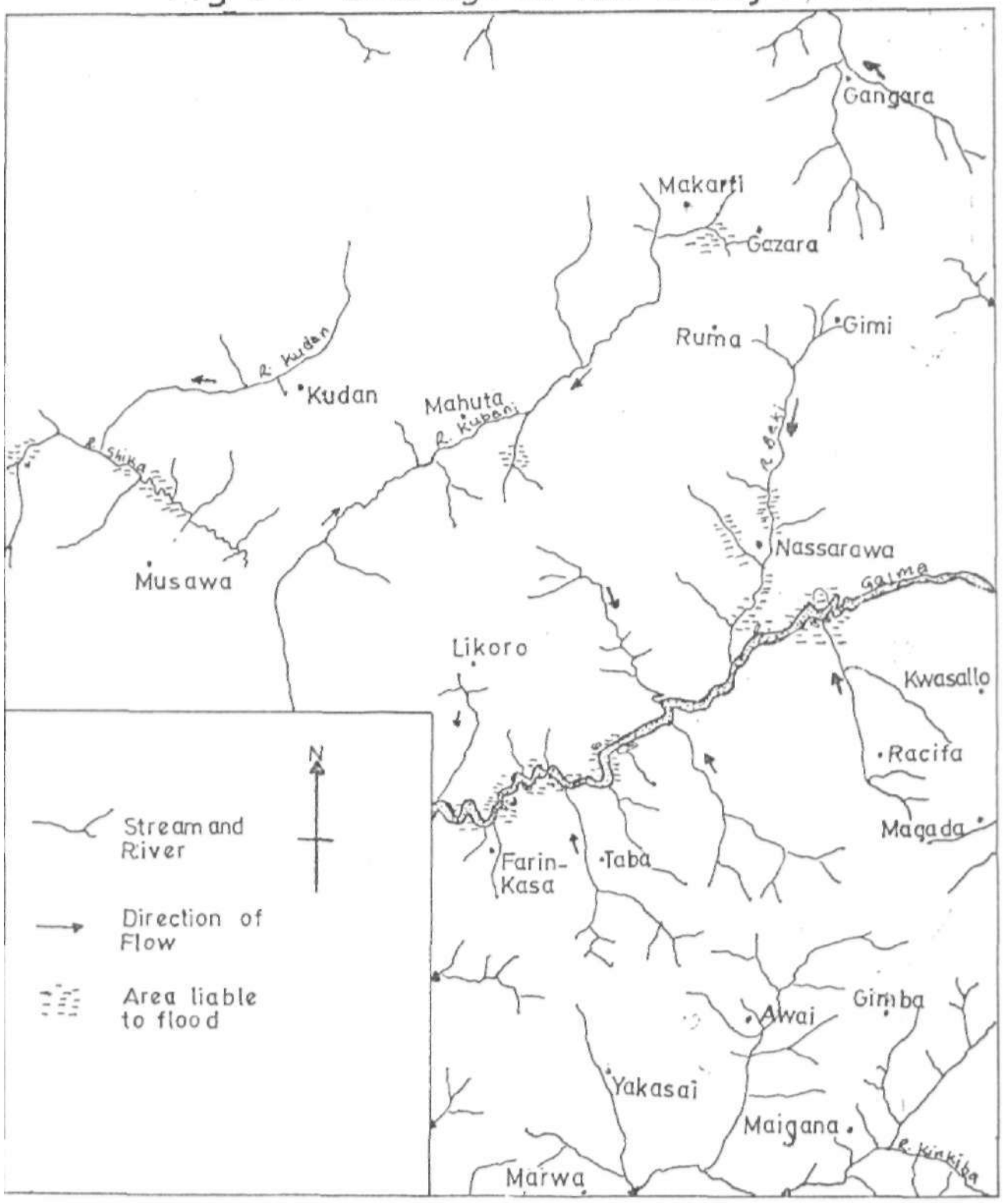
3.3 DRAINAGE

The main rivers draining the area of study are the Galma in the centre, the Kinkiba in the South and the Kubani, Baki and Shika to the north (see figure 3.4). These rivers flow mostly during the rainy season and water may occur in discontinuous pools with large parts totally dry on the surface in the dry season. Alluvial sand deposits occur along some of these rivers.

The drainage pattern are mostly dendritic, especially in deeply weathered areas. This may imply that the water courses are not structurally controlled. However river Galma follow some structural trends in a number of places. In such places the river makes right angled turns between Shika and Farinkasa; between Magada and Taba on the granite gneiss (in the North East). A more prominent right angled turn is observed between Nasarawa and Kwasallo where the river flows along a fault trend almost north for approximately 1.5km before branching off in the south west direction.

The Galma river which is the major river in the study area is at advance stage with gentle slopes and slow rate of erosion. Down stream the river becomes sluggish and a large part of the loads carried (mainly medium to find grain materials) are deposited along its banks.

Fig. 3.4 Drainage of the Study Area.



Source : Survey Department, S/gari L.G

3.4 HYDROGEOLOGY

The basement complex is a general feature of the region of study. Fracturing and weathering of these rocks produce a secondary porosity which permits the flow and storage of ground water.

Two types of interconnected aquifers are indentifiable in this terrain; one is the weathered overburden, a mantle of insite weathering product which likely developed during warm fluvial cycles of the pleistocene epoch and which lies directly on the fractured bedrock which constitutes the second aquifer. (Adanu, 1989). Water occurs as a continuous cell from the weathered material to the fresh basement through the fractured Zone. Static water levels in wells stand between 5 meters and 10 meters below ground surfaces (Adanu, 1989). This means that the fractured Zone is always saturated with water Lowering of groundwater level caused by water discharge along river channels and evapotranspiration usually occurs in the weathering over burden.

Alluvial deposits along the beds of river channels and along the banks of existing river contain water at times of high rainfall but are quickly depleted with the ceasure of rainfall. Figure 3.5 shows a cross section of the aquifer. A continuous body of water is observed from the fresh basement rock up to the lateritic top soil. The weathered profile which is relatively thin but extensive and more or less

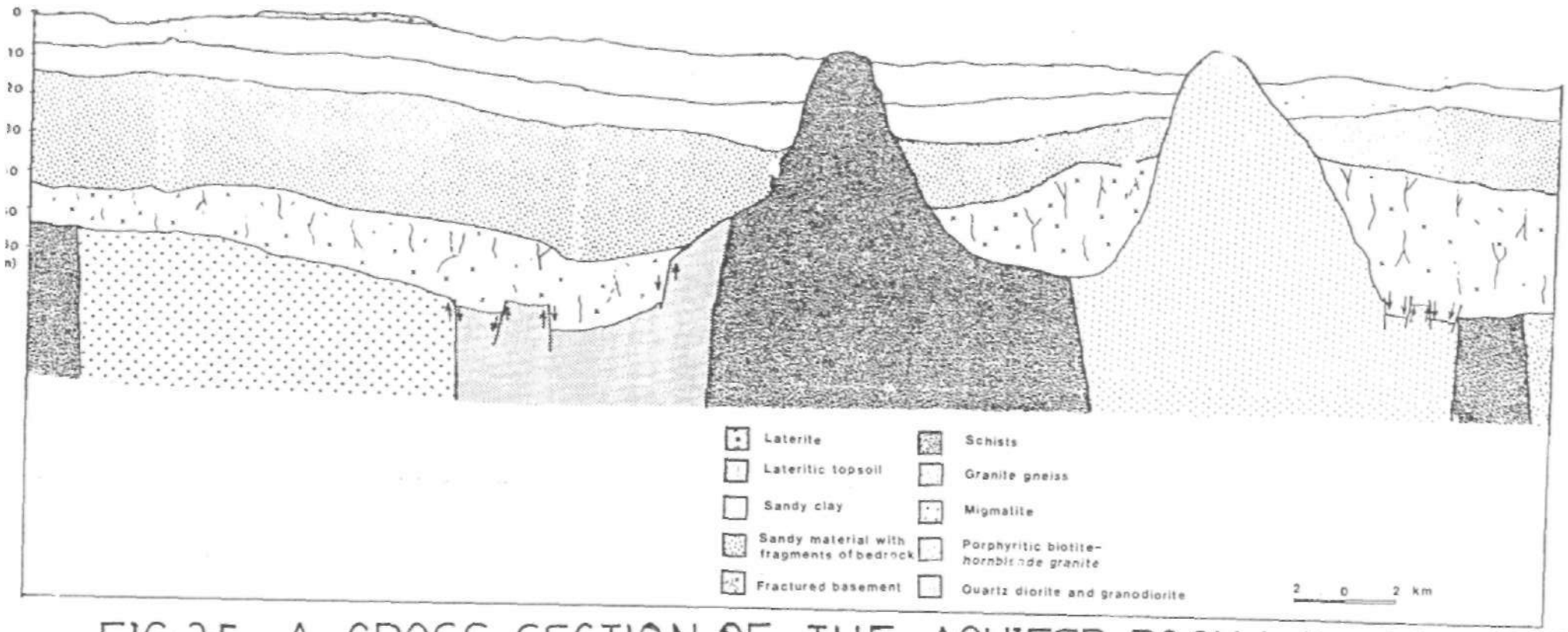
continuous, is of great importance as a source of rural domestic water supply. Usually, boreholes drilled into the fractured bedrock which may be locally highly permeable, draw on the storage of the saprolite cover which is usually sandy and silty.

Water occurs usually as unconfined, but semi confined conditions are also observed. This is due to the relatively impermeable, thin layers of clayey lateric topsoil and duricrust which are always found at depths between 3 and 8 meters below the ground surface. Water is usually struck at the base of this layer during drilling and the rest water level usually stands a few meters above this depths. According to Adanu (1989), the confined conditions are usually observed in schist and gneiss environment. This is because the weathering products of these rocks are high in clay content. On the other hand water table aquifer conditions are observed in granitic environments where the weathered over burden is usually coarse sand and sometimes pebbles.

3.5 POPULATION AND LAND USE

The 1991 population census (provisional results) of the Federal Republic of Nigeria, puts the population figure for Makarfi and Soba LGAs at 211,246 and 187,277 respectively, giving a total population for study area as 398,523.

The population distribution is uneven. There is a large concentration of people along the main road between Zaria and



FIG·3·5 A CROSS SECTION OF THE AQUIFER ROCK (after Adanu 1989).

Soba, where the main activity is agricultural. The land is cultivated for yams, potatoes, maize, tobacco and sorghum. Local swamps are cultivated for sugarcane, tomatoes and, occationally carrots. Except for occasional vegetable farming, crops cultivated here, mainly for subsistance purpose, are seasonal; and therefore not irrigated. Cattle rearing is not uncommon, but because grazing lands are scarce, rearers migrate south wards during the drier period in search of grazing places. Water requirement here is principally for human and livestock consumption because industrial activities are uncommon in the study area.

3.6. THE RESEARCH METHODOLOGY

3.6.1. VILLAGE SAMPLING

For the purpose of this study, 20 villages have been selected. From each of the two local Government areas under study, 10 villages were selected using systematic sampling, making a total of 20 villages. 300 respondents were sampled from among the village residents, 15 in each sample village. All village heads were administered a questionnaire each which was different from that of the villages, so also that of the community development officers in the two LGAs. The random sampling techniques, using the table of random numbers was used to select the villages in order to give each village an "equal chance" of being selected to avoid biases that maybe introduced.

3.6.2. SOURCE OF DATA

To obtain information required for the purposes of this work, two sources of data were used.

Primary Data Sources:

Primary data collected was done through questionnaire and oral interviews, field observation and measurements.

(a) Questionnaire interview

Three sets of questionnaires were designed and administered to three categories of the population. The sets of questionnaires which were designated A,B, and C, were administered on the male adults, and few females, village heads in each of the twenty sampled villages and the community development officers in the two local Government areas respectively.

A total of 300 copies of questionnaire 'A' were administered in all the 20 sampled villages on house hold basis. Only one adult was interviewed irrespective of whether he is the household head or not. The respondents were selected using systematic transect or random sampling depending on the pattern of particular villages. Every third or fourth house was taken from the village head's house or from the market area.

Contents of the questionnaire include: occupation, House hold water collection and use, water safety, adequacy of water supply, and community participation in water supply development (Annex 2).

A total of twenty copies of questionnaire 'B' were administered on each village ahead. The content deals with items relating to village level organisation for village water resources development and supply for domestic purposes, nature of the projects, successes, failure and problems (Annex 3).

A copy each of questionnaires 'C' was administered on the officer in charge of community development in each of the Local Government Area under study.

The content includes the location and extent of the DFRRI wells, functionality of the wells, problems and solutions (Annex 4).

(b) Oral Interviews

The following respondents were orally interviewed:

(i) The State DFRRI officers in charge of Rural Water supply and sanitation (RUWATSAN) based in Soba and Makarfi and the two LGAs community development officers.

(ii) Alhaji Ahmadu Maude of the Kaduna State Water Board and the health officers in the study areas.

(iii) The Chief Planning, Research and Statistic officer of the Federal Ministry of Agriculture, water resources and Rural Development Abuja.

(i) Local residents in the sampled villages.

(c) Field Observation and Measurements

Apart from questionnaire and oral interviews, field observations and measurements of existing situations were carried out to support or ascertain facts obtained from other sources of information earlier highlighted. Of particular interest are the water sources and project sites.

Secondary Data

Secondary data for this study was obtained mainly from books, journals, conference and seminar papers, maps, articles and

dissertations relevant to this study. Official documents from local Government offices, ministries and other Government departments were also consulted.

3.6.3 Data Analysis

Both quantitative and qualitative analysis of data have been used in ths work. Quantitative analysis is simply "systematic use of numbers to describe and explain a phenomenon, situation or case" while qualitative measurement is a form of description such as we would describe or explain a socio-economic reality (Kiabi, 1987) as in Babbie, 1971.

Qualitative measurement has been carried out by computing responses of respondents and other forms of data obtained by the use of the mean and percentages. These are presented in form of data matrix, graphs and charts.

Descriptive (qualitative) analysis has been used to substantiate information got quantitatively.

CHAPTER FOUR

RESULTS AND DATA ANALYSIS

4.1 INTRODUCTION

This chapter presents the analysis of the data collected. An attempt is made to appraise the activities of DFRRI, as regards portable water supply to the people in Makarfi and Soba Local Government Areas, of Kaduna State.

4.2 SPATIAL DISTRIBUTION OF THE WELLS

An objectives of this study is to examine the spatial distribution of the wells. In the study are, most commonly found and used are open hand dug wells. They are drilled by the the simple hand excavation technique, using pulley with buckets. Well diameter ranges between 60-68cm and the wells are protectively concretised while perforated holes like screens are designed in the cyclindrical concrete which are then positioned within the aquiferous layer. Above the ground level, the well is being protected with concrete of about 0.6m in height to prevent influx of impurities into the well and for easy fetching of water by children. Some of these concrete wells are constructed by DFRRI and an example is shown in plate 1.

There are also rotary drilled boreholes constructed by DFRRI in the major villages throughout the study area. Here,

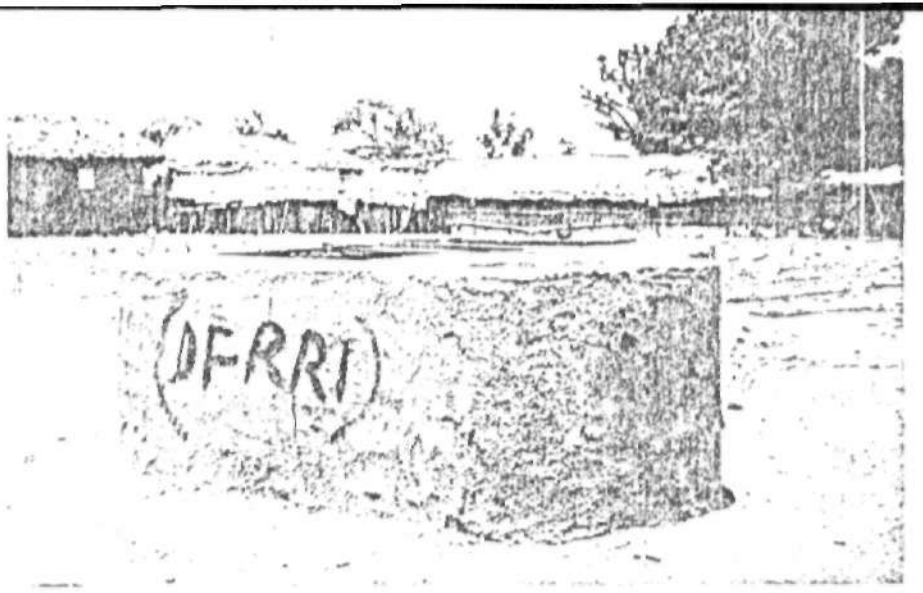


PLATE 1: DFRRI Open concrete well
Source: Field work 1992



PLATE 2: DFRRI non functional borehole with hand pump
Source: Field work 1992

hand pumps of Indian mark II type were installed, but unfortunately some are not functioning (see plate No.2).

The non-functional pumps could have suffered heavy wear and tear due to considerable loss in the height of the static water level (drought) of which some parts, such as starter relies on water for lubrication.

The area distribution or the sitting of the wells was totally controlled by the pattern of rural settlement (see fig.4.1). This however does not mean that the wells are optimally located, for there are quiet a number of settlements that have been neglected and the dwellers have to trek long distances, most especially during the dry season, to get water. It was also ascertained from field observation that most of the boreholes were sited in front of the houses of the head of a particular village, or close to it. This is due to political clout or the influence of the village heads. These sites are not necessary the most groundwater yielding points in the aquifer.

One other interesting aspect of the spatial distribution of the wells ins that they are located near the rivers and streams (see fig 4.1). This means that the water table will be high and it is an indication that DFRRI is trying to minimise cost by utilising available natural water resources in its boreholes programme.

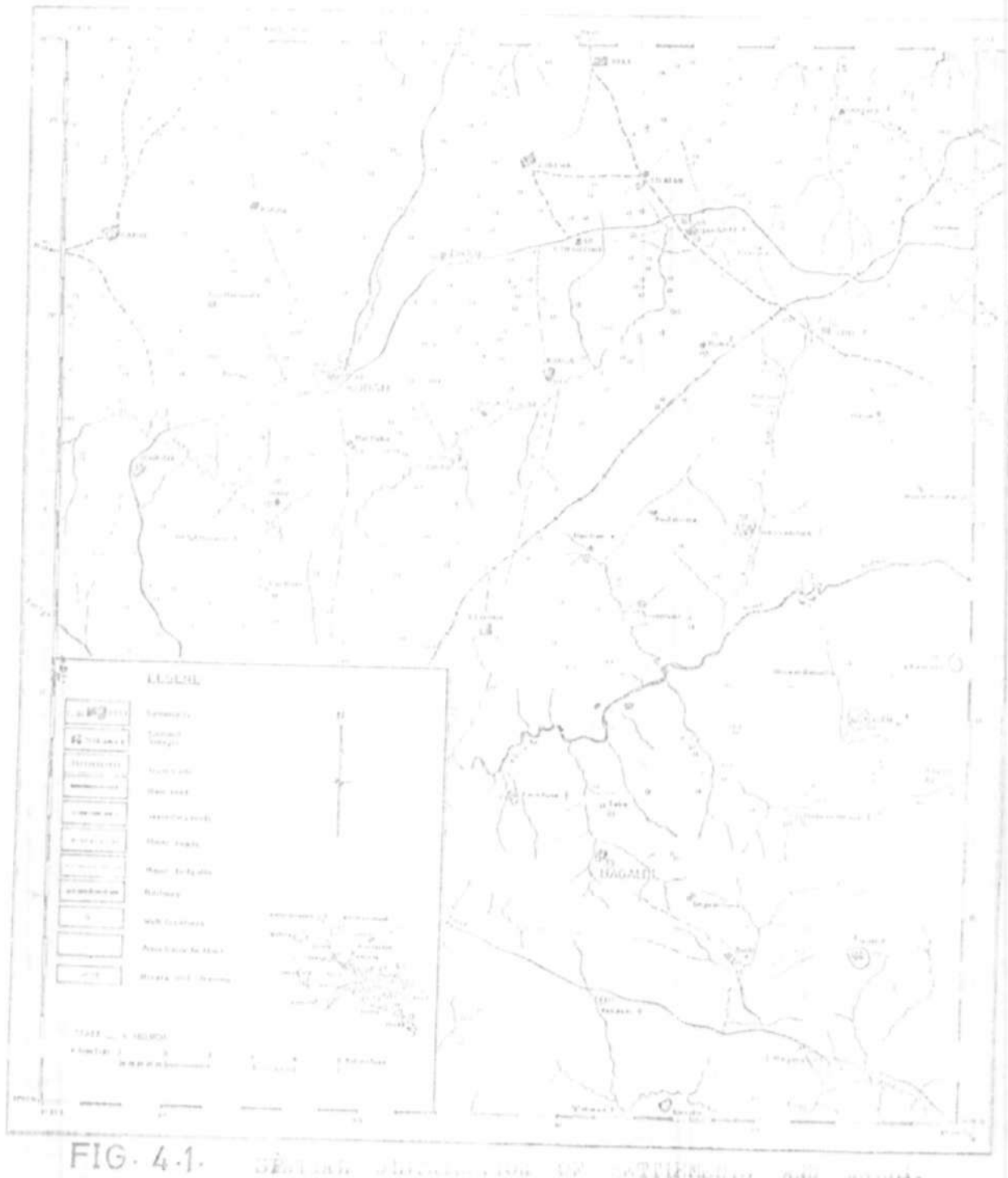


FIG. 4.1.

4.3. INCOME DISTRIBUTION PATTERN

An objective of rural development is to raise and ensure the equitable distribution of income among the rural people. This is in realization of the vital role of income in the development of any area. In the Soba and Makarfi Local Government Areas, low financial capital has been identified as a major problem in meeting the basic needs of the people (Table 4.5).

Table 4. Annual Income of the Respondents

INCOME LEVEL	TOTAL RESPONSES	% OF TOTAL RESPONSES
Below ₦1,000	-	-
₦1,000 - ₦2,000	50	16.7
₦2,001 - ₦4,000	12	4
₦4001 - ₦6,000	20	6.7
₦6,001 - ₦10000	142	47.3
₦10000 and above	76	25.3
Total	300	100

Source: Field Survey, 1992.

The sale of agricultural products and trading in locally manufactured goods form the main source of income while the sale of labour is fast gaining importance as sources of income. The level of technology, poor transportation and market facilities and

and the small size of holdings are the main factors which may make income low. In the study area, more than 70% of the respondents earn less than N10000 per annum, while about 25% earn above N10000 per annum. It is a common knowledge that most people who earn low income do not engage in more than one occupation, while most of those who earn high incomes are traders and farmers who engage in other secondary economic activities (Field survey). These incomes are by Nigeria standard in the Civil Service very low; an indication of the rural areas being a subsistence economy; thus high dependance on Government to finance development projects.

4.4. PORTABLE WATER SUPPLY IN THE RURAL AREAS AND UTILIZATION

In an attempt to provide water for all in the 1990s as directed by the World Health Organisation, the Federal Government of Nigeria establish the Directorate for Food, Roads and Rural Infrastructures (DFRRI) in 1986. One of the objectives of DFRRI is to make portable water available to the rural dwellers. A number of problems have however hampered this noble programme as observed from field survey. For the rural water scheme to be successful and it's impact felt by the people, the problem militating against the borehole/well projects of the DFRRI will have to be identified and possible solutions and recommendation given. As a first step towards achieving this, the focus of the study has been on sources of water supply, water collection and water use in the Makarfi and Soba LGAs.

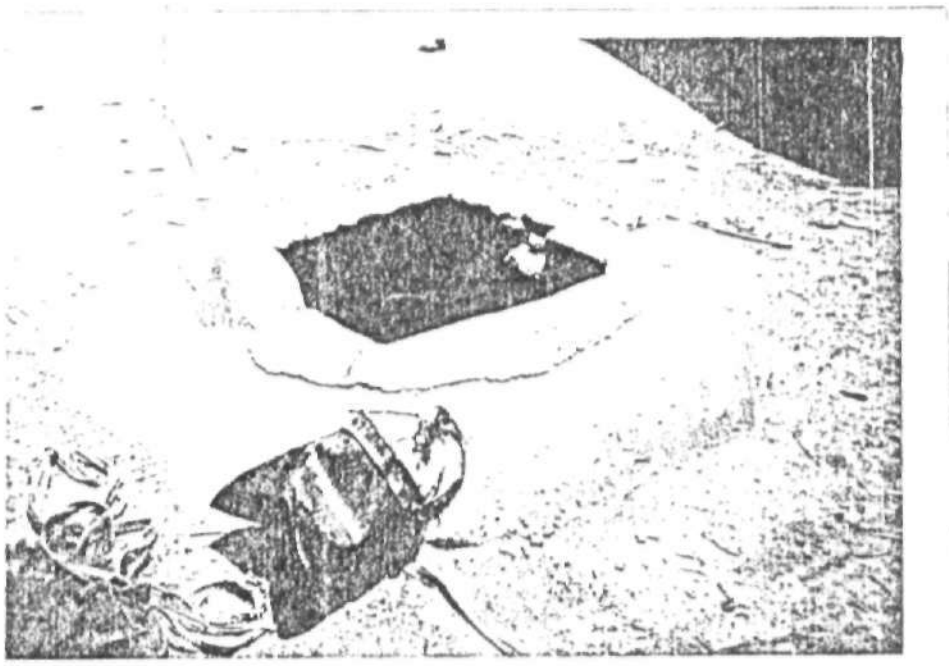


PLATE 3 : TRADITIONAL HAND DUG WELL

SOURCE : FIELD WORK 1992

As an integral part of this study, the level of community participation in the on going and completed DFRRI water projects will also be examined. The next section assesses the extent to which water supply from DFRRI wells meet the water needs of the people.

4.4.1. SOURCESS OF DOMESTIC WATER SUPPLY FOR RURAL HOUSEHOLDS

It is expected that choice of water source will be determined by the quality and reliability and the distance covered. In this respect the sources of water were examined. It was observed that the major sources of domestic water supply in the study area were largely shallow hand dug wells (see plate 3) and bore holes both during the wet and dry seaons. Nearly all (97%) of the respondents in the study area get their water from shallow wells during the wet season while 70% patronize DFRRI wells. About 13% of the respondents indicate getting their water from streams, while 9.3% collect water from ponds.

The direct collection of rain water was another major sources of water for domestic use during the wet season, and 78.3% of the respondents collected rainwater for domestic consumption. Only 1.7% of the respondents patronize water vendors.

During the dry season, majority of the people depend on wells for water. The ponds are dry during this period, so also most of the streams. There is therefore heavy reliance on groundwater. For example all the respondents were reported getting

their water from shallow wells. About 47% of the respondents get water from DFRRI wells but this was largely irregular. Some respondents (14%) purchase water from water vendors to supplement their water requirements. The vendors are of two categories: those bringing water from long distance by motor tanks and those fetching water locally using the 18 litres (kerosin tin) container. The former bring in water to the villages concerned through improved or at least better sources. Most of the motor tanks for example collect their water from the Zaria dam. Those who sell in tins provide no better water than those available to house holds. They are able to sell their products because they are the few that could go longer distance to look for water even at the peak of scarcity in the dry season These sources of water, just like the shallow wells in the house hold, pose the danger of being ladden with water borne diseases. Only 3.7% of the respondents indicate getting their water from stream-bed pits (see Table 4.2).

The result of the survey shows that despite the high percentage dependance on well water, must households still rely on other sources for their water supply. The very high percentage recorded in the usage of shallow wells is because almost all the household have a well in the compound or nearby.

It was observed that the patronage of DFRRI wells fell drastically during the dry season. This is because many of the DFRRI wells do not have water in them, and this can be attributed to the shoddy work carried out by contractors in the construction

of wells and lack of maintenance. Construction work as discussed with the community development officers (CDOs), is usually carried out during the wet season when the water table is high. The implication here is that the water is hit after drilling a few metres. However in most cases this is usually the false aquifer, so that in the dry season when the water table falls considerably, the wells dry up. For example construction work on the completed and two incompleted boreholes in Maigana (Soba LGA) was said to have been carried out between May and June. One of the boreholes close to the Local Government Headquarters was, however, being rehabilitated with an over head tank at the time of this study.

Table 4.2. Sources of Domestic Water Supply

SOURCES	WET SEASON		DRY SEASON	
	NO OF RESPONSES	% OF TOTAL	NO OF RESPONSES	% OF TOTAL
Stream/stream-bed pit	38	12.7	11	3.7
Rain water	235	78.3	-	-
Shallow well	292	97.3	300	100
DFRRI well/Borehole	210	70	141	47
Pond	28	9.3	-	-
Water Vendor	5	1.7	42	14

Source: field survey, 1992.

4.4.2. WATER COLLECTION

Water collection from distance source is one of the problem which the DFRRI borehole schemes were designed to ease. Each family was known to have made its own individual arrangement of person responsible for fetching the amount of water required for their daily household use. Responses on water collection in the questionnaire administered in the area of study shows that water collection is principally done by men and children. 69.3% of the household interviewed stated that this is case. 15.7% indicated that water collection is done only by women while only 15% indicated that the job is done by children (Table 4.3 shows the result).

Result from this survey contradicted with that of other studies (Pacey et al, 1977) Falkenmark, 1980 and Elabi, 1987) conducted elsewhile which portrayed women as solely responsible for water collection for their house holds daily use. The reason for this contradiction could probably not be unconnected with the tradition obtained in the area under study which is predorminantly Hausa/Fulani where Purdah is strictly observed. Thus in a situation where a household has no private well within its compound; and in the absence of a grown up child only the male adults can fetch the needed supply of water for their household use. Observation has however shown that where women were solely involve in fetching water, it could either be due to the availability of a private well within the compound from which enough supply could be drawn by the lady without

necessarily going out of the matrimonial compound; or that the household was not observing the purdah system coupled with the absence of a grown-up child in the household who could helped fetched the needed supply for the day's use. The findings of this work shows that the task of carrying water was principally shouldered by the men and children with the women giving a helping hand.

The benefits that were likely to be derived from an improvement of the water schemes include among others the reduction of distance that will have to be covered to and from the water supply source as well as the time it takes an individual to fetch enough for his daily house hold use. This will help to conserve energy and time which could as well be utilised in other productive activities. In view of this, this study also attempted to find out the distance and time it takes the people to fetch water for their house hold use.

4.3. INDIVIDUAL HOUSEHOLD WATER COLLECTION ARRANGEMENT

WATER COLLECTION	NO OF RESPONSES	% OF TOTAL RESPONSES
Men	208	69.3
Women only	47	15.7
Children only	45	15
Total	300	100

Source: field survey, 1992.

The distance covered by various households to obtain water is however within tolerable limit when compared with situation obtained else where in Africa. For example, in their extensive survey of water use in East Africa, **et al** (1972) observed that women in Mukaa cover a distance of about 4.8km to get to their water source. White et al, also noted that the Mukaa case is even more tolerable when compared to the case where "Shilluk women in the Sudan started before dawn and journey more than eight kilometres to the Nile for water" (Elabi, 1987).

Related to distance is time taken by individual house holds to get enough water for a day domestic use. A look at table 4.4. above, shows variations in the time spent to collect water depending on the season, location of the residence and water point. During the wet season 76% of the sampled population spent less than 30 minutes to get water. This can be attributed to numerous private wells, functional DFRRI wells, streams and ponds. 14.3% of the respondents said they spent between 30 minutes to 1 hour to fetch water. 2% of the respondents spend between 1 to 2 hours. There was no response from 7.7% of the sampled population.

During the dry season, 36.3% of the respondents attest to spending between 1 to 2 hours to obtain water for domestic purposes. 32% spend between 30-60 minutes, 24% however still spend less than 30 minutes to obtain water. There was no response from 7.7% of the sampled population because this consist mainly the elderly men and women. It was also observed that water collection is usually done more than once a day. Most of the households collect water in the mornings and evenings and sometimes in the afternoons. Thus several trips may be made in a day.

It is pertinent to note here that an improvement in water source will lead to less time spent in collecting water and conversely allow more time for other productive purposes.

Table 4.4. DISTANCE TRAVELLED AND TIME TAKEN BY INDIVIDUAL HOUSE HOLD TO FETCH WATER DAILY

DISTANCES (IN KM)	WET SEASON NO. AND % RESPONSES		DRY SEASON NO AND % RESPONSES	
	NO.	%	NO.	%
< ½	245	81.7	158	52.7
½ - 1	40	13.3	103	34.3
1 - 2	2	0.7	26	8.7
> 2	-	-	-	-
NO RESPONSE	13	4.3	13	4.3
TOTAL	300	100	300	100
TIME (IN HOURS)				
< ½	228	76	72	24
½ - 1	43	14.3	96	32
1 - 2	6	2	109	36.3
> 2	-	-	-	-
NO RESPONSE	23	7.7	23	7.7
TOTAL	300	100	300	100

Source: Field survey, 1992

4.4.4. PROBLEMS OF WATER SUPPLY

One of the major problems of water supply in Nigeria is inadequacy which often leads to shortage. The problem of water shortage is widely prevalent in both the urban and rural areas. It is however the adequacy and frequency that marks out the rural areas for mentioning. In order to evaluate if the DFRRI water supply programme meets the needs of the people in the study,area, sampled respondent were asked about the adequacy of DFRRI wells in the ameliorating their water problem.

Table 4.5. below reflects the responses. In Makarfi Local Government, of the 150 persons interviewed, 76.7% said the DFRRI water projects are adequate in their locality and thus satisfy their needs. This is not surprising, since of the 26 bore holes in the local government area, only 3 are not functioning. In addition to the functional boreholes are the hand dug wells. 17.3% of the respondents indicated the project to be inadequate. These sampled population are mostly from villages with non functional DFRRI wells; an example is Likoro. There was no response from 6% of the respondents.

In Soba Local Government, 74% of the respondents complained of the inadequacy of the DFRRI water wells. This tallies with the field observation that about 70% of the boreholes in the local government area are not functioning and thus not meeting the water requirements. 23.3% of the respondents are satisfied with the water projects; while there was no response from 2.7% of the sampled population.

The result of the survey showed that the inadequacy of water supply by DFRRI is more prominent in Soba local government, while in Makarfi LGA, the DFRRI water scheme can be said to have attained a degree of success, thereby meeting the needs of the people at least to a satisfactory extent.

TABLE 4.5. ADEQUACY OF DFRRI WATER SUPPLY PROJECTS

RESPONDENTS

LGA	ADEQUATE	% OF TOTAL	INADEQUATE	%	NO RESPONSE	%
Makarfi	115	76.7	26	17.2	9	6
Soba	35	23.3	111	74	4	2.7

SOURCE: FIELD SURVEY, 1992.

Limited water supply, and hence low consumption level has implication on welfare and health. A number of activities are constrained by water shortage as shown on tables 4.6 and 4.7 respectively.

In Soba local government area, washing and watering of animals are the most affected with 42% and 25% respectively responding to water shortage being a constrain to these activities. 9% complained of scarcity in terms of drinking, 13% food processing, while 11% said other uses such as bathing is affected.

The most affected activities in Makarfi local government on the other hand are washing and food processing, with 38% and 21% respectively complaining to water shortage being a constrain. 12% complained of scarcity in terms of watering of animals, 10% other uses and 10% said their drinking habit is affected. One is left with no doubt from the responses that inadequate sources, pump breakdown and wastage as well as inadequate electric power for pumping water from the boreholes are among major causes of such shortage.

TABLE 4.6. HOUSE HOLD ACTIVITY, MOST AFFECTED BY WATER SHORTAGE IN [illegible] L.G.A.

ACTIVITY	RESPONSES NO	%
Drinking	13	9
Washing	63	42
Watering of animals	37	25
Food processing	20	13
Other uses	17	11
T o t a l	300	150

SOURCES: FIELD SURVEY, 1992.

TABLE 4.7. HOUSE HOLD ACTIVITY, MOST AFFECTED BY WATER SHORTAGE IN MAKARFI L.G.A.

ACTIVITY	RESPONSES NO	%
Drinking	15	10
Washing	57	38
Watering of Animals	18	12
Food processing	32	21
Other uses	28	19
T o t a l		

SOURCE: FIELD SURVEY, 1992.

The close relationship between water supply and health makes it inevitable to ask the sampled population on how they take care of their water and cases of water related diseases were also examined. As shown on table 4.6 below, 5% of the respondents treat their water through the application of alum, 14% agreed to boiling their water before drinking, 5% apply cloth filtering 69.3% of the respondents do not treat their water. The implication for this is that quiet a number of the population stand the risk of being exposed to water related diseases, since the main source of water for the people are the open wells which are subject to pathogenic activities. The irony of this however is that none of the sampled population attested in the questionnaire to have suffered from any water related disease; but from oral interview with health officials in the study area, they said most of the cases brought forward and diagonised were diseases such as Cholera, diarrohoea and malaria. The none response to this issue could be due to ignorance or apathy on the part of the people.

Table 4.6 Treatment of Water Before Drinking

METHOD	NO OF RESPONSES	% OF TOTAL RESPONSES
Addition of Alum	15	5
Addition of Calcium Hypochlorite	-	-
Boiling	42	14
Cloth filtering	5	1.7
Other method	-	-
Do not treat	208	69.3
No response	30	10
Total	300	100

Source: Field survey, 1992

Respondents were further asked on why they do not treat water, a look at table 4.7 shows that 22% of the respondents state that the water looks clean enough, 13.3% believe it is safe, 34% of the sampled population said they never gave it a thought while there was no response from 30.7% of the sampled population.

Table. 4.7 Why Certain House Holds Do Not Treat Water Before Drinking

REASONS	NO OF RESPONSES	% OF TOTAL RESPONSES
Clean enough	66	22
Believe safe	40	13.3
Never thought of it	102	34
No reponse	92	30.7
Other reasons	-	-
Total	208	100

4.6 OPERATIONALITY OF THE DFRRI WELLS

An objective of this study is to find out the magnitude of the failure of the DFRRI wells and identify the causes for such failures.

DFRRI had laudable objectives when it set out to ameliorate the water problem confronting the rural dwellers, through the construction of bore holes in the villages. The

degree of success of this projects is however questionable. In most of the villages in the study area, the boreholes projects were a failure. The failure rate was however more prominent in Soba Local Government Area. From the field work undertaken and available records, it was observed that of the 14 bore holes in Soba LGA only 4 (28.6%) are functional. This means that a large percentage (71.4%) of the wells were not functioning. On the other hand, only 3 (11.5%) of the 26 boreholes were not functioning in the Makarfi L.G.A.

The major reasons given by the respondents were political corruption on the part of Government officials and bureaucratic ineptiness. These usually encourage contractors to perform poorly since there is no proper monitoring or supervision of the work. In a number of cases sites were chosen for the construction of the boreholes without proper geophysical survey, just to satisfy the political ambition of the prominent indigenes of the locality who influenced the siting of the prominen in their vicinity; such sites are not ncessarily the most water yielding points in the aquifer. Thus they yield waterfor only a very short period. Another reason is high population pressure on the few functional boreholes which leads to the break down of some of the pumps due to excessive use. The boreholes are also not properly maintained.

The community are not involved in the water projects, thus they do not see it as their responsibility to maintain the boreholes.

In order to find out from the sampled population on how to improve their water supply, provision was made in the questionnaire administered to suggest how best this can be done. The responses showed that most people believe in the efficacy of Dam construction schemes as part of the strategy for improving the water supply situation in their respective locality; 38.3% hold this opinion, a significant number of respondents (34%) however put their hope in the construction of more boreholes, 20% believe that improving the hand dug wells will improve water supply, 7.7% believe that other alternatives such as installation of pipe borne water will be a solution (see Table 4.8.)

Table 4.9. SUGGESTED STRATEGIES FOR IMPROVING WATER SUPPLY BY RESPONDENTS

SUGGESTED STRATEGIES	NO OF RESPONSES	% OF TOTAL RESPONSES
More boreholes	102	34
Construction of dams	115	38.3
Improving on the hand dug wells	60	20
Ponds	-	-
Other actions	23	7.7

Source: Field Survey, 1992.

4.7 COMMUNITY PARTICIPATION IN DFRRI WATER SCHEME

Public participation is a popular and interesting concept which influences many aspect of human activities. It is an indispensable component of rural development. The success of rural projects depends on the extent to which the community is involved during the planning stage. Enthusiastic community participation can play a significant role in developing and increasing community awareness, a sense of responsibility, and pride of ownership towards any projects, culmunating in success and a high level of performance system.

One of the objectives of this research work is to determine the level of community participation in the on going and completed DFRRI water projects.

There is ample evidence that community and individual have traditionally developed their own water resources. Most of the compounds visited in the course of this survey have hand dug wells that are maintained throughout the year. DFRRI after its establishment in 1986, as part of its programme, constructed boreholes in various communities. The study area was no exemption; however in the execution of the boreholes projects where they exist, it was discovered that the benefiting communities were never involved in either the planning, development or maintenance, despite the existance of development associations in all the twenty sampled villages.

With growing awareness of the respondents on the significance of these projects, majority of the villagers interviewed indicated their desire to participate in the DFRRI water projects through one

form of contribution of the other. As shown on table 4.9 50.3% of the total respondents from the two local government area under study are prepared to contribute their labour 26.7% are ready to give financial contribution, 9% indicated willingness to contribute food and drinks to the workers on the project, 3.5% of the respondents indicated preparedness to contribute other materials such as cement, gravels and working tools. There was no response from 10.7% of the people.

Table 4.10 Willingness of sampled population to be Involved in D Water Supply Scheme

Type of INVOLVEMENT	MAKARFI	%	SOBA	%	TOTAL RESPONSES	% of TOTAL RESPONSES
Financial contribution	37	24.7	43	28.7	80	26.7
Labour	86	57.3	65	43.3	151	50.7
Food and Drink	15	10	12	8	27	9
Other materials	4	2.7	6	4	10	3.3
No response	8	5.3	24	16	32	10.7

Source: Field survey, 1992.

The enthusiam shown by the majority respondents in wanting to contribute to the DFRRI water projects, shows their willingness to cooperate in solving the current water problem they are experiencing.

CHAPTER FIVE

ORGANISATIONAL MODEL FOR RURAL WATER SUPPLY DEVELOPMENT IN THE STUDY AREA

5.1 Advocating a New Stretegy

The preceeding analysis shows that water supply situation in the study area is rather inadequate, especially in Soba LGA While the establishment of DFRRI was meant to ameliorate this problem with the active involvement of the communities in government sponsored projects, there are a number of problems militating against the success of DFRRI's water schemes. The failure of DFRRI to actively involve the people in its water projects resulted in its poor performance and non-commitment on the part of the people in the maintenance of established projects.

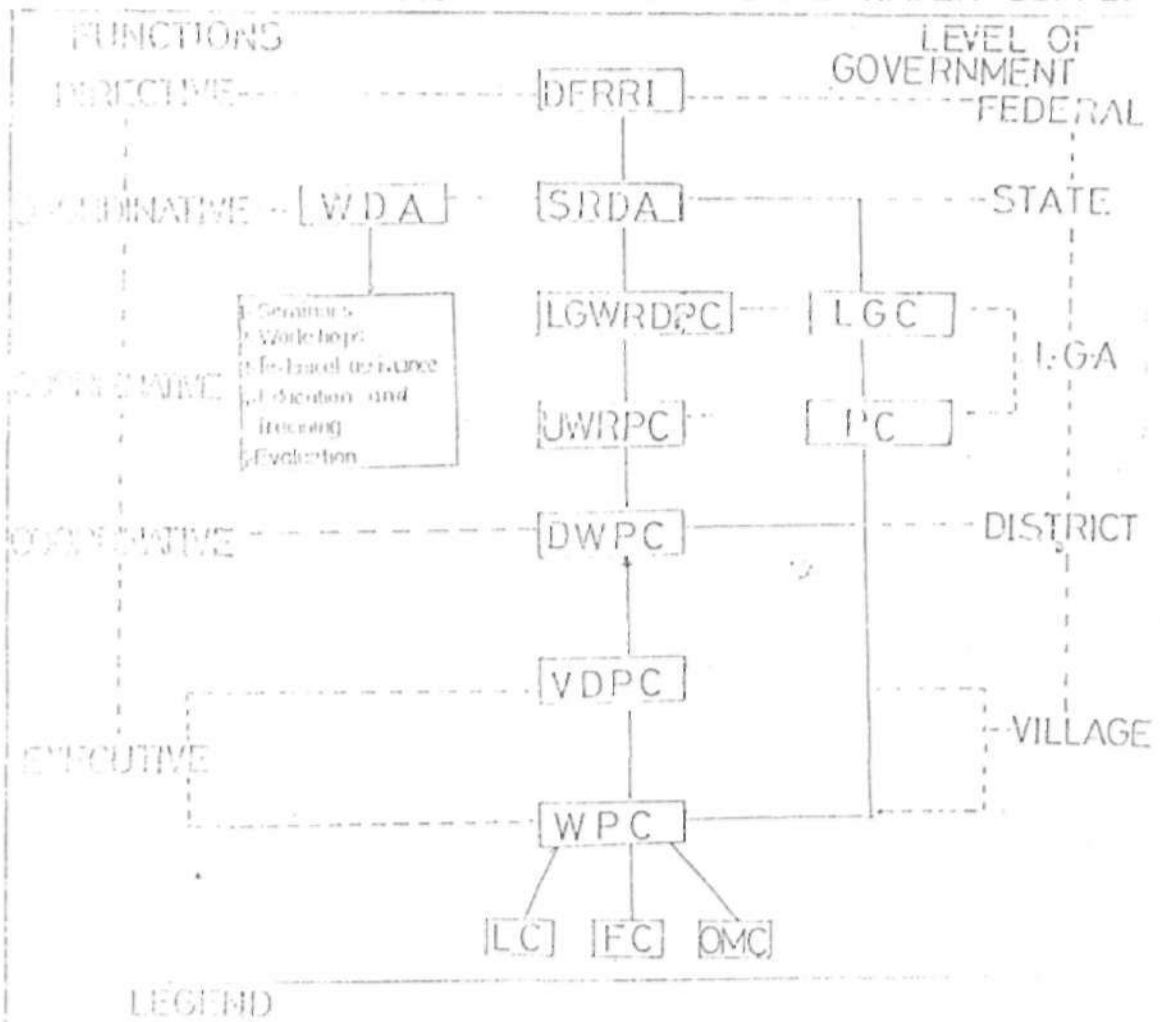
While the importance of rural development in the economy of this country cannot be over emphasized, in order for it to be effective however, the people should be involved in projects. In the remaining part of this chapter, an institutional model that would effectively incorporate people's input to water resources development in Nigeria in general and in Makarfi and Soba Local Government Areas in particular is proposed. It is expected that a careful implementation of the organisational structure of the proposal would improve the success rate of DFRRI's water schemes in the area of study.

5.2 THE MODEL

The proposed model draws heavily on the work of Elabi, (1978) and is based on the premises that water supply schemes in the Makarfi and Soba LGAs can attain the desired success through the active involvement of the people themselves in as many stages as possiblein the entire process. The model is fashioned on the concept of appropriate organisation that will bring communities together to work effectively. It involves a two-way relationship between and within parties in the planning process. This, according to Kaltho (1985), is an avenue where the community can reach the authority and where the authority reaches and responds to the community needs. A schematic form of the model is shown in figure 5.1. For an effective development, utilization and management of underground water resources in the area of study, the organisational set up structured in the model will be operating at two levels: the local government and the villages.

At the local government level, there will be a unified water resources planning committee (UWRPC). This committee will be responsible for coordinating and harmonizing planned water projects. The advantage here is the eradication of duplication of functions by other water development agencies such as DFRRI, water Board and Community Development Departments. This will lead to an efficient allocation, utilization and prudent management of the material, financial, and human resources imperative for the sustainance of water provision in the area. The monitoring and evaluation of projects will also be made.

FIG. 5.1 ORGANISATIONAL MODEL FOR RURAL WATER SUPPLY



LEGEND

DFRRI - Directorate of Food, Roads and Rural Infrastructures

WDA - Water Development Adviser

SRDA - State Rural Development Agency

LGWRDPC - Local Government Water Resources Development Planning Committee

LGC - Local Government Council

UWRPC - United Water Resources Planning Committee

PC - Publicity Committee

DWPC - District Water Planning Committee

WPC - Water Project Committee

OMC - Operation and Maintenance Committee

F C - Finance Committee

L C - Labour Committee

At the village level, there will be a Village Department Planning Committee (VDPC). This Committee will set up a water projects committee (WPC) which will be responsible for actual water development. The WPCs in each district will come and form into a district water planning committee (DWPC). The State Rural Development Agency (SRDA) which will include DFRRI at state level, Water Board and Agency for rural development and the Directorate of Food, Roads and Rural Infrastructure at the Federal level, will together with the DWPC be in the UWRPC. It is at this level that matters relating to water development in each local government will be tackled. The water Development Adviser (WDA) will counsel the UWRPC on matters relating to water resources development.

5.3 THE MODEL COMPONENTS

5.3.1 THE VILLAGE DEVELOPMENT PLANNING COMMITTEE (VDPC)

The VDPC is to be a conglomeration of all voluntary associations, clubs, or societies. The leaders of the various groups will constitute the VDPC council. Representation on the council should be on equal basis to avoid conflict of interest that might arise. Membership into the council should be limited in a situation where the voluntary groups are many so as to avoid rowdiness and ineffective control during delibrations. Thus only three executives of the members should be nominated into the council (the Chairman, Secretary and Treasurer). Where the groups are few, more members can be appointed into the council. Membership of the council should however not be too small or too large. As suggested

by Kandawire (1980) and Hassan (1991) about seven to twenty members are workable sizes.

To ensure effective participation and support of the people membership of the VDPC council should cut across the socio-political and economic structure of the village community. The head of the village (Mai Ungwa) will be the chairman of the council. It is pertinent to state that all heads of wards and hamlets should be members of the council including at least two women.

Where no development association is in existence, the local Government Council in conjunction with other Government rural development agencies will see to the formation and organisation of one. The formation of these clubs or association should not be forced on the people. They should be part of the formative process otherwise the aim will be defeated.

The VDPC executive will serve for only two years except the chairman. Transfer of local government employees helping in the VDPC should be limited so as not to jeopardise the programme. Transfers should coincide with the end of term of the VDPC and other committees.

The VDPC council will be responsible for taking decisions on the type of water project to be embarked upon for the community. It will identify action to be taken to implement the project, and its operation and maintenance of completion. The WPC will be set up to make plan for water projects. This plans will be approved by the VDPC council who will then make available funds and materials

needed to execute the project. Any water project approved by the VDPC will be handled by the WPC. It will take charge of feasibility studies, planning, costing, liaising with the DWPC, the UWDRC, other agencies and institutions and technical experts. This is in addition to carrying out the construction or installation of the project.

The operationality of the WPC will be through sub committees set up by the VDPC. These include labour committee, finance and operation and maintenance. Heads of the working committees will be from the VDPC. The Head of the finance committee will be the Chairman of this Committees. The WPC is responsible to the VDPC.

The village working committees will be charged with specific responsibilities and membership of the different committees with be based on capabilities such as Education, leadership ability and professionalism.

The working committee will be made up of the labour committee, finance committee and operation and maintenance committee.

Labour Committee(LC)

The head of this committee will be the leader of the youths (matasa) and will also be a member of the VDPC. The secretary will be a community development village level worker. A prominent woman, usually the Magajiya (head of the women staying on their own), is recommended to be on the committee so as to represent and help mobilize the women. Membership of the committee should not be less than five or exceed eight

depending on the population size of the village.

Mobilizing the work force to carry out a project, will be the responsibility of the LC. The work pattern will be organised on club bases. Movement of material and construction work will be done by different groups. Women will also engage in light work or take charge of the workers feeding. Entertainers are mobilized to stimulate the workers.

Finance Committee (FC)

Membership will comprise of a member of the VDPC who will be the Chairman. The head of the village school should act as financial Secretary and a woman as treasurer. An influencial ward head and a respectable rich man should be coopted members. The FC will be responsible for organising financial and material contribution from the people. It will also take charge of collecting levy of not more than two naira (₦2) from the people. The amount will however depend on the nature of the project being embarked upon and the estimates of the project submitted to the UWRDC through the VDPC. The FC, through the DWPC, will obtain loan from Community Bank in the district. Refunding will be through the levy collected. All records of financial transaction and material contribution will be kept and handled to the VDPC.

Operation and Maintenance Committee (OMC)

Once a project is certified as completed and functioning, it is handed over to the operation and maintenance committee who will take charge of its daily operation and maintenance. The OMC will be supported by balance resources in terms of finances, manpower, material and transportation. In this regard each family benefiting from the project will be taxed monthly between one to two naira (₦1 - ₦2). Repair of faulty equipment or break down of projects will be done with the assistance of a Technical Officer from the Local Government Council (LGC) who should be disciplined enough to have a sense of commitment to public service. Where large labour force is required to carry out repairs, the OMC will, with the LC mobilize the required labour.

Membership of the OMC will consist of a representative of the LGC who will act as supervisor, the WDA who will advice the Community on Sanitary matters. A village craftsman and mechanic, three youths who together with the village craftsman or mechanic will be given on the job training. The Committee members will attend workshops or training course organised by the WDA or other rural development agencies. The VDPC will borne the cost of such workshops and training.

5.3.2 The District Water Planning Committee (DWPC)

The organisation of this committee will be within each district of a Local Government Area. Membership include all WPCs within the district, Chairman of the FCs and LCs, elected Councellor or prominent politician, and the district head who will be the Chairman.

The scribe of the committee will be the most senior headmaster in the district schools. With an average of fifteen village units per each district in the study area, membership of the DWPC will not be more than twenty. The DWPC will be a forum for sharing experiences among the villages. It will accept any project proposal by any village, have it properly screened before submission to the UWRP at the local government level. The DWPC will coordinate with the VDPCs to work out strategies towards establishing Community Banks. Once the banks are established the WPCs will be able to obtain loans with the DWPC serving as a link and guarantors. On approval by the UWRPC of any projects proposal submitted by the DWPC and WPC, financial, technical and material assistance is given directly to the particular WPC; the DWPC only act as an observer.

Though domestic water supply is yet to meet the required need in the study area, there are indications that most of the villages may like to undertake large water projects such as dam construction for irrigation purpose. From field survey, irrigation is practiced in some villages though on a small scale. When this felt need begin to materialize and planned for, the UWRPC will serve as a mediator in case of conflicts likely to arise as a result of termpering with other village's water sources or flooding of farm lands. Where the development of the water source involves more than one village, cooperation among the villages as regards finance, labour material etc will be decided at the UWRPC level.

5.3.3 The Unified Water Resources Planning Committee (UWRPC)

The UWRPC will operate at the local government level, but local state and federal departments will form membership of the council. The local government chairman will head this council; the district water board managers, community development officer, heads of works, information and agriculture departments at the local government level are recommended to be on the council, including representatives of the state rural development agency and DFRRI. The Secretary of the council will be the LGA Secretary.

The main function of the UWRPC will be to coordinate the various water development projects of the development institutions and the VDPCs. It should also meet and decide on the assistance to be given to village projects. Depending on the nature of the project being contemplated by a community, the UWRPC will decide to give a marching grant on the amount collected by the village or any other contribution it will deem fit. The UWRPC will liaise with the WDA to educate the people on the maintenance, protection and care of water supply systems. The UWRPC will also consist of a publicity committee (PC).

The PC will be a means of increasing the awareness of the people promoting their development effort as well as obtaining their loyalty. It will have a mobile information and enlightenment unit in each village to assist in the process of information dissemination. The membership of the PC will consist of members of the UWRPC. The PC will be chaired by the information officer of the local government and the community development officer will

be the secretary. The villages will be educated (e.g through films) on the impacts of poor water quality, prevention of water related disease through water treatment, storage and sanitary conditions around water sources and work on community development projects from different areas.

It is thus the responsibility of the PC to mobilize the people towards self help and self reliance in water supply development. When the success of this is attained, it can then be applied to other facilities. On the completion of any project by the WPCs, the PC will help in publicising the commissioning. It will liaise with the VDPCs to organise the commissioning ceremony. The PC will document the ceremony for posterity and also to show other villages the need to improve on their water source through self project. The local government should finance any cost incurred by the PC, and members (UWRPC and PC) are not to be paid any form of remuneration.

5.3.4 The Water Development Adviser (WDA)

The WDA has the status of local government chairman but has his sit in the state headquarters, Kaduna, with the state Rural Development Agency (SRDA). The main function of the WDA would include advising the various development committees on a more professional and long term understanding of the implication of their responsibilities and commitments. The adviser should gather and analyse data on any water project that is, proposed, and assist in the Education and training of the CMC by organising seminars and workshops. Furthermore, the adviser should offer specialist and technical assistance.

5.4 Functional Problems of the Model

As with all development plans or proposals, the model proposed for rural water supply in the study area is expected to have some limitations or face problems during its implementation process. Some of the factors which may hinder the operationality of the model may include:

(i) Qualitative and honest leadership, organisational frame work and cultural conservatism;

(ii) Personality conflicts and confrontation among community leaders;

(iii) A general ineffectiveness of organisational capacity and

(iv) The disillusion of the community following the collapse of self-help schemes consequent upon increasing rather than decreasing their financial burden.

If local initiative and people's response to local needs and challenges are to be maximized, there is the need for enlightened, mature, trustworthy and purposeful local leadership. This according to Ibe (1987) is capable of motivating and mobilizing the resources of the locality in the development process.

The model is structured to give a sound frame work from the organizational point of view, but what will pose problems is the leadership role at both the village and district levels. Though cultural conservatism might be significant it may not affect any meaningful development in the area of study.

Rather, the structure of the committee should not be undemocratic. It should cut across all interest groups with no ethnic or religious bias.

Thus the major problem envisaged in the implementation of this model is that of leadership. The VDPC and DWPC have the village head and District head as their respective chairpersons. There is the danger of the traditional leaders becoming too autocratic and rigid in their performance in these committees and engage in political corruption.

To avoid this, funds or materials for projects are to be disbursed directly by the UWRPC to the WPC and the WPC will be accountable to the UWRPC. Where a particular leader constitute a clog to the wheel of progress, the person should be called to order by the Local Government.

In financing of projects, the establishment of community banks in the district will help the villages to get the necessary funds to execute their projects through issuance of loans.

Solving the organisational problems of rural water supply in the area of study will enhance rural development in general. It will entail utilizing the human, material and financial resource in the area. This can be attained by bringing together all agencies in charge of water supply, DFRRI, SRDA, community development department, works, health, information departments and the local communities. In this way a well-integrated development process will be achieved.

CHAPTER SIX

6.1 SUMMARY, RECOMMENDATIONS AND CONCLUSION

This study investigates the DFRRI portable water supply schemes in Makarfi and Soba Local Government Areas of Kaduna State viz-aviz the level of operation of the DFRRI wells. These LGAs experience water scarcity for the greater part of the year , especailly in the dry season which lasts between 7-8 months. During this period, the people depends on only the underground water source.

As a theoretical background, the development of water resources for rural communities was reviewed. The place of Groundwater in the hydrologic cycle was examined, and the Nigerian government's attempts to provide portable rural water supply was discussed. The involvement of the rural communities in water provision was also examined. It was noted that while the government recognised the problem of water scarcity in the rural areas, policies towards improving the lot of the people have taken little cognisance of the need for effective participation of the communities.

This research reveals that the main reasons for the failure of the DFRRI wells include:

(i) construction and completion problems such as improper design of the project;

(ii) improper evaluation of the aquifer characteristics and

(iii) wrong choice of site and defective pumps.

It was also discovered that the DFRRI headquarters in the state is solely responsible for the award of contracts for well construction in the local government areas. The local government officials are only informed after the completion of the work. As a result of this, the success of the work cannot be ascertained since there is no proper supervision of the contract job by qualified personnels. The contractors for example were drilling wells to only a depth of 20 metres instead of an average of 30 metres required in most of the sites. To worsen the situation, work is usually done in the peak of the rainy season when water table is high. Thus most of the boreholes provide no water at the peak of the dry season. The state DFRRI does not seem to have project monitoring personnel who are supposed to follow up on the job execution and appraisal once jobs are awarded.

The study also reveals that high cost prevents the construction of the number of required wells to meet the needs of the target population. For example it costs about ₦40,000 to construct a borehole, and about ₦7,000 - ₦14,000 for an open concrete well.

Interviews conducted with rural development coordinators in the two LGAs show that groundwater development and management is quiet poor. The DFRRI water supply scheme today is being poorly executed. It was also found that consultation between DFRRI officials and the rural communities was virtually absent,

hence adequate information on needs and preference of the rural dwellers is lacking.

The investigation further revealed that participation by the people in the execution of DFRRI rural water supply projects is very low. This is because the initiation, planning and implementation are often done by the directorate itself. During the process of actual projects execution, people within the local communities where the project is sited are only made to participate indirectly as hired labour. This type of participation cannot be seen as democratic and beneficial because the people usually lack commitment in the maintenance of established projects.

Also it was found that even if the people are willing to participate in the execution of the Directorates water projects, there is communication gap between the authority and the people either due to inaccessibility of some villages or lack of vehicles. This have made effective mobilization of the people difficult.

One other major constraint observed in the execution of water projects was the lack of basic planning data. The role of data collection has regretably either been under played or ignored. It is therefore always very difficult to assemble reliable and adequate technical and socio-economic data capable of assisting in the assessment, planning, design, construction and maintenance of various development projects. The failure of some DFRRI boreholes could be due to unreliable and inadequate data on which analysis, planning and management are based.

Drought is another factor which affects the water supply situation in the study area. During drought years only small amount of excess rainfall is available to recharge aquifers and local water course. This excess is itself subject to the same inter annual flutuations, making this zone particularly sensitive to human interventions that disrupt soil permeability.

In the final analysis, the result of our analysis shows that the two LGAs are faced with alomst similar problems on water projects in their respective communities. The case of Soba LGA is however more pronounced because of the high percentage of well failures. Generally there is good evidence of an inappropriate approach to water resources development in the area of study.

The implementation of the water supply plans for the area is rather disjointed uncoordinated and greatly influenced by political rather than physical consideration.

The situation makes it inevitable to advocate for a new strategy to improve water supply in the area. Consequently an organisational model is proposed. Its basic principle is embedded in an effective organisational frame work for water resources development for the rural communities upwards from the village level. It involves full participation and contribution of the rural dwellers who will be the beneficiaries. If the proposed plan is adopted and implemented by the Makarfi and Soba Local Government Areas, it is hoped that adequate water supply would be achieved by the communities on sustainable basis.

6.2 Recommendations

The importance of water to life and on the overall development of any nation cannot be overemphasised. The Nigerian Government has introduced different programme to improve both the urban and rural water supply. There is however the need to streamline the activities of their agencies for proper coordination of these programmes.

While water supply inadequacy is a general phenomenon in developing countries and the demand for it is growing daily, rural dwellers feel the effect most. To cope with the problem, proper hydrological study of both surface and undergroundwater resources on the basis of abundant and accurate data is inevitable. The availability of abundant longer distance or statistical data will ensure sound planning and design practices.

To ensure success in this direction, the active participation of the communities at every stage of the projects is very vital. This will make the communities to identify with the projects. According to Haile (1980), the involvement of the people will lead to identification of felt-needs and priority setting, the choice of suitable technology and the location of the projects in a way that is acceptable to them. This is important because it will help in knowing which technology is appropriate; for each project has its own peculiar problem which need to be appreciated.

To ensure effective involvement of communities in any development programme, it is pertinent for the Government to

identify the needs of the community and inform it on the contribution expected during and after the completion of the project and specifying the community's and agency's responsibilities with respect to operation and maintenance task. Government should also make effective use of the mass media so as to bridge the communication gap between the people and development institutions; introduce adult education and vocational training programme and ensure participatory democracy. The model proposed in this study is thus recommended for adoption; for it will ensure meaningful public input into water resource development so as to attain self reliance.

6.3 CONCLUSION

From this study it has become apparent that the DFRRI water supply scheme in the Local Government Areas under study has not attained the desired success; especially in Soba Local Government. Most of the boreholes are not functioning. There is thus inadequacy of portable water supply. As a result of this, people in the villages had to travel data, records and resort to unhygienic sources to get water, most especially in the dry season.

It is pertinent to note that the high percentage of functional wells in Makarfi Local Government, is not solely due to DFRRI's efforts, but that of the Local Government Community Development Officer, who involved the Local Government Council in the rehabilitation of broken down DFRRI wells.

Findings from the research work had shown that the wells are not optimally located. Also political clout rather than physical consideration appears to have played a prominent role in the siting of some of the boreholes.

In conclusion, the analysis of the data shows that there is low participation by the people in DFRRI water projects in both local government areas. It is therefore not surprising that the success rate of the water schemes is low. The Kaduna State Government should take necessary steps to motivate the public into active participation in water schemes in the state.

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ANNEX 1

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Meterological Observations, Samaru 1976 (Sheet one)

Month	rainfall (mm) 1976	rainfall (mm) 1928 to 1976	days of rain 1976	days of rain 1928 to 1976	relative humidity 1976 am	relative humidity 1976 pm	relative humidity 1938 - 1976 am	relative humidity 1938 - 1976 pm	air temperatures °C 1976 min	1976 max	1976 mean	1938-1976 min	1938-1976 max	1938-1976 mean	sunshine hours 1976	sunshine hours 54-76
Janary	0.0	0.2	0	0.1	16.6	13.5	17.7	13.3	13.3	29.3	21.3	11.1	30.4	22.2	9.5	1.7
February	0.0	1.0	0	0.2	25.6	14.8	15.4	10.3	17.5	34.0	25.8	16.3	32.7	24.4	8.9	9.5
March	0.0	7.4	0	0.9	17.7	12.0	25.9	14.0	18.7	34.8	26.8	19.5	35.3	27.5	8.6	8.6
April	86.2	37.0	6	3.9	42.5	33.7	48.7	29.2	21.2	35.1	28.1	21.7	35.7	28.8	8.0	8.0
May	135.5	129.6	9	9.9	68.0	50.6	63.1	42.8	21.0	32.1	26.6	21.2	33.2	27.4	8.1	8.2
June	206.9	162.4	14	12.9	75.3	62.7	72.1	56.4	19.5	29.5	24.5	19.9	30.7	25.5	7.4	7.8
July	226.4	226.8	16	16.4	81.1	68.3	79.1	65.8	19.1	27.7	23.6	19.5	28.4	23.8	6.7	6.1
August	188.1	280.0	13	20.3	81.1	67.7	81.2	69.5	19.1	27.6	23.4	19.3	27.7	23.5	6.1	5.2
September	191.0	226.4	15	16.5	75.0	59.9	75.6	62.7	19.2	29.2	24.0	19.1	29.2	24.2	7.6	6.9
October	162.2	38.2	15	4.1	74.9	67.3	59.8	42.5	19.3	29.5	24.4	17.7	31.4	24.8	7.0	6.8
November	0.0	1.1	0	0.2	40.8	27.8	29.0	21.0	12.7	29.9	21.3	15.6	31.6	23.5	9.5	9
December	0.0	0.1	0	0.0	21.1	15.8	21.2	15.9	11.4	29.8	20.6	13.9	30.5	22.3	8.9	9.2
Total	1196.3	1101.2	88	85.4	-	-	-	-	-	-	-	-	-	-	96.3	96.3
Mean	-	-	-	-	51.6	41.2	49.1	37.0	17.7	30.7	24.2	18.1	31.4	25.0	8.0	8.0

Note: (1) Before 1953 observations taken at 0800 and 1300 GMT.
After 1953 observation taken at 0700 and 1500 GMT.
(2) Sunshine Records from Campbell Stokes Recorder.

Annex 1: Meteorological data from the area of study.

Meterological Observations Samaru 1977 (Sheet one)

Month	rainfall (mm) 1977	rainfall (mm) 1928 to 1977	days of rain 1977	days of rain 1928 to 1977	relative humidity 1977 am	relative humidity 1977 pm	relative humidity 1938 - 1977 am	relative humidity 1938 - 1977 pm	air temperatures °C 1977 min	1977 max	1977 mean	1938-1977 min	1938-1977 max	1938-1977 mean	sunshine hours 1977	sunshine hours 54-77
Janary	0.0	0.2	0	0.1	20.1	20.0	17.8	13.6	12.7	29.4	21.1	14.0	30.3	22.2	8.0	8.7
February	0.0	1.0	0	0.2	13.5	10.0	15.3	10.3	14.0	30.6	22.3	16.0	32.7	24.4	7.9	9.4
March	0.0	7.3	0	0.9	17.7	11.7	25.5	13.9	18.9	32.3	25.6	19.5	35.2	27.5	4.7	8.4
April	0.0	36.4	0	3.9	27.6	13.9	47.8	28.6	20.8	36.8	28.8	21.7	35.8	28.8	7.7	8.0
May	78.3	119.8	12	9.9	57.9	39.6	62.9	42.7	21.3	34.3	27.4	21.2	32.9	27.4	8.4	8.2
June	101.7	161.3	13	12.9	74.2	58.8	72.2	56.6	20.3	30.7	25.5	19.9	30.7	25.5	7.7	7.8
July	59.0	223.7	12	16.3	77.9	62.0	79.1	65.7	20.2	29.7	25.0	19.5	28.4	23.9	6.0	6.1
August	302.7	289.4	19	20.3	82.1	72.1	81.3	69.6	19.9	27.6	23.8	19.3	27.7	23.5	4.6	5.1
September	199.5	225.9	13	16.4	76.4	64.9	75.7	62.8	19.5	30.0	24.8	19.2	29.3	24.2	7.7	6.9
October	4.3	37.6	1	4.0	65.2	45.4	60.0	42.6	17.7	30.7	23.9	17.7	31.4	24.8	8.8	8.8
November	0.9	1.1	0	0.2	22.5	21.2	28.7	21.0	12.0	30.7	21.4	15.5	31.6	23.6	10.1	9.5
December	0.0	0.1	0	0.0	21.8	19.0	21.2	16.0	12.1	27.9	20.0	13.9	30.5	22.2	8.4	9.2
Total	745.5	1094.8	70	85.1	-	-	-	-	-	-	-	-	-	-	90.3	96.1
Mean	-	-	-	-	46.2	36.6	49.0	37.0	17.5	30.9	24.1	18.1	31.4	24.3	7.5	8.0

Note: (1) Before 1953 observations taken at 0800 and 1300 GMT.
After 1953 observation taken at 0700 and 1500 GMT.
(2) Sunshine Records from Campbell Stokes Recorder.

Annex 1 (cont.).

Meterological Observations Samaru Zaria 1978 (Sheet one)

Month	rainfall (mm) 1978	rainfall (mm) 1928 to 1978	days of rain 1978	days of rain 1928 to 1978	relative humidity 1978 am	relative humidity 1978 pm	relative humidity 1938 - 1978 am	relative humidity 1938 - 1978 pm	air temperatures °C 1978 min	1978 max	1978 mean	1938-1978 min	1938-1978 max	1938-1978 mean	sunshine hours 1978	sunshine hours 54-78
Janary	0.0	0.1	0	0.1	19.9	18.0	17.9	13.8	12.9	29.3	21.1	13.9	30.3	22.1	9.2	8.7
February	0.0	1.0	0	0.2	16.8	14.4	15.3	10.5	16.0	33.6	24.8	16.0	32.7	24.4	9.8	9.4
March	1.3	6.5	1	0.9	30.5	17.0	25.7	14.1	19.4	35.5	27.5	19.5	35.3	27.5	8.7	8.4
April	77.7	37.5	8	3.9	62.9	42.3	48.4	29.1	22.0	33.7	27.9	21.7	35.7	28.7	6.9	8.0
May	193.9	122.9	15	10.0	71.1	52.7	63.3	43.1	20.3	32.0	26.2	21.2	32.9	27.4	8.1	8.2
June	164.7	160.2	8	12.8	77.6	64.8	72.4	56.9	19.8	29.6	24.7	19.9	30.7	25.4	7.4	7.8
July	145.3	218.6	15	16.3	82.2	72.2	79.3	65.9	19.7	26.2	23.3	19.5	28.4	23.9	4.6	6.1
August	324.9	277.7	20	20.3	79.9	69.2	81.2	69.6	19.5	28.6	24.1	19.3	27.7	23.5	6.2	5.2
September	207.2	224.8	15	16.4	78.6	65.6	75.8	62.9	18.9	29.5	24.2	19.1	29.3	24.2	7.4	6.9
October	33.9	36.5	4	4.0	67.1	51.8	60.3	43.0	19.1	31.7	25.4	17.7	31.3	24.8	8.2	8.8
November	0.0	1.0	0	0.2	31.8	24.7	29.1	21.1	14.4	30.1	22.3	15.5	31.5	23.5	8.6	9.5
December	0.0	0.1	0	0.0	20.3	20.6	21.2	16.2	12.8	29.7	21.3	13.8	30.4	22.2	9.0	9.2
Total	1148.9	1086.9	86	85.1	-	-	-	-	-	-	-	-	-	-	94.1	96.6
Mean	-	-	-	-	53.2	42.8	49.2	37.9	17.9	30.8	24.4	18.1	31.4	24.8	7.8	8.1

Note: (1) Before 1953 observations taken at 0800 and 1300 GMT.
After 1953 observation taken at 0900 and 1500 GMT.
(2) Sunshine Records from Campbell Stokes Recorder.

Annex 1: (cont.).

Meterological Observations Samaru 1979 (Sheet one)

Month	rainfall (mm) 1979	rainfall (mm) 1928 to 1979	days of rain 1979	days of rain 1928 to 1979	relative humidity 1979 am	relative humidity 1979 pm	relative humidity 1938 - 1979 am	relative humidity 1938 - 1979 pm	air temperatures °C 1979 min	1979 max	1979 mean	1938-1979 min	1938-1979 max	1938-1979 mean	sunshine hours 1979	sunshine hours 54-79
January	0.0	0.1	0	0.1	13.0	14.2	17.7	13.8	13.9	30.2	22.5	13.9	30.3	22.1	8.9	8.7
February	0.0	1.0	0	0.2	14.4	14.9	15.3	10.6	15.8	33.6	24.7	16.0	32.7	24.4	8.9	9.4
March	10.4	6.6	1	0.9	26.3	19.0	25.7	14.3	19.8	35.2	27.5	19.5	35.3	27.4	7.4	8.4
April	19.8	37.1	2	3.9	45.1	32.7	48.3	29.2	21.3	35.8	28.6	21.7	35.7	28.7	8.7	8.0
May	86.3	122.2	8	10.0	67.6	45.3	63.4	43.1	21.1	32.8	27.0	21.2	32.9	27.4	8.2	8.2
June	220.2	161.2	15	12.9	74.7	62.8	72.5	57.1	20.5	30.1	25.3	19.9	30.7	25.4	7.6	7.8
July	373.8	221.5	19	16.4	82.3	71.7	79.4	66.1	19.4	28.9	24.2	19.5	28.4	23.9	6.9	6.1
August	299.8	278.2	19	20.2	81.6	71.8	81.2	69.6	19.7	28.8	24.3	19.3	27.7	23.5	5.7	5.2
September	142.8	232.2	15	16.4	77.8	62.6	75.9	62.9	18.9	29.6	24.3	19.1	29.3	24.2	6.8	6.9
October	30.8	36.1	4	4.0	63.2	45.6	60.4	43.1	18.1	32.1	25.1	17.7	31.4	24.8	8.7	8.8
November	9.8	0.6	1	0.2	32.6	29.4	29.3	21.4	15.1	32.3	23.7	15.5	31.5	23.5	8.7	9.5
December	0.0	0.1	0	0.0	20.4	18.5	21.1	16.3	12.2	28.3	20.2	13.8	30.3	22.2	8.3	9.1
Total	1193.7	1087.9	84	85.2	-	-	-	-	-	-	-	-	-	-	94.8	96.1
Mean	-	-	-	-	49.9	40.7	49.2	37.4	18.0	31.5	24.8	18.1	31.4	24.8	7.9	8.0

Note: (1) Before 1953 observations taken at 0800 and 1300 GMT.
After 1953 observation taken at 0900 and 1500 GMT.
(2) Sunshine Records from Campbell Stokes Recorder.

Annex 1: (cont.).

Meterological Observations Samaru 1980 (Sheet one)

Month	rainfall (mm)		days of rain		relative humidity				air temperatures °C						sunshine hours	
		1928		1928	1980		1938 - 1980		1980			1938-1980				
	1980	to 1980	1980	to 1980	am	pm	am	pm	min	max	mean	min	max	mean	1980	54-80
Janary	0.0	0.2	0	0.1	16.3	15.1	17.7	13.8	13.2	31.2	22.2	13.9	30.3	22.1	9.5	8.7
February	0.0	0.9	0	0.2	13.4	14.0	15.2	10.8	15.8	32.4	24.1	16.0	32.7	24.4	7.9	9.3
March	0.0	7.1	0	0.9	21.2	12.8	25.6	14.2	18.8	35.4	27.1	19.5	35.3	27.4	8.5	8.4
April	3.7	36.2	2	3.9	37.4	23.4	47.9	29.0	21.9	36.5	29.2	21.7	35.7	28.7	7.3	8.0
May	154.4	121.1	9	10.0	68.4	51.4	63.6	43.4	21.3	33.0	27.2	21.2	32.9	27.4	7.1	8.2
June	116.4	161.6	9	12.8	74.9	63.6	72.6	57.3	19.8	30.3	25.1	19.9	30.7	25.4	8.3	7.8
July	268.9	225.7	19	16.4	81.3	68.8	79.5	66.2	19.6	28.7	24.2	19.5	28.4	23.9	6.5	6.1
August	215.8	280.4	20	20.2	93.1	71.7	81.7	69.7	19.4	28.1	23.8	19.3	27.7	23.5	6.1	5.2
September	71.9	221.4	11	16.3	75.5	62.6	75.9	62.9	19.4	30.6	25.0	19.1	29.3	24.2	7.6	7.0
October	16.3	37.0	3	4.0	66.0	43.9	60.6	43.1	18.8	32.0	25.4	17.7	31.4	24.8	8.6	8.8
November	0.0	1.2	0	0.2	28.2	19.5	29.2	21.4	13.9	31.9	22.9	15.4	31.6	23.5	8.9	9.4
December	0.0	0.1	0	0.0	21.3	17.4	21.2	16.4	11.7	28.4	20.1	13.8	30.3	22.1	7.6	9.1
Total	847.4	1092.8	73	85.0	-	-	-	-	-	-	-	-	-	-	93.9	96.0
Mean	-	-	-	-	49.8	38.7	49.2	37.4	17.8	31.5	24.7	18.0	31.4	24.8	7.8	8.0

Note: (1) Before 1953 observations taken at 0800 and 1300 GMT.
After 1953 observation taken at 0900 and 1500 GMT.
(2) Sunshine Records from Campbell Stokes Recorder.

Annex 1: (cont.).

Meterological Observations Samaru 1981 (Sheet one)

Month	rainfall (mm)		days of rain		relative humidity				air temperatures °C						sunshine hours
		1928		1928	1981		1938 - 1981		1981			1938-1981			
	1981	to 1981	1981	to 1981	am	pm	am	pm	min	max	mean	min	max	mean	1981
Janary	0.0	0.1	0	0.1	10.3	13.3	17.4	13.8	11.5	28.2	19.9	13.9	30.3	22.1	10.0
February	0.0	1.0	0	0.2	14.1	11.2	15.2	10.7	15.4	32.4	23.9	16.0	32.7	24.3	9.3
March	0.0	6.3	0	0.9	20.7	15.5	25.4	14.2	18.9	34.8	26.9	19.5	35.2	27.4	8.0
April	109.7	37.6	5	3.9	40.7	26.1	47.6	28.9	20.1	36.0	28.1	21.7	35.7	28.7	8.9
May	90.7	122.3	9	10.0	68.9	54.9	63.8	43.9	20.8	31.9	26.4	21.2	32.9	27.4	8.0
June	159.0	160.3	11	12.8	71.5	56.9	72.6	57.3	20.5	30.7	25.6	19.9	30.7	25.4	7.9
July	254.8	222.8	17	16.4	79.5	66.2	79.6	66.4	19.5	28.1	23.8	19.5	28.4	23.9	5.7
August	280.6	277.0	19	20.2	81.7	69.7	81.7	69.7	19.5	28.4	24.0	19.3	27.7	23.6	6.5
September	133.3	218.7	13	16.2	75.9	62.9	75.9	62.9	19.4	30.1	24.8	19.2	29.3	24.2	7.7
October	0.0	35.0	0	3.9	60.1	47.7	60.6	43.3	17.3	32.5	24.9	17.7	31.4	24.9	8.7
November	0.0	1.1	0	0.2	23.6	21.7	29.0	21.4	14.2	29.1	21.7	15.4	31.5	23.5	7.1
December	0.0	0.1	0	0.0	20.5	17.5	21.1	16.4	12.7	30.3	21.5	13.7	30.3	22.1	9.3
Total	1019.1	1081.1	74	84.8	-	-	-	-	-	-	-	-	-	-	97.1
Mean	-	-	-	-	47.3	38.6	49.1	37.4	17.4	31.0	24.3	18.1	31.3	24.8	8.1

Note: (1) Before 1953 observations taken at 0800 and 1300 GMT.
After 1953 observation taken at 0900 and 1500 GMT.
(2) Sunshine Records from Campbell Stokes Recorder.

Annex 1 (cont.).

Meterological Observations Samaru 1982 (Sheet one)

Month	rainfall (mm)		days of rain		relative humidity				air temperatures °C						sunshine	
		1928		1928	1982		1938 - 1982		1982			1938-1982			hours	
	1982	to	1982	to												
		1982		1982	am	pm	am	pm	min	max	mean	min	max	mean	1982	54-82
Janary	0.0	0.1	0	0.1	18.7	18.1	17.5	14.0	13.9	29.7	21.8	13.9	33.3	22.1	8.6	8.8
February	0.0	1.0	0	0.2	19.3	17.0	15.3	11.0	15.1	31.3	23.2	15.9	32.7	23.9	7.8	9.3
March	0.0	6.3	0	0.9	21.5	14.3	25.3	14.2	19.8	34.6	27.2	19.5	35.2	27.4	7.6	8.3
April	59.7	38.0	10	4.0	53.0	34.9	47.8	29.1	21.5	35.5	28.5	21.7	35.7	28.7	8.1	8.0
May	172.1	121.4	7	9.9	67.2	46.4	63.9	43.9	21.8	33.5	27.7	21.2	32.9	27.4	8.2	8.2
June	113.9	159.5	8	12.7	75.1	57.7	72.7	57.3	21.0	30.8	25.9	20.0	30.7	25.4	7.3	7.8
July	168.7	221.9	10	16.3	78.8	63.9	79.5	66.3	19.9	29.5	24.7	19.5	28.5	23.9	6.6	6.1
August	190.7	275.6	17	20.1	82.4	70.2	81.7	69.7	19.5	28.0	23.8	19.3	27.7	23.6	6.6	5.3
September	117.6	216.9	12	16.1	77.8	63.5	76.0	62.9	19.5	29.6	24.6	19.2	29.3	24.2	7.1	7.0
October	45.3	35.2	2	3.9	69.7	50.7	60.9	43.5	18.7	31.1	24.9	17.7	31.4	24.9	8.0	8.8
November	0.0	1.1	0	0.2	21.3	20.6	28.8	21.4	13.3	30.1	21.7	15.4	31.5	23.4	8.0	9.3
December	0.0	0.1	0	0.0	16.1	13.7	20.9	16.3	13.6	30.0	21.8	13.7	30.3	22.1	8.4	9.1
Total	768.5	1077.1	66	84.4	-	-	-	-	-	-	-	-	-	-	92.3	96.0
Mean	-	-	-	-	50.1	39.2	49.1	37.5	18.1	31.1	24.7	18.1	31.4	24.8	7.7	8.0

Note: (1) Before 1953 observations taken at 0800 and 1300 GMT.
After 1953 observation taken at 0900 and 1500 GMT.
(2) Sunshine Records from Campbell Stokes Recorder.

Annex 1: (cont.).

Meterological Observations Samaru 1983 (Sheet one)

Month	rainfall (mm)		days of rain		relative humidity				air temperatures °C						sunshine
		1928		1928	1983		1938 - 1983		1983			1938-1983			hours
	1983	to	1983	to											
		1983		1983	am	pm	am	pm	min	max	mean	min	max	mean	1983
Janary	0.0	0.1	0	0.1	20.8	16.2	17.6	14.0	13.8	23.6	18.7	13.9	20.1	22.0	8.5
February	0.0	1.0	0	0.2	12.0	9.6	15.3	10.9	18.1	32.4	25.3	16.0	22.7	24.3	8.1
March	0.0	6.0	0	0.9	14.4	12.8	24.9	14.2	17.0	33.0	25.0	19.4	25.2	27.3	7.7
April	0.0	36.7	0	3.9	22.4	12.8	47.0	28.6	19.9	37.5	28.7	21.6	25.8	28.7	7.7
May	73.3	118.4	10	9.9	62.6	39.6	63.9	43.8	21.6	34.7	28.2	21.2	32.9	27.4	8.6
June	74.3	155.3	9	12.6	72.8	51.9	72.7	57.2	19.6	31.9	25.8	20.0	30.7	25.5	6.9
July	107.5	215.9	15	16.3	81.0	64.4	79.6	66.2	23.4	28.8	26.1	19.6	28.5	23.9	6.7
August	259.7	270.4	16	20.1	81.2	69.9	81.1	69.7	16.7	28.4	22.6	19.3	27.8	23.5	6.7
September	93.4	211.0	12	16.1	76.3	60.4	76.0	69.5	17.3	29.9	23.6	19.1	29.3	24.2	7.4
October	0.0	34.1	0	3.8	35.4	25.6	60.1	42.9	14.3	31.8	23.6	17.7	31.4	24.8	7.5
November	0.0	1.1	0	0.2	19.4	15.3	28.5	21.2	12.6	32.0	22.3	15.3	31.5	23.4	9.3
December	0.0	0.1	0	0.0	17.0	15.3	20.8	16.3	12.9	31.0	22.0	13.7	30.4	22.1	8.6
Total	608.1	1050.1	62	84.1	-	-	-	-	-	-	-	-	-	-	88.7
Mean	-	-	-	-	42.9	32.8	49.1	37.8	17.3	31.3	24.3	18.1	31.4	24.8	7.4

Note: (1) Before 1953 observations taken at 0800 and 1300 GMT.
After 1953 observation taken at 0900 and 1500 GMT.
(2) Sunshine Records from Campbell Stokes Recorder.

Annex 1: (cont.).

Meterological Observations Samaru 1984 (Sheet one)

Month	rainfall (mm)		days of rain		relative humidity				air temperatures °C						sunshine	
		1928		1928	1984		1938 - 1984		1984			1938-1984			hours	
	1984	to 1984	1984	to 1984	am	pm	am	pm	min	max	mean	min	max	mean	1984	54-84
January	0.0	0.1	0	0.1	16.4	12.4	17.5	14.0	11.8	28.3	20.1	13.8	30.1	22.0	6.8	8.5
February	0.0	1.0	0	0.2	11.7	10.4	15.2	10.9	14.8	31.7	23.3	16.0	32.7	24.3	8.1	9.2
March	5.2	6.1	1	0.9	26.6	15.0	25.0	14.2	20.7	35.5	28.1	19.4	35.2	27.4	7.7	8.3
April	30.1	37.2	6	4.0	45.9	28.1	46.9	28.6	22.7	35.0	28.8	21.6	35.8	28.7	6.7	8.0
May	98.9	120.2	8	9.9	67.4	52.0	64.0	44.1	21.3	31.9	26.6	21.2	32.9	27.4	7.7	8.2
June	55.4	156.2	9	12.5	70.8	53.3	72.6	57.0	20.5	31.5	26.0	20.0	30.7	25.5	7.3	7.7
July	173.8	219.1	16	16.3	79.0	63.0	79.6	66.1	19.2	28.9	24.1	19.6	28.5	23.9	6.4	6.1
August	158.1	273.1	11	19.9	77.1	63.1	81.6	69.5	19.5	29.8	24.7	19.3	27.8	23.6	8.1	5.5
September	189.0	214.2	11	16.0	75.3	66.4	76.0	63.0	19.2	29.5	24.4	19.1	29.3	24.2	6.9	7.0
October	177.5	37.1	6	3.8	60.9	50.4	60.1	43.2	18.6	30.5	24.6	17.7	31.4	24.8	6.7	8.7
November	0.0	1.1	0	0.2	25.0	19.8	28.3	21.1	13.6	31.2	22.4	15.3	31.5	23.4	7.7	9.3
December	0.0	0.1	0	0.0	22.0	19.4	20.9	16.4	12.8	27.6	20.2	13.7	30.3	22.1	6.3	9.0
Total	888.0	1065.5	60	83.8	-	-	-	-	-	-	-	-	-	-	86.4	95.5
Mean	-	-	-	-	48.2	37.8	49.0	37.3	17.8	31.0	24.4	18.1	31.4	24.8	7.2	7.8

Note: (1) Before 1953 observations taken at 0800 and 1300 GMT.
After 1953 observation taken at 0900 and 1500 GMT.
(2) Sunshine Records from Campbell Stokes Recorder.

Annex 1: (cont.).

Meterological Observations Samaru 1985 (Sheet one)

Month	rainfall (mm)		days of rain		relative humidity				air temperatures °C						sunshine	
		1928		1928	1985		1938 - 1985		1985			1938-1985			hours	
	1985	to 1985	1985	to 1985	am	pm	am	pm	min	max	mean	min	max	mean	1985	54-85
January	0.0	0.1	0	0.1	18.4	14.0	17.6	14.0	14.6	31.6	23.1	13.8	30.1	22.0	8.0	8.5
February	0.0	1.0	0	0.2	12.8	10.9	15.1	10.9	14.3	29.5	21.9	15.9	32.6	24.3	6.4	9.1
March	32.9	6.6	2	0.9	35.2	24.7	25.3	14.6	21.2	35.1	28.2	19.4	35.2	27.4	5.6	8.2
April	0.0	36.6	0	3.9	29.0	19.6	46.4	28.8	21.8	34.5	28.2	21.6	35.7	28.7	4.8	7.9
May	140.7	120.5	9	9.7	66.7	44.3	64.1	44.1	22.2	33.5	27.9	21.2	32.9	27.4	7.7	8.1
June	142.2	156.0	9	12.5	75.5	59.6	72.7	57.1	18.7	30.0	24.4	20.0	30.7	25.4	7.5	7.7
July	313.1	220.7	17	16.3	86.3	75.3	79.8	66.4	17.3	27.8	22.6	19.5	28.5	23.9	5.9	6.1
August	256.3	273.0	19	19.9	81.3	69.8	81.6	69.5	15.5	28.8	22.2	19.2	27.8	23.5	7.2	5.5
September	163.3	213.8	15	16.0	77.6	67.7	76.0	63.1	17.8	29.3	23.6	19.1	29.4	24.2	7.2	7.0
October	3.3	36.5	2	3.8	42.6	34.4	59.5	42.9	15.5	31.2	23.4	17.7	31.4	24.8	7.6	8.6
November	0.0	1.1	0	0.2	23.2	21.8	28.2	21.1	13.0	32.3	22.7	15.2	31.5	24.0	9.6	9.0
December	0.0	0.1	0	0.0	24.6	22.1	21.0	16.6	13.3	28.3	20.8	13.7	30.3	22.0	6.2	8.9
Total	1051.8	1066.0	73	83.5	-	-	-	-	-	-	-	-	-	-	83.7	94.6
Mean	-	-	-	-	47.7	38.7	48.9	37.4	17.1	31.0	24.1	18.0	31.3	24.8	7.0	7.9

Note: (1) Before 1953 observations taken at 0800 and 1300 GMT.
After 1953 observation taken at 0900 and 1500 GMT.
(2) Sunshine Records from Campbell Stokes Recorder.

Annex 1: (cont.).

ANNEX 2

QUESTIONNAIRE A: FOR VILLAGE RESIDENTS

Village _____ Local Govt. Area: _____

This questionnaire has been designed for the purpose of gathering information on a research programme titled "An Appraisal of the Directorate of Food, Roads and Rural Infrastructures Rural Water Schemes in Soba and Makarfi Local Government Areas of Kaduna State which is in part fulfilment of the requirements for the award of the M.Sc. Degree (Rural Development) of Ahmadu Bello University, Zaria.

Your co-operation towards the success of this research will therefor be highly appreciated.

SECTION A : Personal Data

1. Gender: Male ☐ Female ☐
2. Age _____
3. Marrital Status: Married ☐ Not Married ☐
4. Family set up: Nuclear ☐ Extended ☐
5. Size of family (number of persons): _____
6. Sexes: Male ☐ Female ☐

SECTION B: Occupational Characteristics

1. What is your main occupation ? _____
2. Secondary Occupation ?
   (a) Trading ☐ (b) Tailoring ☐ (c) Weaving ☐
   (d) Others ☐ (e) No response ☐
3. What is your annual income ?
   (a) Below N1000 ☐ (b) N1000 - N2000 ☐
   (c) N2001 - N4000 ☐ (d) N4001 - N6000 ☐
   (e) N600 - N10000 ☐ (f) N10000 and above ☐

Section C: Household Water Collection and Use

1. What are the sources of your water needs in the wet season ?
   (a) Stream/stream bed pit /___/ (b) Rain water /___/
   (c) Shallow well /___/ (d) Pond /___/ (e) DFRRI well/ borehole /___/ (f) Water Vendor /___/

2. How do you meet your water needs in the dry season?
   (a) Shallow well /___/ (b) Water Vendor /___/ (d) Pond /___/ (d) Stream/bed pit /___/ (e) DFRRI well/borehole /___/

3. Who is responsible for collecting the needed supply for your daily use ? Children /___/ (b) Male Adult /___/ (c) Women /___/

4. No of trips per day /___/ /___/ /___/
   1 2 3

5. Do you have a private well in your compound ? Yes /___/ No /___/

6. If yes , does it provide water throughout the year ? Yes /___/ No /___/

7. If yes do you patronise the DFRRI well ? Yes /___/ No /___/
   If/no well in your compound, where do you get water from ?
   (a) Community well /___/ (b) Pond /___/
   (c) DFRRI well /___/ (d) Water Vendors /___/ Tanzers /___/ Hand pu Cans /___/
   (e) River /___/ (f) Others (specify) _____

8. If water is purchased, at what cost daily ? _____

9. How far is your water source from your house ?

	In the raining season	Dry season
Less than ½km	/___/ 57	/___/
½km - 1km	/___/	/___/
1ku - 2km	/___/	/___/

10. How much time does it take you to fetch enough water for a day's use ?

	Raining Season	Dry Season
Less than 30mins	/___/	/___/
30 Mins to 1hr	/___/	/___/
1hr to 2hrs.	/___/	/___/

More than 2hrs. (specify) _____

11. Is the household satisfied with the amount of water fetched by water shortage ?

12. If not which household activity is most affected by water shortage?

Drinking ☐

Washing ☐

Watering Animals ☐

Food processing (Specify) _____

Other uses (specify) _____

13. Would you therefore like the DFRRI water supply increased by :

Half ☐

Double ☐

Three times ☐ More than three times (specify) _____

SECTION D: COMMUNITY WATER SUPPLY

1. Are there any wells/bore hole construction by DFRRI In your village ? Yes ☐ No ☐

2. If Yes, how many ? ☐1 ☐2 ☐3 ☐4 ☐5

3. How many of them produce water throughout the year ?_____

4. What time of the year do the wells usually fail if they do?_____

5. What in your own opinion is the cause for the failure of the DFRRI Wells(s) ?

Flutuating water table ☐

Collapse of the well (s) ☐

Increase demand above the capacity of the well ☐

Pump failure ☐

Other reason(specify)_____

6. Also the well (s) fail to actually dry-out what does the community do ?

Deepen the wells / ___ /

Reconstruct the collapsed ones /___/

Dig new wells /___/

Shift to other resources /___/ (name them) _____

7. How far is the distance of the DPRRI well from your house ?

Less than ½ km /___/

½ km - 1 km /___/

More than one1km (specify) _____

8. What alternative sources of water do you think can be developed for your Village ?

Impoundments (dams) /___/

Improving the traditional hand dug well /___/

More bore holes /___/

Ponds /___/

Other (specify) _____

9. Who maintains the well ?

Government Only /___/

Jointly by Government and community /___/

Community Only /___/

No body /___/

SECTION X Water Safety

1. Do you treat your water obtained from any of the mentioned sources before drinking ? Yes /___/ No /___/

2. If Yes by what method ?

By the addition of Alum /___/

By the addition of calcium hypochloride /___/

By boiling /___/

By filtering /___/

Other method (specify) _____

4. If no, why do you not treat it ?

   It looks clean enough /___/

   It is believed safe /___/

   Never thought of it /___/

   Other Reasons(specify) _____

4. Have there been cases of water - related diseases in the family ?

   Yes /___/ No /___/

5. If yes which of the following ?

   Diarhoea /___/ Dysentary /___/ Typhoid /___/

   Trachoma /___/ Guinea worm /___/ Cholera /___/

   Skin Ulcer /___/ Bilh. zlasma /___/ Malaria /___/

   Trypanosomiasis (sleeping sickness) /___/ Saviva /___/

   Other (specify) _____

6. How frequent is/are the problem (s) ?

   Through out the year /___/

   After every 3 months /___/

   After every 6 months /___/

   Once a year /___/

   No noticeable frequency /___/

7. What time of the year are the cases prevalent ?

   Wet season /___/

   Dry period /___/

   Throughout the year /___/

8. Have the siting of the DUMP well (s) reduced the frequency of any water related disease (s) ?

   Yes /___/ No /___/

SECTION F: Commun' Participation in water supply Development

1. Is there any ...unity development association or club in the Village ? Yes /___/ NO /___/

3. Was invited the formation ? Government [ ] Community [ ]
Jointly between Government and Community [ ]

4. Is the association involved in the DFRRI water supply projects ?

Yes [ ] No [ ]

4. If yes, is it : Wells [ ] Boreholes [ ]

Impoundments [ ] Other (specify) _____

5. Is the work on: Construction [ ] Maintenance [ ]

6. If association/club is not engaged in the supply projects, are you prepared to serve in any committee that will improve water supply in your area? Yes [ ] No [ ]

7. If yes, what will be your contribution ?

Labour through self help [ ]

Finance [ ]

Food and drinks [ ]

Other materials (specify) _____

8. If no clubs exist now, has any existed before ?

Yes [ ] No [ ]

9. If yes why did it stop functioning ?

Lack of support from community leaders [ ]

Lack of support from Government [ ]

Lack of effective club leadership [ ]

Cheating by Club officials [ ]

Mistrust among members [ ]

Association imposed by Government [ ]

Irrelevance time of the association in contemporary times [ ]

Other reasons (specify) _____

10. Do you think self help efforts can help improve your water supply ?

Yes [ ] No [ ]

11. If yes in what ways _____

_____

12. If no, give reasons _____

_____

QUESTIONNAIRE B: For Village Heads

SECTION A: Personal Information

1. Name of Village ----------

2. Local Government Area ----------

3. Age of Village Head ----------

4. How long have you been the Village Head ----------

5. Have you attended any formal school ?

   Yes (____) No (____)

6. If yes, to what level ?

   Primary (____)

   Secondary (____)

   Other (specify) ----------

7. How old is the village ? ----------

8. What is the estimated population size ----------

SECTION B: Community Water Supply

1. What are the main sources of water supply to the village ?

   Well (____) River (____) Pond (____)

   Borehole (____) Other (specify) ----------

2. Are there public water sources ? Yes (____) No (____)

3. If yes, who developed the sources ?

   Community self help (____)

   DFRRI (____)

   Jointly by DFRRI and Community (____)

   Charitable organisation(Specify) (____)

   Other (specify) - ----------

4. If the projects are developed and/or maintained jointly by Government and the Community, what is the community's contribution ? Labour (____) Money (____)

   Materials (specify) ----------

   Other (specify ----------

5. Are the projects functioning satisfactorily ?

Yes (____) No (____)

6. If no what is the problem ?

Lack of funds (____)

Lack of trained personel (____)

Lack of spare parts (____)

Other reason (specify) ----------

7. Can the community help to solve the problem in number 6 above ? Yes (____) No (____)

8. If yes, what is the arrangement so far ?

Community is contributing money (____)

D.F.R.R.I. is contacted (____)

Water board is contacted (____)

Other arrangement (specify) ----------

9. If community cannot solvethe problem, why ?

It is beyond communities ability (____)

No response from agency (ies) contacted (____)

Other reason (s) (specify) ----------

10. Generally is there any water shortage in the village ?

Yes (____) No (____)

11. What alternative sources of water will you advocate to remedy the problem ? Wells (____) Dam (____)

Boreholes (____) Other (specify) ----------

12. Why do you think so ? Because they are cheaper (____)

easier to maintain (____) can provide more water (____)

Other reason (s) (specify) ----------

13. Why are they not developed at present ?

Lack of funds ( ) Lack of Technical Experts ( )

Lack of Community Initiatives ( )

Other reason (s) (specify) ----------

14. Do people migrate in the dry season? Yes ( ) No ( )

15. If people migrate, where do they go to ?

Near water points ( ) Distant water points ( )

Town ships ( )

16. What activities do they seek by migrating ?

Fadama farming ( ) Watering Animals ( )

Other (specify) ----------

17. Do you think DFRRI has help improve water supply situation ?

Yes ( ) No ( )

18. Do you think self-help effort can help improve water supply in the village ? Yes ( ) No ( )

19. If yes, what prevents it ? People refuse to cooperate ( ) It has never been discussed communally ( ) Other reason(s)(specify) ----------

20. Can you suggests other ways by which the water supply can be improved ?

SECTION C: Plans for Water Development

1. Are there any plans for water development for the villages ?

Yes ( ) NO ( )

2. If yes, what are the plans Wells ( ) Pond ( )

Boreholes ( ) Others (specify) ----------

3. Who proposed the plans? The Community ( ) D.F.R.R.I. ( )

Local Government Authority ( )

Other Agency (specify)----------

Local Government Area _____

2. Rank of Officer _____

Gender: Male /___/ Female /___/

3. Since when have you been on the job in this area ?

_____

4. What was the portable water supply situation in the local Government area on assumption of duty ?

_____

_____

_____

5. How many well/boreholes have so far been constructed by UNDP in the local government area ?

(a) Open concrete wells _____

(b) Boreholes _____

6. At what time of the year is construction work usually carried out ?

_____

8. Who awards the contract for the construction of the well/borehole. (a) UNDP National Headquarters /___/

(b) UNDP State Headquarters / /

(c) Local Government Headquarters / /

9. How many of the wells/boreholes are functioning?

(a) Open concrete well /__ /

(b) Bore holes /___/

10. If any not functioning, what is the cause(s) _____

_____

_____

_____

11. How many wells/boreholes are constructed per village ?

(a) Well _____ (b) Bore holes _____

13. Is the community involved in the DPWRI

Water project? Yes /__/ No /__/

13. If yes, at what level ? _____

_____

_____

14. If no, why ? _____

_____

_____

_____

15. What is the average cost of construction?

(a) Borehole N _____ (b) Open concrete

wells N_____

16. Who supervise the construction work ? _____

_____

17. Who influenced the siting of the wells

Community /__/

DPWRI formular /__/

Personnel judgement of DPWRI officials /__/

18. Are the wells arbitrarily developed or Geophysical surveys

carried out before developments _____

_____

_____

19. Are there well locations for the wells?

Yes /__/ No /__/

20. What type of pumps are installed in the boreholes ? _____

_____

21. What type of screen is used in the boreholes ?

_____

_____

17. Who often does the pump mechanic ?

18. Who does the servicing of the pumps ?

OFWAT / / Community / /

Local Government /___/

19. Could the pumps be responsible for the reported failure ?

Yes / / No / /

20. Are the wells cased Yes / / No / /

21. What is the average depth of the

Boreholes _____Metres

Well _____Metres.

22. What is the depth of the dry season water table ?

23. Are you, as an official of OFWAT, satisfied with the overall water supply situation in your local government area ?

Yes /___/ No /___/

24. If no, why ? _____

25. Is there any hope to revive non-Functional wells ?

26. What suggestion do you have in improving the water supply situation in the local government area ? _____