AN INVENTORY OF AGROFORESTRY PRACTICES AMONG SMALLHOLDER FARMERS IN BIRNIWA LGA, JIGAWA STATE

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APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science in Geography.

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CERTIFICATION

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DECLARATION

I hereby declare that this thesis is the product of my research efforts, except where otherwise stated. I also declare that it has not been previously or concurrently presented as a whole for award of Degree or Certificate at Bayero University Kano.

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DEDICATION

This thesis is dedicated to my beloved parents, and my entire family who instilled the value of education in me at a very young age. Your unconditional love, support, understanding, and guidance provided me with the strength and determination to achieve this goal and continue to challenge myself.

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ABBREVIATION AND ACRONYMS

AFARC	=	Agroforestry Agency for Rural Committee
APCU	=	Afforestation Project Coordinating Unit
DAFDC	=	District Agroforestry Development Committee
DAFRMP	=	Directory for Agroforestry Research, Monitoring and Planning
DFRRI	=	Directory for Food, Road and Rural Infrastructure
FAO	=	Food and Agricultural Organization
FAN	=	Forestry Association of Nigeria
FORMECU	=	Forestry Management, Evaluation and Coordinating Unit
ICRAF	=	International Centre for Research in Agroforestry
IITA	=	International Institute for Tropical Agriculture
JARDA	=	Jigawa state Agricultural and Rural Development Authority
JIGAP	=	Jigawa state Afforestation Programme
L. G. A.	=	Local Government Area
LGAFDC	=	Local Government Agroforestry Development Committee
MANR	=	Ministry of Agric and Natural Resources
MOE	=	Ministry of Education
NGO	=	Non-Governmental Organization
NOA	=	National Orientation Agency
SPSS	=	Statistical Package for Social Science
UNCOD	=	United Nation Conference on Desertification
VAFEA	=	Village Agroforestry Extension Agency
VEAS	=	Village Extension Assistant

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ABSTRACT

Man through his numerous activities aimed at development has exploited the environment to an extent that human existence today is faced with many problems. These problems can only be reverse through the appropriate environmental measures. The feasible means for restoring the threatened environment to stable condition by ensuring ecological balance is agroforestry practices. In this regard, the study is aimed at identifying the nature of agroforestry practices and its impact as its objectives. The research acquired the data through questionnaire administration to one hundred and fifty (150) agroforestry farmers with the view of understanding how the system was adopted by the farmers across the areas. The data generated were analysed using descriptive statistics. The findings indicate that about sixty five percentage (65%) of the farmers adopt the agrosilvicultural system. The five identified agroforestry technologies/models that are most used are as follows:-Alley cropping (14.5%), Scattered planting (10.9%), woodlot (17.4%), Orchard (20.2%) and Natural tree regeneration (25.3%). The farmer's perceptions of benefits and effects of agroforestry technology on crop land were highlighted. The key factors limiting the acceptance of the system include; (1) effect of long tree gestation period on land tenure issue and (2) The farmers were found to have fully understood the domestic use of fuelwood. Finally, the work proposes organizational model for rural agroforestry development and that the three tiers of government should intensify efforts at Unified Agricultural Extension System and that Non-governmental organizations (NGO's) should participate in enlightening and educating general public on the importance of agroforestry in the study area and Jigawa state at large.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Before Nigeria's independence, development policies have progressed substantially since the 1950s. The move in this direction was necessitated by the need to 'catch-up' with the developed nations of the world by modernizing the economy, so as to ensure rapid growth in productivity (Kuhnen, 1990). The move has therefore, been marked by numerous national and international sponsored development programmes in agriculture, industry, water supply, transport, etc. However, most of these projects have been or are being implemented with less environmental considerations and involvement of the intended beneficiaries and therefore have had a high rate of failure. Most often, these projects are discrete and have a limited time span. Hence, as soon as the project executors leave at the expiration of the projects, the projects start collapsing and sometimes compound the problems of the community where they are cited. Conversely, projects planned with the environmental considerations and full involvement of beneficiaries from the onset, on an appropriate scale, and using their skills and available environmental resources, have had a relatively high success (Spore, 1992).

In recent times, it has become obvious that to achieve much success on sustainable basis, Farming System Research and Extension have to be intensified. This involves improving and modifying where necessary the farmers methods of soil improvement, crop and animal production, environmental protection, etc. Sustainability means 'making things last, making them permanent and durable.' What is being sustained can be an object of choice such as economy, industry and ecosystem or set of ecosystems, (Pearce, 1988). The

need and means for ensuring sustainable development should transcend all generations and be international in scope, if long lasting records are to be obtained (Mamman and Ogbonna, 1993). Thus, the ecology debate of the past twenty-five years has been characterized by increasing concern for problems of the whole; man, biota, the globe and the biosphere (Pearce, 1988). Growing population pressure, and unabating droughts in recent years together with excessive deforestation, overgrazing and yearly bush burning, and have all combined to bring about rapid rate of desertification in the northern fringes of Nigeria, particularly in north-eastern Jigawa State which is our study area. Desertification is a term used to describe the spread of desert-like conditions in arid or semi-arid environment such as steppe and Sahel Savanna (UNCOD, 1977).

Before examining the development initiatives undertaken in Nigeria, an examination of experiments and experiences of other countries in finding solutions to wind erosion/land degradation is in order. One general experience of countries confronted with this problem is that vegetation provides the most desirable and permanent solution. Moreover, plants are ecologically beneficial to destabilized areas and add organic matter to the soil. Addition of organic matter to the soil improves the plant micro-environment and exerts a binding effect on the soil (Peter and Harris, 1994).

Agroforestry is a popular concept among agricultural development and is often invoked by scientists as a solution to rural development needs. It is not a new enterprise since it has been practiced under different conditions and in diverse locations for more than a century (Anumudu, 2000). Agroforestry covers a variety of land use systems which are designed to encourage people participation through a number of flexible and locally acceptable environmental management techniques which combine trees or livestock rearing

with agricultural crop production on the same piece of land. The trees that are combined with crops could be horticultural trees to improve the nutritional value of rural peoples or trees for poles or fuelwood that is, strategies that are compatible with culture of the local populace (Daniel, 2002).

One of the objectives of agroforestry is the provision of greater benefits for the land use than agriculture or forestry alone. Among the benefits derivable from the system include soil fertility, soil conservation, and increased yield, reduces risk of crop failure, pest/diseases control and socio-economic needs of the rural population. As the crop yields in the arid zone are very low because of drought, effect of desertification, the need for the introduction of agroforestry to improve nutrients cycle, moisture balance, and also the diversity of agricultural products arise (Daniel, 2002).

Rural communities are increasingly affected by the tremendous pressures on their local forest. The forests and trees resources of many areas are becoming severely diminished by two major activities; both of which are essential to the well-being of many communities: farming and fuel wood collection. As population increases, tracts of forest are being cleared for farming. Often the lands cleared are of marginal quality, located on steeps, rocky hillsides or in dry drought-prone areas. Such lands can become wasteland after only a few years of farming (Susan and June, 1988). Additional reductions in forest cover can be attributed to decreasing fallow periods. In many rural areas, land was traditionally allowed to revert to bush or forest after a few years of farming. This provided a more sustainable supply of forest resources and allowed soil to regain lost fertility.

The demand for fuelwood and other tree products places even more pressures on forest resources. Rural communities can be greatly affected by these trends. More time and

energy must be devoted to collecting the wood upon which they depend for cooking family meal, building homes and carrying out other essential activities. The availability of fertile farmland is being reduced. What can farmers and their communities do to address these forestry-related problems? agroforestry is one potential solution. By planting trees on their land, farmer can boost local forestry resources. They can also improve the quality of their farmlands and provide other benefits to the community (Susan and June, 1988).

Agroforestry is a compound word formed by a union of the two words Agriculture (which in its widest sense is used to refer to the practice or art of cultivating food crops and/or rearing animals) and forestry (which is the science of growing trees). Therefore, one can refer to agroforestry as any land use system that involves a close association of trees or shrubs with crops, animals and/or pasture. Agroforestry is a popular concept among agricultural, forestry and environmental scientists, its popularity stems from the increasing evidence that trees and shrubs can be managed to significantly enhance and guarantee the sustainability of agricultural system. Agroforestry offers an alternative approach to intensive agricultural "development" schemes that in the past often resulted in decreased soil fertility and loss of soil restoration potentials (Weber and Stoney. 1986).

According to the World Agroforestry Centre as quoted by Nair (1989), agroforestry is a collective name for land use systems and practices in which woody perennials are deliberately integrated with crops and/or animals on the same land management unit. The integration can be either in a special mixture or in a temporal sequence. Nair (1989) further added that agroforestry is the growing of both trees and agricultural/horticultural crops on the same piece of land. They are designed to provide tree and other crop products and at the

same time protect, conserve and sustain vital economic, environmental, human and natural resources.

Agroforestry practice should not be considered replacement for the conservation of native tropical forests, but an agroforester can play a key role in helping to conserve biological diversity (biodiversity) of species. Agroforestry planting can provide expanded habitat for a wide range of species, from soil micro life to insects to mammals. Agroforestry is made up of land use practices such as (a) Agrosilviculture (for food crops and tree production e.g. alley cropping) (b) Silvopastural (for tree and livestock production e.g. fodder bank) (c) Agrosilvopastural (for food crop, tree and livestock e.g. apiculture). Inappropriate agricultural and forestry production systems and population growth (animal and human) outstripping production lead to land degradation. This problem is severe in the semi-arid north eastern Jigawa State where the pressure of population is high, ecosystems are fragile and exploitation of forest cover is ruthless. The consequence is that wood and food supplies are dwindling. It is against this background that strengthening agroforestry practices using appropriate trees and shrubs would encourage semi-arid zone dwellers in tackling environmental problems (Haruna, 2006).

1.2 STATEMENT OF RESEARCH PROBLEM

Forest constitutes one of the principal renewable natural resources of the natural environment. The importance of trees within our environments cannot be over emphasized. Trees play such vital roles of protecting the soil and water resources that sustain all agricultural production to feed the ever increasing population of the world, improving supply of fuelwood and fodder for man and his livestock, as well as generating income through the sale of forest products and above all, leaving a legacy for future generations.

Inspite of the numerous functions of forest resources, forest ecosystem are increasingly under threat as a result of the growing population, together with excessive deforestation and expanding consumption of forest resources (FAO, 2001). The needs for fuel and fodder, subsistence farming, and the neglect of soil and water conservation in the study area have all contributed to the rapid decline of forest cover (Kwagyang, 1996).

In view of the growing gap of forest resources exploitation against the background of an increase pressure on land for the production of food and wood for the increasing population have made it mandatory to look in to various ways of maximizing the uses of agricultural land in different parts of the world (Mikail, 2001). However, in recent years series of studies have been conducted on agroforestry, most of which was on growing concern over the importance of agroforestry to sustaining agricultural practices and food security.

The high rate of population growth in Birniwa L.G.A, as attested by Labode et al, (1996), has resulted in intense pressure on land and indications of the decline in the crop yield and soil fertility by the farmers with the intensification of land degradation in the area. Saminu (2012) conducted a study on the assessment of agroforestry practices in Gezawa L.G.A Kano state, Nigeria. The study was necessitated by the new approaches to agroforestry as opposed to the traditional system. Agroforestry has been claimed to have the potential of improving agricultural land use systems towards providing lasting benefits and alleviating adverse environmental effects at local and global levels in the tropics (Azeez, 2005). There is therefore, the need to reverse the foregoing scenario with a view to addresses the sustainability of the agroforestry system among farmers in the land use system

of the area. This is what necessitated further study by documenting an inventory of agroforestry practices among smallholder farmers in the study area.

Prominent research questions from which answers are sought in this study include:

1 What is the nature and extent of agroforestry practices in the study area?

2 To what extent does (the impact) of agroforestry practices meet the basic needs of food, shelter and fodder of the rural populace?

3 What are the challenges (constraints) of agroforestry in the study area?

4 What sort of organizational structure can be formulated and adopted for agroforestry development?

1.3 AIM AND OBJECTIVES OF THE STUDY

The aim of this study is to assess the agroforestry practices and its impact in meeting the basic needs of food, fodder, income and environmental protection needs of smallholder farmers in Birniwa LGA of Jigawa State.

To achieve this aim, the study has the following objectives:

i. To assess the nature and extent of agroforestry practices in the area.

ii. To assess the impact of agroforestry in meeting the basic needs of food, shelter, fodder and environmental protection needs of the rural populace.

iii. To identify the constraints to the practice of agroforestry (and make necessary recommendations).

iv. To recommend an organizational structure for rural agroforestry development in the study area.

1.4 SIGNIFICANCE OF THE STUDY

This study focuses on the environmental assessment, of resources to make for sustainable rural development, it would be of interest to formulate farming model compatible with semi-arid north-eastern part of Jigawa State. In this part of Nigeria, rainfall is very erratic and scarce and exploitation of natural resources is very high. If we are really concerned about the future generations, we must engage ourselves in deep thinking on how to manage our environment and develop our resources for the benefit of all without degrading the environment.

To bring about a lasting solution and develop a sustainable model for environmental amelioration of the area, there is a need for a departure from conventional generalization of mere tree planting to agroforestry approach which provides for basic needs holistically (Ballama, 2004).

1.5 SCOPE AND LIMITATION OF THE STUDY

The study focused on an inventory of agroforestry practices among smallholder farmers in Birniwa Local Government area of Jigawa state. It particularly determined to assess the nature and extent of agroforestry practices, its impact in increasing the basic need of the rural populace as well as identified the problems associated to the practice of agroforestry and lastly recommends an organizational system for rural agroforestry development in the area.

The study cover two (2) districts (Birniwa and Diginsa) and three villages were selected from each district .The sample villages in Birniwa district were Birniwa, kasarwa, and Matara uku while in Diginsa district were Barburam, Karanga and Kishinde. Among the limitation in the conduct of the study were poor attitude of the respondents towards

answering questionnaire, problem of accessibility to the villages, financial constraint that limits the researcher to make adequate visits of the study area.

1.6 THE STUDY AREA

Birniwa local government is located in north-eastern part of Jigawa State. It lies approximately on latitude 12^0 34'58N to 12^0 59'46N and longitude 9^0 46'5E to 10^0 16'19E. The study area is bordered to the North by Machina Local Government (Yobe State), to the East by Nguru Local Government (Yobe State), to the South by Kirikasamma (Jigawa State) and to the West by Mallam Madori and Kaugama L.G.A. (Jigawa State). In terms of landmass and population, it has an area of 1,567km2 and a population of 142,329 people at the 2006 census. It is about 184Km away from the Jigawa state capital Dutse (Fig: 1).

1.6.1 PHYSICAL SETTING

GEOLOGY

The study area is underlain by the Chad formation, composed largely of unconsolidated sediments. These sediments are of tertiary terrestrial origin (Olofin, 1987). On the surface they consist of vast, tertiary accumulation of sand on plains and interfluves and recent alluvial accumulation in channel complexes, as well as recent accumulation of silt and clay in depressions. The vertical profile is an alternating band of sand (aquifer) layers, which has abundant underground water.

SOIL

The soil on the Chad formation is mostly sand, silt, or sandy loam. These soils occur on the well drained interfluves and silt loam occurs on the lower slopes and the outer rim of

depressions. At the bottom of the depressions, especially those associated with swamps formed by disappearing streams, hydromorphic soils occur. In some areas trace of sand occurs (Olofin, 1987).

RELIEF AND DRAINAGE

The study area falls within the plains of the Chad formation, with a mean altitude of about 480m (ASL) (Olofin 1980). The sources of water that flows through the area originated from the north-central highland and the Jos Plateau forming the Hadejia-Jama'are system. The two systems meander over the dry plains and flow in several distributaries into the Nguru-Hadejia-Gashu'a wetlands. Due to the high rate of evaporation, more than 50% of the discharge gets evaporated before reaching Lake Chad. (National atlas, 1978 and Essiet, 1993).

CLIMATE

According to Koppen's climatic classification the semi-arid zone has an AW type of climate in which there are two distinctive seasons namely the wet and the dry seasons.

The climatic condition of the study area has been irregular with relatively wide and rapid changes of humidity. The North-east trade wind blow across the area which leads to harmattan season as from November and reaches its peak between December and January and stops in March. While hot weather condition starts late in March to early June with rainy season starting from mid of June to September or October.

The temperature of the study area is warm to hot throughout the year, even though there is a slightly cool period between 31.7^0c in the coldest month (December/January) and 41^0c in the hottest months (April/May) (JARDA Meteorological Station).

Rainfall is very important element to consider which is very critical in the study area. The area is semi-arid with highly variable range of rainfall. Seasonal movement of the two air masses causes West-African rains, North of latitude 80 to 90 North there is only one wet season separated by a long dry season. The mean annual rainfall of the study area is less than 600mm. (JARDA, 2013).

Evaporation is very high in the study area, which is estimated at about 75% of annual rainfall and average annual duration of the sunshine is about 8.5h/d while that of relative humidity is about 49 – 55%.

VEGETATION

The vegetation of the study area is the Sudan Savannah and consists of a variety of trees, shrubs and grass communities. Three vegetation units are recognized in the study are: the Fadama (flood plain), Tafki (Pond) and the Firgi (clay flat). In all the units, there exists a gallery forest. Man-made vegetation is restricted to towns and villages. Also there are government owned shelterbelts and forest reserves at the outskirts of the towns and the villages.

The common plants in the ecosystem of the area include the shrubs and woody trees such as *Acacia senegal* (Dakwara), *Ziziphus mauritiana* (magarya), *Faidherbia albida* (Gawo), *Balanite egyptiaca* (Aduwa), *Acacia nilotica* (Gabaruwa), *Termarindus indica* (Tsamiya), *Acacia hockii* (Farar kaya), *Hyphaene thebiaca* (Goriba), *Ziziphus abysinica* (Kurna), *Diospyrous mespiloformis* (Kanya), *Gueria senegalensis* (Sabara), *Adansonia digitata* (Kuka), *Ficus sycomorus* (Baure), *Leptadenia hastate* (Yadiya), *Ximenia americana* (Tsada), *Piliostigma thoningii* (Kargo), *Moringa oliefera* (Zogale), *Azadirachta indica* (Darbejiya) and *Eucalptus camaldulensis* (Turare), Two exotic tree species, *Azadirachta*

indica and *Eucalyptus spp* are tree species commonly found in settlements and shelterbelt establishments. They are used for shade and wind break in the area.

1.6.2 HUMAN AND ECONOMIC ACTIVITIES

The ethnic composition of the population in the study area comprise of Mangawa, Hausa and Fulani. Two ethnic groups (Hausa and Mangawa) live together within the community while the Fulani community lives at a distance from the village/town in the grazing lands.

Arable farming is the most important economic activity and can be categorized into two types: namely the upland farming (Noman tudu) and low land (Fadama) farming within the flood plains. The types of crops cultivated in upland are rain fed crops such as millet, sorghum, cowpea etc. These three crops provide the dominant staple food for the people of the study area. Virtually every household grows them. Other minor cash crops are melon, groundnut, sesame etc.

Lowland crops include rice, tomatoes, onions, garden eggs and wheat. Rice is grown in the rainy season along the flood plain of river Hadejia - Jama'are while wheat, onion and vegetables are irrigated during the dry season. Fishing is also practiced in the study area especially among those who live close to the rivers. Smoked or dried fish trading is under taken by the local people of the study area

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

The rate of environmental degradation in semi-arid zone of Nigeria is alarming due to human activities and few natural catastrophes. It was predicated that within the next 25 – 30 years most of the (world's) humid tropical forest as we now know will be transformed into unproductive land and the deterioration of the savannah into desert will continue on ever increasing speed (Umar, 1997). Mendie and Akpan (1999) defined environment as a "totality of space in which man operates" comprising of land, air and vegetation. These components make up the interdependent entities that operate as a system. The institutional land tenure practiced makes the country's arable land fragile or contains low nitrogen and organic matter due to continuous cultivation (Masiri, 1997).

Over the years, a number of factors have directly or indirectly contributed to the degradation of the environment. Consequently food, fodder, fuel wood and other daily needs are drastically affected. Human and animal pressures on the environment became unabated. Also peasant farmers are engaged in "slash and burn" agriculture involving burning of the

debris from land preparation. Large areas of forest/savannah lands including trees, shrubs and economic tree species are cut to serve man's need without effort of replenishment.

The late 1970's saw an increased interest in agroforestry, culminating in the establishment of the International Centre for Research in Agroforestry (ICRAF) in Nairobi, Kenya in 1978. A booklet appeared entitled "Trees, Food and People" (Bane *et al.,* 1977) it amounted to a call for more interdisciplinary work, especially between foresters and agriculturalists. Food production and tree management became recognized as closely related practices, as trees have always played an important role in mankind's survival.

Concept of sustainable development is linked with agroforestry, as shown from the definition of Brundtland Report (1987) our common future. "Development that meets the need of the present without compromising for future generation to meets their own". The environment should be seen as an asset, a stock of available wealth but if the present generation spends this wealth without investment for the future then the world will run out of resources. This calls for ecological production and utilization levels where everything removed is then replaced so as to ensure continuity and not to harm the ecosystem. Forestry development is a dynamic process which should ensure social and economic sustainability of the populace (FAO, 1978). The major problems in Birniwa Local Government Area are degradation of agricultural lands, rapid deforestation, disappearing of woodlots and desertification due to intense biotic pressure. The trend of thought can also be extended to the traditional farmers to be actively involved in agroforestry practices as a strategy for sustainable development of rural economies in their communities.

2.2 CONCEPT OF AGROFORESTRY

Agroforestry is a term for an age-old land use system where forestry, agriculture and pastoralism are practiced on the same piece of land sequentially or simultaneously (Anon, 2002).

Agroforestry is further defined as a multiple land use system where annual or biennial Agricultural crop and perennial or forest tree crops and or livestock are deliberately planted together on the same unit of land either sequentially or simultaneously in a specially designed manner so as to prevent harm from being done to any of the crops and at the same time ensures optimum output or productivity and finally enable the land to remain productive perpetually or continually (Kareem, 2002). Under agroforestry scheme, trees are usually planted at very wide spacing to allow good development of agricultural crops or pasture underneath. It is permanently used to take advantage of the productive and protective attributes of trees to improve the total output from the land.

Agroforestry is a system that generally yields greater economic rates of return than the traditional forest management system of plantation establishment. However, such benefits effect or raising trees and crops or animals together are not automatically achieved without certain conditions being met. Compatible species in optimum spatial arrangements can be used. Trees at wide spacing and heavy pruning are carried out as in the case of Alley cropping (Musa, 2000).

The concept of agroforestry has been articulated in several publications from International Centre for Research in Agroforestry (ICRAF) and other organizations. Thus, agroforestry is no longer a “new” term. It is widely accepted as an approach to land-use involving a deliberate mixture of trees with crops and/or animals. However, the question of

"what is agroforestry?" comes up occasionally even today in many discussions and some publications (Samarriba, 1992 and Zerihun and Kaba, 2001).

Agroforestry is a collective name for land-use and practices where woody perennials (trees, shrubs, palms, bamboos etc) are deliberately grown on the same land management unit with agricultural crops and/or animals, either in some form of spatial arrangement or temporal sequences (Lundgren, 1987). In agroforestry systems, there are both ecological and economic interactions between the different components. Besides providing wood, food and/or animal, the integration of trees in the farming system helps to ameliorate the environment. Agroforestry is a system of land management, which integrates trees, plants and animals in conservative, long term productive systems. It is one of the most self-sustaining and ecologically sound agricultural systems. The system makes maximum use of the land, as every part of the land under agroforestry is considered suitable for plants that are useful both to the system and the farmer. It reduces risks associated with agriculture, small scale or large, and as well increases the sustainability of agriculture through soil conservation and improvement, among others (Brils, 1994).

According to Aju and Popoola (2005), agroforestry is the combination of agriculture and forestry technologies to create integrated, diverse and productive land use systems. The concept which is popular among agricultural and environmental scientists can enhance the rural development needs in the developing nations.

Okafor and Obam (2003), described agroforestry as a multiple land use system in which agricultural crops and woody perennials are grown on the same land management unit. The system may or may not involve the production of livestock. Furthermore, Okafor

and Obam (2002) stated that in agroforestry system, the tree provides food, shelter, drug, cash income, raw materials and improvement of soil fertility for crop growth.

Azeez *et al* (2005) opined that agroforestry enhances food production which will last so long as forests do. This is a pointer to the indispensable role of forestry in improving the present and future world food security, most especially in the developing part of the global village. As pointed out earlier, there are three basic components managed under agroforestry land use system. These are: tree (woody perennial), herb (agricultural crops, including pasture species), and animal. Based on the structure and function of these components, agroforestry has been classified into three categories. These are: Agrosilviculture (trees and crops); Silvopastoral (trees and livestock) and Agrosilvipastoral (trees, crops and livestock) systems. Other types of agroforestry systems include apiculture (bee keeping), aquaculture (fish rearing), woodlot plantation (Banerjee, 1995).

2.3 AGROFORESTRY APPLICATION AND PEOPLES PARTICIPATION

Agroforestry can be intensively practiced just like intensive agriculture, on good, fertile lands. The practice of agroforestry is not restricted to the semi arid region usually with unfavorable weather conditions and may be with low population density but also applicable to the high forest areas with favourable weather conditions often faced with the problem of high population density resulting into land hunger (Anumudu, 2002). Areas for agroforestry application may include:- rampant deforestation both for wood/livestock, rapidly increasing population, poor farming practices, uneven distribution of farmland, unfertile soil, denuded and eroded areas and sloping agricultural land.

People participation means just convincing people to carry out the tasks identified for them in a programme (Dada, 1986). It means that people either individually or

collectively are involved in identifying the problems and their cases and assessing the nature, scope and magnitude of interventions required to ameliorate them. It means also that people should be helped to analyze the risks involved and later to monitor and evaluate to enable them adopt the activities required to achieve the desired results (Dada, 1986).

One of the important reasons for insufficient people's participation is because of the traditional and different to change "top-down" decision making approach in implementation of such programmes, which rarely if at all trickles down to the community and individual level for foresters accustomed to sociology working with and through people's is a difficult transition which also needs substantial institutional adjustments (FORMECU, 1986). Success of agroforestry programmes with active peoples participation at all stages requires bare foot foresters, who worry less about the technology or technological aspects of trees growing, but more about how rural poor and small farmers can be persuaded voluntarily to plant and nurture trees and woodlots that will be of use to them in the decades ahead (FORMECU, 1986). Social change required continual participation of whole communities in planning and implementing the proposed programmes. If agroforestry is to succeed in the long run, farmers and grazers must willingly give up harmful land use practices to which they have long accustomed (FORMECU, 1986).

Social forestry programme to be successful must reflect the needs, problems and aspiration of rural people as seen through their eyes, more rhetoric about the improvement of the environment and ecology, to ensure a better quality of life for them, does not make such sense to halt starved rural people. Also may not take long for these hard headed realists to recognize quickly real benefits materializing before their eyes through implementation of social forestry programmes (Adams, 1982).

It is generally believed that in order to succeed, community participation also calls for new attitudes and policies, as the main issue now is how tree growing and agriculture can be combined to raise the living standards of the land that sustain them (Tiwari, 1983).

Forestry contribution to community development in Nigeria has been highlighted by many people. Appraise it contribution to landscape development and to the establishment of stable communities. Many towns have developed from forest settlement (Bello, 1991).

2.4 AGROFORESTRY DEVELOPMENT IN BIRNIWA LOCAL GOVERNMENT AREA

The ecological effects of forestry are of vital importance to rural development in particular. Because of their sheer size, trees have major role to play in the cycle by which nutrients pass from soil through plants and animals back to the soil. The canopy of foliage protects the soils from the direct impact of sun, rain and wind, and the falling leaves and fruits provide regular flow of nutrients to the soil (FAO, 1981). In this way, agricultural productivity which depends largely on soil fertility will be improved.

The development of agroforestry in Birniwa Local Government would be related to the state forestry department but more effectively related to the evolution of forestry II project in Nigeria and Jigawa state in particular (JIGAP, 1993).

Prior to the inception of World Bank assisted forestry II project, the state forestry sector accounted for some farm forestry (agroforestry) design, involving peasant farmers in forestry activities. But this could not materialize for long because; the actual funding to the forestry sector was dismally low. From 1981 – 1984 for example, forestry sector took only 2- 4% of the Federal Government Budget. Similarly, states were faced with similar constraints, often in greater dimension and this has led to staff reduction and stoppages to

new investments. The World Bank Assisted Forestry II project on inception was able to enhance the rejuvenation of this programme (agroforestry) to make it economically effective and efficient (FORMECU, 1997).

The forestry II project was identified in 1982 during the course of the first forestry project. The FAO/IBRD cooperative programme completed a preparation report in 1983 and FDF under took additional preparation work in 1984. The project became effective in 1986 (Igbeogwu, 1988).

The project aimed to:-

Strengthen the structural base of the sector through improved policies, training and research.

Stabilize soil condition on threatened areas and improve the supply of fuel wood, poles and fodder by supporting farm forestry (agroforestry) and shelterbelts activities

The farm forestry programme comprises a set of activities designed to encourage tree planting and maintenance on farmlands. It includes development to provide sufficient seedlings of various types, efforts by forestry extension staff to encourage and advice farmers on tree planting, protection and maintenance and mass media campaign to increase farmer's awareness of the need for the benefits of additional tree cover (Igbeogwu, 1988).

FORMECU served as the national headquarters of the forestry II project, while APCU serves as the regional headquarters of the AP states.

Since, the bifurcation of the former Kano state into Kano and Jigawa states in 1991, it also inherited from the former Kano state; Jigawa state intensified in Afforestation Programme to combat the menace of desertification. The forestry II project became responsible for the social forestry in the state.

The organization (forestry ii project) became much concerned with community participation phenomenon. The organization arranged some strategies to inculcate in the minds of the rural populace, planting of trees in their domains, farms and for the amenities and also to project them. The organization employed and sent village extension assistants (VEAS) to various locations who used to impart and at the same time receive information to and from the peasant farmers for change and research respectively (JIGAP, 1993).

The forestry II project evolved training and visit extension system in Jigawa state and hence in Birniwa local government area. The organization used to raise seedlings in its departmental nurseries for distribution to farmers to plant and also used to encourage community nurseries for farmers to participate actively in seedling production for their own use. It sent its staff to encourage and assist planting in various farmers sites (JIGAP, 2001). Women are good home and environment managers. The organization evolved female participation in forestry activities.

2.5 SYSTEMS OF AGROFORESTRY

Agroforestry can be classified based on structure or function and these classes are:

2.5.1 Agrosilvicultural System

This is a system whereby agricultural crops and trees are grown together. Example of this is dispersed trees on farmland, trees on boundaries, natural regeneration, improved fallow system etc.

2.5.2 Silvopastoral System

This is a system whereby pasture / animal are managed with trees on the same piece of land. It involves herding livestock through plantations and reserves to graze the naturally occurring under storey grasses and legumes and browes shrubs

and tree fodder species. Dispersed trees on farmland, improve fallow system etc, are examples of this system (Nair, 1989). Some of the tree forages like *Fadherbia albida* and some Acacias provide nutritive fodder during the rain season.

2.5.3 Agrosilvipastoral System

Agrosilvipastoral involves raising food crops, tree forages and annual forages, and livestock together in the same piece of land. In essence, it is silvipastoralism with food crops introduced but during the rain season, the animals are restrained in padlocks and fed with farm wastes or forages cut from the trees or annuals. During the dry season, the animals could be released into the farm to browse the tree forages or farm wastes. This system is practiced in the Nigeria savannah zones consciously or unconsciously (Adedire, 1992).

Alley cropping and border line planting are some models and design established in this system.

2.6 AGROFORESTRY MODELS/DESIGNS

Trees can be combined with food crops in many ways. This refers to the models or design of establishment of farmland based on intended system and can vary with species and escapement (Ekwebelam, 1988). An agroforestry practice is a specific land management operation. Baumer (1990) reported that an agroforestry nature' means that at least one species of woody perennial is involved and interacts ecologically and/or economically with other elements (animal and/or vegetable) in the system.

Below is a brief description of some of the agroforestry practices identified by the International Centre for Research in Agroforestry (ICRAF).

2.6.1 Shifting Cultivation

This is the oldest agroforestry practice in the tropics, and it is suited for areas of low population densities (25 – 30 persons/km^2) (Adedire, 1992; Ovorak, 1993). The term shifting cultivation refers to farming system in which land under natural vegetation is cleared, planted to agricultural crops for a few years, and then left unattended while the natural vegetation regenerates (Nair, 1993).

2.6.2 Scattered Farm Trees (Parkland)

This is otherwise known as parkland farming (Spore, 2000). It is a common land use system whereby trees are deliberately retained on cultivated or recently fallowed land. This system dominates agricultural practices in the savannah regions generally and particularly in Nigeria (Nsien *et al.,* 2010). This sometimes incorporates animal production and it involves no special techniques, species type or density per unit area. The trees are allowed to grow and they appear scattered over the farm. The species commonly found are *Termarindus indica*, *Adansonia digitata*, *Diospyrous mesplifomis*, *Parkia biglobosa*, among others.

2.6.3 Alley Cropping

This system was popularized in Nigeria by scientists at the International Institute for Tropical Agriculture (IITA) Ibadan, in the late 1970s. The farmers plant fast growing tree species in rows with their agronomic crops. This, they do with the hope of getting fodder for their livestock in addition to other derivable to this system by intercropping with *Moringa oleifera* (Zogale). It provides shade, retention of soil moisture, among others.

2.6.4 Shelter Belts

These are strips of planted trees (vegetation) across the direction of the prevailing wind, which help to reduce wind speed, erosion, evaporation, as well as damage of

farmland, livestock and settlements. The increase in crop yields was further highlighted by Adegbehin (1986) when he discovered that increase of between 183-363% in maize and millet occurred in some parts of Jigawa State compared to 114-89% in unsheltered areas.

2.6.5 Boarder Line Planting

This is another agroforestry practice by the farmers in the study area. Trees are planted at the boundaries of the farmland or areas of land hunger, example is in the Jos Plateau, where cactus species are used to demarcate farm boundaries. The species of plants used vary significantly depending on location. The woody species, apart from preventing boundary disputes, also augment fuel wood supplies of the family. Tree species, like grasses and shrubs mostly used by the farmers are: *Acacia nilotica, Faidheribia albida, Ziziphus spinichristi, Andropogan gayanus*, *Euphorbia, Commuphora spp* etc are used to mark property boundaries especially around farm field. Sometimes trees, particularly fruit bearing species like *Tamarindus indica, Annona senegalensis* and *Borassus aethiopum* are growing in boarder lines to mark the corners of field (Ekwebelam, 1988).

2.6.6 Orchard

This is a system of planting multi-purpose trees on the farmland with some economic trees. Orchard is a stand of trees, usually of a single species, that is managed for fruits, nuts or seeds. An orchard can be as small as 0.1 ha and as large as many hectares depending upon the farmers ability to maintain regular watering, maturing and weeding. Fertility is usually maintained through the addition of crop residue, animal wastes and household refuse. This practice has helped in providing not only food, but also vegetables, fruits and medicine. Species mostly planted include the following: *Mangifera indica*, *Citrus species*, *Moringa* oleifera, *Musa parasidiaca* among others (Fagge, 1992).

2.6.7 Woodlots

This involves the establishment of small plantation consisting of either trees species alone or a mixture of tree species and horticultural plants like *Mangifera indica, Anacardium occidentale, Psidium guajava* etc.

Species used are *Eucalyptus species, Acacia nilotica, Azadirachta indica, Cassia siamea, Dalbargia sissoo,* and other *Acacias.*

The main advantage is that the mixture of tree species provides a variety of forest products like fuelwood, fodder and food. Protection and establishment costs are markedly lower and decreases with area.

2.6.8 Natural Tree Regeneration

This is a situation where trees are severed during land preparation for the planting season. As most of the indigenous species are not fast growing, they are also difficult to raised in nursery and eventually die back after. They are therefore more resistant if allowed to continue growth on germinating and regenerating on the farmland. They can be allowed to grow at random or systematically.

Consequently the method involves operations aimed at encouraging self sown seeds to germinate and the resulting seedlings as well as all pre-existing young trees of the desirable species to develop through removal of their competitors (Nwoboshi, 1982).

2.6.9 Apiculture (Beekeeping)

Beekeeping is the rearing of honey bees for man's needs. It is an age long practice in Nigeria. However, the practice has not fully developed; nevertheless it is the rural farmer's subsistence activity. The benefits from beekeeping includes bees products such as honey, bee wax, jelly and help in pollination of trees and crops, and in addition, provides extra cash

income to sustain livelihood for rural communities. Honey, bee wax and propolis have ready markets and are in high demand and command high prices both locally and abroad. Unfortunately the production is steadily falling today. This is because the practice receives a little or no attention from the government or researchers. Elsewhere, for instance in Tanzania, India and Caribbean Island bee wax and honey have been the sources of export commodities (Linder, 1972).

2.6.10 Aquaculture (Aqua farming)

Aqua farming is the system or practice of farming of aquatic organisms such as fish, crustaceans, and mollusk and aquatic plants. Aquaculture as one of the practice of agroforestry enhances production, such as regular stocking, feeding, protection from predators, etc. Fish farming is one of the most important sub-sectors of fishing industry in agricultural activities in the study area. Steps taken to boost the supply of fish protein, will contribute a long way to the growth of national economy and the living standard of the farmers.

2.7 ECONOMIC BENEFITS OF AGROFORESTRY TECHNOLOGY

One of the objectives of agroforestry is the provision of greater benefits for the land use than agriculture or forestry alone. Trees can provide numerous benefits to rural communities. Agroforestry is beneficial through production, protection and socio-economic aspects (Okwonkwo, 2002). The beneficial aspects are: it provides fuelwood, protein, medicine, prevent erosion, improve microclimate and drought and also provide socio-economic like increase in farm income, and improve nutrition and health. Attributes of

agroforestry practice include sustainable output per hectare in agricultural sector, especially in the fragile lands of semi-arid north-eastern Jigawa State.

Studies have shown that livestock (meat and production) incorporated in different forms of agroforestry practices provide a large proportion of the animal protein in many parts of Nigeria, especially in the south-western part of the country (FAO, 2010). A study by Ibrahim and Aduradola (2005) revealed that a considerable number of people who practice Silvopastoral agroforestry in semi-arid zone of Nigeria depend on the animal component of the practice for their meat consumption. Significant part of the livestock is sold in order to generate income for them.

Rural dwellers make use of the fuelwood extracted from trees of the agroforestry practices. For example, in a study conducted in south-eastern Nigeria by Okafor (1981), it was found that home gardens provided 15 – 20% of the total fuelwood requirements of the local households. The trees in agroforestry plots that have been widely used for fuelwood especially in the northern part of the country include: *Faidherbia albida*, Acacia species, *Vitelaria paradoxa*, *Cordia aliodora*, etc. Adeghebin and Igboanugo (1990) have reported increase in the yield of some crops cultivated under Agroforestry practices in different ecological zones of Nigeria. From the preliminary findings on the effects of some farm trees on the yield of agricultural crops in the northern Guinea, especially *Dioscorea rotundata* (yam) which gave 30% higher yield under light shade of *Mangifera indica* (mango) or *Acacia auriculformis* than open land.

Ujah (1985) reporting a study carried out at Dambatta, Kano State (Sudan Zone) and stated that the biomass of millet planted on sheltered farmlands have shown an increase of 34%, 282%, 363% and 183%, the grain yields have also increased by 189%, 114%, 121%

and 117% in the years 1979, 1980, 1982 and 1984 respectively compared with the yields from unsheltered farmlands. In Ujah's (1985) report *Arachis hypogea* (groundnuts) showed a leading yield while *Vigna unguilata* (cowpea) gave lower yield. This may be, due to the allelopathic effects of Eucalyptus in part of the belts.

Verinumbe (1987), also experimented in the North-east (Sahel zone) with 12 year old stand of *Azadirachta indica* (Neem), *Eucalyptus camaldulensis* and *Prosopis jullifera* involving *Zeamays* (maize), *sorghum vulgare* (millet) and *Arachis hypogea*, the yields of some crops recorded higher yields on forest influenced soil, particularly in the areas sheltered with Neem.

Adegbehin and Igbonuago (*Loccit*) suggested that planning of forest plantation in the country should be combined with livestock farming (Agrosilvopastoral systems) in the savannas since livestock such as cattle, sheep and goats, feed on grasses and indigenous tree species. This practice only exists to some extent.

Potentials for agrosilvopastoral system exists in the study area as species such as *Faidherbia albida*, *Acacia nilotica* are edible by livestock and retain their leaves during the dry season. These are raised on farm lands.

Elsewhere in the arid-zone of the world, potentials of agroforestry practices have been tested and reasonable success have been obtained. In neighboring Niger with similar climatic conditions as the study area, in Maggia valley tree productivity testing programme, researchers have complied information on yields from individual trees cut under different management cycles, on crop yields with and without wind breaks on distribution of benefits. During a year of above average rainfall sorghum and millet yields in fields protected by *Azadirachta indica* wind break were as much as 23% higher than in unprotected fields

nearby. With rainfall of 46% below average, yields nearby, with rainfall of 46% below average, yields were still about 16% higher with wind breaks (Rochelean, *et al.,* 1988).

Darnhofer (1983) reporting on Gezira Scheme Sudan, predicted that the yields of existing fields would increase and save water to irrigate additional land. The cotton yields are expected to increase by 6 – 16%, while crop yield increase of 5% would be enough to cover all establishment and management costs. In addition to crop yield increases there are also increases in wood, fodder and honey production and soil improvement.

In addition to cotton water increases, Darnhofer (*Loc. Cit)* estimated that a family with 10 hectares would harvest 75 cubic meters of wood and 1 ton of fodder from shelterbelts each year, plus 0.14 ton of extra land allow 200 new families to join the scheme, each with an allocation of 10 hectares under irrigation.

Dennison (1986) carried out a study on the quality of wood that could be harvested from the belts of Neem trees in the Maggia Valley in Niger. He reported that under proper management, yields between 3 and 7kg of fuelwood per year were possible. Rochcleau (loc. Cit) reporting another benefits of agroforestry, stated that seeds and pods could be collected daily to supplement livestock feed and some could be sold. He also showed that pods from prosopis and *Acacia seopiodes* planted in the Maggia Valley in Niger, are used for traditional leather tanning. This contributes a lot to the economy of the local people. Similar report was given by F.A.O (1986) in Senegal on *Anacardium occidental* (cashew). The report showed that the nuts provided important addition to the local diets. Similar reports on productive roles of agroforestry were received from Singida District of Tanzania and Kenya (USAID, 1987).

Bankole et al (2012) studied that farmers in Oluyole Local Government Area, Oyo state Nigeria have not received enough information on agroforestry activities. Few women have opportunities of education and training in agroforestry. Many programmes tend to overlook women's specific needs regarding agroforestry mainly because policymakers and planners lack adequate information to address them. Hence this study is designed to provide information on women's awareness and utilisation of agroforestry practices in Oluyole local government area of Oyo state, Nigeria.

Agroforestry development is a dynamic process which should ensure social and economic sustainability of the populace. A very good extension structure or network is necessary for an improved technology in forestry development to provide such services as employment, protection of farmlands, recreation and income among other things for the rural dwellers (Eremie, 1994).

2.8 AGROFORESTRY AND ENVIRONMENTAL PROTECTION STRATEGY

The benefits that are .derivable from agroforestry are numerous. From the environmental perspectives, its benefit lies with the capability of the system to allow for the integration of the trees and shrubs on vast farmers lands. These along side with governmental tree planting efforts will bring about a tremendous increase in vegetation cover, which will offer the machinery for regulating the carbondixode content of the atmosphere. It will ensure stability of the environment through reduction of wind and water erosion; check desertification and drought through ensuring efficient water cycle (Argungu, 2000).Furthermore; it will ensure a clean and healthy environment through the increase of oxygen content of the atmosphere. The type of trees normally raised from agroforestry programme to protect the environment in the study area includes *Azadirachta indica*, *Acacia*

nilotica, *Acacia senegalensis*, *Guerea* species etc. In agroforestry systems, there are both ecological and economic interactions between the different components. Besides providing wood, food and or animal, the integration of trees in the farming system helps to ameliorate the environment. The microclimate within the farm is modified and minerals are recycled through natural processes that include organic matter from dead leaves, branches and manure from livestock (Adedire, 1992).

Furthermore, a mixture of tree and annual crops of different height provide a more complete ground cover, which again helps protect the soil from erosion and make maximum use of available sunlight. The tree cover helps moderate extremes of temperature, preventing rapid heat loss from the soil at night and protecting crops from extensive heat during the day and it will also ensure a clean and healthy environment through increasing the oxygen content of the atmosphere (Anon, 1988). By providing farmers with a means of producing fuelwood, timber, building pole and other forest products on farmland, agroforestry can significantly reduce the demand on forest and natural woodlands. By doing this in ways that enhance and sustain agricultural productivity, agroforestry can also alleviate some of the pressure for the conversion on forestland into farmland (Rain tree, 1988).

2.9 EFFECTS OF AGROFORESTRY TECHNOLOGIES ON CROP LAND

The potential of agroforestry technologies however are not without limitations. Inspite of the prospects, there are some challenges to the survival of some agroforestry trees and the adoption of the practices on the sustainable development of semi-arid rural economies in the study area. Precaution should be exercised while selecting tree species for agroforestry. The species and the crops should be compatible under respective agroforestry practice of a particular site. For instance, in northern part of Nigeria, where there is issue of

drought trees like *Myrianthus* arboreous, *Dacryoide sedulis*, *Gnetum africanum* etc cannot withstand the harsh environmental condition. Consequently, the ability of such trees to protect environment and sustained rural economy when incorporated into agroforestry in such area is repeated pruning e.g. *Sesbania sesban*, *Leucaena* leucocephala and *Grilici diasepium*. Therefore, care must be taken in selecting the species for agroforestry practices.

Rocheleau *et al* (1988) reported that crop land lost to mature trees over 10 years old was estimated at about 17% due to shading, whereas agricultural crops planted near some exotic trees did not perform well (Adegbeghin and Igboanugo loc. cit). Igboanugo (1986) studied tree crop interaction in Northern Guinea Savanna, and found out that some agricultural crops such as *Dioscorea spp* (yam), *Vigna unguiculata* (cow pea), *Capsicu mannum* (pepper), *Abelmoscus esculentus* (okro) and *Amaranthus* caudate (African Spinach) do not perform well when grown near *Eucalyptus citriodora*.

According to Azeez (2002), the major challenges of agroforestry in Nigeria are illiteracy, lack of information, lack of research, government policy as well as insufficient capital.

CHAPTER THREE

METHODOLOGY

3.1 INTRODUCTION

This chapter presents the methodology adopted by the study that covers data sources, research design, data collection techniques (i.e. reconnaissance survey, selection of study villages, questionnaire design and administration), sample and sampling techniques and data analysis procedure.

3.2 SOURCES OF DATA

3.2.1 PRIMARY SOURCE

In this regard, a questionnaire was designed in order to collect quantitative data for this study. The questionnaire contains two sections. The first section consists of the questions on demographic information of the respondents, while the second section contains questions on the study on constructs (field work) used in the study.

The questionnaire includes variables and illustrated with 1-5 (A-E) items. In total the respondents are to answer 36 questions, 32 items aimed at finding out the nature and extent of agroforestry practices and its impact in meeting the basic needs like food, shelter and fodder to the rural populace in the study area.

3.2.2 SECONDARY SOURCE

This source involves textbooks, journals, e-books, conference, and seminar, magazines, articles, news papers and government publications such as bulletins, annual report, projects manuals from Jigawa State Afforestation Office (JIGAP), and Jigawa state Agricultural and Rural Development (JARDA) were all used which are all relevant to agroforestry practices.

3.3 RESEARCH DESIGN

Birniwa Local Government Area has three (3) districts namely Birniwa, Diginsa and Kazura. Among these three districts, two (2) districts were selected for the study because of the predominance of agroforestry practices in the area.

The selected districts are Birniwa and Diginsa. Within each districts three (3) villages were selected purposively for the study. The selected villages in Birniwa district were Birniwa, Kasarwa and Matara-uku while those selected in Diginsa district were Barburam, Karanga and Kishinde.

3.4 DATA COLLECTION

As first step in data collection a reconnaissance survey was conducted. This enabled the researcher to become more familiar with study area, customs and settings of the people. Based on these, the sampling frame and method of data collection were carried out on a few agroforestry farmers in the study area to verify if the data measured what it was expected to measure.

In the second stage of data collection, villages were selected. A total of 784 smallholder farmers were found to be engaged in agroforestry practices within Birniwa and Diginsa districts (JIGAP, 2013). Three (3) villages selected in Birniwa district were Birniwa, Kasarwa and Matar-uku while those in Diginsa districts were Barburam, Karanga and Kishinde.

Samples of 160 respondents were purposively selected from the study area, proportionately to the number of participating farmers in each village.

Table: 3.1

DISTRICT	VILLAGES	POPULATION	NO. OF QUESTIONNAIRE ADMINISTERED	NO. OF QUESTIONNAIRE RETURN
BIRNIWA	Birniwa	260	52	50
	Kasarwa	80	16	15
	Matara-uku	95	20	18
DIGINSA	Barburam	125	26	24
	Karanga	115	24	22
	Kishinde	109	22	21
	TOTAL	784	160	150

Source: Field survey, 2014

3.5 SAMPLE AND SAMPLING TECHNIQUES

A multi-stage sampling technique was employed in the selection of the sample. The first stage of the sampling involves purposive selection of two (2) districts (Birniwa and Diginsa) out of three (3) districts due to the predominance of agroforestry activities in the study area.

In the second stage, three (3) villages were randomly selected from each of the two (2) selected districts to give a total number of six (6) villages for the study.

The third (3) stages involved a proportional random sampling of 160 respondents from the selected villages from each village.

A total of 784 farmers were found to be involved in engaging agroforestry practices in the study area (JIGAP, 2014). A random sample of 160 farmers were selected and served with questionnaire for the responses on agroforestry practices with the assistance of village extension workers (V.E.W.) from JIGAP, after which a total of 150 questionnaires were returned with completed and useful information for the analysis upon collection.

3.6 DATA ANALYSIS

The data collected were analyzed using descriptive statistics. This statistics includes frequency counts and percentages were used for data presentation. Therefore, in order to achieve the purpose of this study, SPSS software version 20.0 was employed to help and analyzed the collected data.

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter presents findings from one hundred and fifty questionnaires administered to the respondents who mainly were farmers engaged in agroforestry practice in two different sampled districts of Birniwa and Diginsa in Birniwa LGA of Jigawa state.

The data was processed using SPSS software and relevant analyses have been run and result documented accordingly. This chapter is also divided into two sections in which, section one covers the demographic profile of the respondents and section two involves analysis of agroforestry system.

4.1 DEMOGRAPHIC PROFILE OF RESPONDENTS

As mentioned earlier the study was performed among farmers engaging in agroforestry practice in the study area. The data were collected from September 2014 to November 2014. Out of 160 administered questionnaires, only 150 (93%) were received.

Before the analysis of the answers the description of statistic about the personal information of the respondents is prepared at (Table 4.1)

Table 4.1: Demographic Profile of the Respondents

Demographics	**Sampled Villages**	**Frequency**	**Percentage**
Selected Districts	Selected Villages		
1 Birniwa	1 Birniwa	37	24.67
	2 Kasarwa	27	18.0
	3 Matara- uku	20	13.33
2 Diginsa	1 Barburam	22	14.67
	2 Karanga	18	12.0
	3 Kishinde	26	17.33
Total		150	100
Gender			
Male		137	91.3
Female		13	8.743
Total		150	100
AGE			
20-29		29	19.3
30-39		36	24.0
40-49		42	28.0
50 and above		43	28.7
Total		150	100
Marital Status			
Married		136	90.7
Single		14	9.3
Total		150	100
Educational Level			

Primary		24	16.0
Secondary		30	20.0
Tertiary		69	46.0
Non-formal education		21	14.0
None		6	4.0
Total		150	100
Occupation			
Farming		70	46.66
Fishing		16	10.66
Rearing		20	13.33
Farming/fishing		15	10.0
Fishing/rearing		10	6.67
Farming/rearing		12	8.0
Civil-servant		07	4.67
Total		150	100

Sources: Field work (2014)

As illustrated in (Table 4.1) two different sample districts were selected out of three and questionnaires were administered to three different selected villages purposively within each districts in the sample areas, with Birniwa district having 56.0% of the total respondents followed by Diginsa district with 44.0%.

Able-bodied people (men and women) are always needed in farming activities to make it successful and perpetual. The sex distribution of respondents indicates that 91.3% of the respondents were male in comparison to 8.7% females (Table above). The result of the study indicated that agroforestry in Birniwa and Diginsa districts as study area is male dominated activity. This could be attributed to religious belief of the respondents who are mainly Muslims that restrict female from outdoor activities, buying and selling outside matrimonial home and frequent intermingling with male. It was found out from the study that the performance of the trees planted and managed by the women were encouraging. They interact and receive extension services from the officials of Local Government, State Government forestry sector and agroforestry extension staff through agroforestry forum.

Age of respondent is equally a very good criterion when it comes to the assessment of agroforestry practices in an area. This is so because agroforestry is energy tasking job and in most cases the physical appearance of an individual denotes to a level of his participation in active physical work. Bearing this in mind the ages of the respondents in the study area was taken.

The majority of the respondents were between the age of 40-49 years and 50 and above years, which constituted about 28.0% and 28.7% respectively. From the field results, respondents within the age bracket of 30-39 years and 40-49 constituted a very significant percentage of the population. The reasons for this development are linked to the fact that, majority within this class are students and some are out learning trade. This implies that the farming system (agroforestry) will suffer.

Respondents within the range of 50 and above years have a very high percentage of 28.7%, this indicates that those that are engaged in agroforestry farming in the study area were mostly within this age bracket. The implication of this is that, if the young ones are not carried along, then within a certain period, there may likely be a vacuum created especially at the agroforestry labour force. Age of respondents significantly affects the performances of the various agroforestry plots found in the study area. The age of the respondents affects not only the establishment of the agroforestry plots but also the tree performances. The study indicates that those within the age brackets of 50 years and above have better and well managed agroforestry plots than those below them. Their agroforestry plots are well kept and the area better managed.

Marriage as an institution plays a very important role in the farming system, especially in the rural community. The couple jointly manage the farm and in some cases if

one is not around, the other takes perfect care of the farm. From the research carried out, the results show that majority of the respondents were married with 90.7% and only 9.3% are single. It was very clear that, the married family jointly contributed to the development and management of the agroforestry plots in their farm lands.

The rural sector no doubt occupies a central position in Nigeria that economy in terms of agricultural, human and mineral resources. It can be seen from (Table 4.1) farming occupation constitute the highest number of the respondents having (46.6%) engaged in the agroforestry practice, followed by rearing with 13.33% and least not the last fishing occupation with 10.6%.

Another important concern is the educational attainment or status of the respondent which is often used as one of the many social and economic indicators to ascertain the stage of development of agroforestry project in the study area. It can be seen from (Table 4.1) that 14.0% of the respondents have non formal education (Islamic education). Formal education refers to western type of education. Some 16.0% of the respondents have primary school education while 20.0% have secondary school education. Those who have post secondary school education accounted for highest number with 46.0% of the respondents. Only 4.0% of the respondents recorded none.

As important as education is to the increment of agroforestry activities, particularly during this age of improved agroforestry technologies, the implication of this finding is that the general low level of education of the sampled respondents could affect the agroforestry activities in the study area.

4.2 ANALYSIS OF THE AGROFORESTRY SYSTEM

This section presents and discusses the frequency for each of the variables involved based on the framework used in the study.

Table 4.2: Ownership, number and size of farms

Responses	Frequency	Percentage
Personal farmland	115	76.7
Lease	12	08
Rent	15	10
Borrowed	08	5.3
Total	150	100
Number of farms		
1-2	79	52.7
3-4	45	30.0
5-6	15	10.0
7 and above	11	7.3
Total	150	100
Farm Size(ha)		
Less than 1	44	29.4
1-2	57	38.0
3-4	29	19.3
5 and above	20	13.3
Total	150	100

Sources: Field work (2014)

Land is of great importance in agroforestry as no aspect of crop, tree or animal production can be carried successfully without access to land (Beatrice, 2008). From (Table 4.2) the result indicates that 76.7% of the respondents own their land personally but those that own farm through lease, rent or borrow are only allowed to practice agroforestry on the land subject to written agreement with the owner. Bearing this in mind that acquiring of farm land by a farmer is one of the basic criteria for agroforestry practice.

Land is competitively shared among the various farming units such as cereals farming, livestock and fisheries among others. From the survey carried out, it was revealed out that majority of the respondents have 1 – 2 ha of farm land, followed by 3 – 4 ha of farm lands. The last and the or least with 7.3% percent have seven and above hectares of land.

The various sizes of the farms in the study area range from half hectare to more than five (5) hectares. Thirty eight percent (38%) of the various respondents across the study areas indicated that they have farm size of 1 – 2 ha. These categories of farmers have the liberty to practice various aspects of agroforestry technologies.

The studies also reveal that fewer respondents 29.3% percent have their size of farms less than 1 hectare. The implication of this is that care must be taken in recommending the type of agroforestry technology to be adapted to the size. It must be a technology that will not consume much land and at the same time create less competition with the arable crops. Furthermore only 13% of the respondents within the area that have large areas and have significantly utilized it to meet various uses of agroforestry technologies such as wind breaks and others that utilize large area of the respondent's farmland. Prominent technologies practiced in the area, are boarder line planting, woodlot and orchard development. These are practices that do not require large land.

Table 4.3: Nature and extent of agroforestry practices

Responses	**Frequency**	**Percentage**
Awareness of Agroforestry		
Yes	138	92.0
No	12	8.0
Total	150	100
Practice of Agroforestry		

Yes	138	92.0
Portion of Land Designated for Agroforestry (ha)		
Less than 1	70	50.7
1-2	38	27.5
3-4	20	14.6
5 and above	10	7.2
Total	138	100
Agroforestry Systems Practice		
Agrosilvicultural	90	65.2
Silvopastoral system	15	10.9
Agrosilvopastoral system	23	16.7
Agrosilvicultural/ Silvopastoral system	10	7.2
Total	138	100
Predominant Agroforestry Practices		
Alley cropping	20	14.5
Scattered planting	15	10.9
Woodlot	24	17.4
Orchard	28	20.2
Woodlot/ Orchard	16	11.5
Natural Tree Regeneration	35	25.3
Total	138	100

Sources: Field work (2014)

From the table above, 92.0% percent of the total respondents have awareness of agroforestry programme, while (12) 8.0% percent are not.

On the views of the respondents on agroforestry practice, it shows that 92% of the total respondents do practice agroforestry in their various farmlands because of the derivable benefits they realize from the practice. Also some of the respondents are of the view that if there is an incentive whether cash or in kind the number of the participants would increase and willing to continue practice. As I learnt from the respondents, there was incentive initially given to them and the incentive was withdrawn earlier which supposed to stay longer.

In identifying and assessing the various agroforestry practices in the study area. It is very pertinent to determine the proportion of the farmland the farmers devote to the various

agroforestry practices. The survey significantly indicated the commitment of the participatory farmers towards the selection of the various agroforestry systems in their farmlands. Farmers viewed their selection in view of their general background, structure and characteristics of the systems selected, occurrence and pre-conditions of the species planted, their management, benefits and constraints.

According to the respondents views on the portion of farmland designed for agroforestry, the result indicates that 50.7% of the total respondents designate less than 1 hectare of their farmland for agroforestry programme in the study area. Follow by 27.5% percent of them having 1-2 hectares. The last and the least with 7.2% percent having 5 hectares and above and these respondents are not devoted their farmland for agroforestry practice in the study area.

From the study majority or the highest number of the respondents come from Birniwa town probably because it is the seat of the local government Headquarters and by extension have big time farmers that can afford large expanse of land. Also the level of awareness of the farmers significantly contributed to agroforestry.

Generally all the portions that were dedicated to the agroforestry practices, as found out from the survey were performing quite well. In fact, some were used as models by the extension officers from Jigawa State Afforestation Programme (JIGAP) and Jigawa State Agricultural Development Authority (JARDA).

According to the table above, the results indicate that 65.2% percent of the respondents practice agrosilvicultural system (i.e. Agricultural crops and forest trees only), 16.7% percent practice agrosilvopastoral system (i.e. agricultural crops, forest crops and livestock together), and 7.3% percent agrosilvicultural/silvopastoral. Majority of the

respondents are of the view that the systems on ground should be improved by authority concerned in order to ensure the perceptivity of the programme.

In agroforestry models or designs, tress can be combined with food crops in many ways which can improved productivity and reduce inputs, while mitigating some of the environmental damage caused by the past processes of deforestation and the removal of trees from the landscape.

From the survey carried out within the study area as shown in (Table 4.3) that different agroforestry technologies were practiced. And these are Alley cropping (14.5%), Scattered planting (10.9%), Woodlot (17.4%), Orchard (20.0%), Woodlot/Orchard and Natural tree regeneration (25.3%).

One technology that is very common to all respondents as indicated variously in their responses is the scattered tree on farmland. Scattered planting is one of the earliest and oldest forms of agroforestry. People use to keep the tree based on either its economic, medicinal, social or cultural values. Prominent tree species here include the following: *Mangefera indica, Ziziphus spinochristii, Faidherbia albida, Termarindus indica, Psidium guajava, Balanites aegyptiaca* among others. And most recently *Moringa oleifera* is seriously being propagated and the farmers are adapting to their farming system.

Table 4.4: Source, Service, Duration and Access to loan for Agroforestry

Response	Frequency	Percentage
Sources Of Seedlings		
JIGAP	50	36.2
JARDA	14	10.1
IFAD	10	7.2
State Forestry Sector	17	12.3
Self-Raising	2	1.4
JIGAP/JARDA	19	13.7
JARDA/IFAD	15	10.9
JIGAP/Forestry	11	8.0
Total	138	100
Services of Agroforestry Extension Staff		
Yes	114	76
No	36	24
Total	150	100
Duration of Visit by Extension Agent		
Weekly	22	19.3
Fortnightly	17	14.9
Monthly	28	24.6
Seasonally	47	41.2
Total	114	100
Access to Agricultural Loan Scheme		
Yes	38	25.3
No	112	74.7
Total	150	100

Sources: Field work (2014)

For any afforestation activity to succeed, sources of seedling available for planting have to be from a very good and tested source. That is taking care of its origin, penology, viability among other things. Once the seedlings are of good source and the supply is steady, then the production is likely to be good. From (Table 4.4) on the sources of tree seedling to farmers, it indicates that Jigawa State Afforestation Programme (JIGAP) is the chief source of seedlings for the respondents. About 36.2% percent sourced their seedling from JIGAP, 12.3% sourced from state forestry and only 1.4% sourced the seedling through self raising. This signifies commitment to the cause. It indicates that they know and appreciate the value of what they are doing.

Equally it shows that, extension services provided by the various organs of the Government are reaching the target population. Furthermore it was very clear from the interactions with the farmers that, the supply of tree seedlings from the Government nurseries were not steady and adequate to meet their needs.

Extension is an educational process that communicates with farmers as individual and groups to help them learn and adopt knowledge, technology, skills and attitudes that bring about positive changes in their behavior which tend to increase crop and animal production, income, standard of living and rural development (Iyere, 2002).

As the government is encouraging the Afforestation Programme through village extension assistant (VEA'S), incentives were given to the farmers to motivate them to plant trees. These incentives include free and available technical services, product grading and marketing, provision of fencing materials, seedling supply among other things.

From (Table 4.4), it was found out that 76% of the respondents receiving or getting free technical services and free seedlings supply from the various agroforestry extension workers. While interacting with farmers, it was found out that the provision of free technical service and incentive packages have significantly helped them not only to plant the trees but to tender it maturity. And also contribute to the adoption of agroforestry in the area. While interacting with the farmers, it was found out that 24.0% of the respondents were not aware about the existence and rendering of services by extension agent in the study area.

For any project or organization to be accepted in a community, the organization should arranged some strategy in the minds of the rural populace, planting of trees in their domains, supply of amenities to them. The organization employed and sent village extension assistants (VEAS) to various locations who used to impart, supervise and at the

same time receive information to and from the peasant farmers for change and research respectively (JIGAP, 1993). For a successful agroforestry venture, this relationship between the farmers (who produces) and the extension agent has to be established and maintained.

It can be seen from the (Table 4.4) that, about 41.2% of the respondents opined that the extension agent used to visit them seasonally, followed by 24.6% percent monthly and the least 14.9% fortnightly. The major challenges faced by extension agent on duration of visit of agroforestry activities is enormous, because agroforestry practice is energy, time and capital consuming job which required frequent and regular visit to monitor the activities. The frequent visit will only be possible when there is capital, vehicles for supervision by extension agents to use.

Agricultural loan scheme is a type of assistance given to farmers by the government or agricultural bank with hope of boasting agricultural activities. Since agroforestry practice have the potential of improving agricultural land use systems towards providing lasting benefit and alleviating adverse environmental effects of the study area. As a result of this loan disbursed to farmers there will be effective management of agroforestry practices.

From (Table 4.4), it was indicated that 25.3% of the respondents in the study area had access to agricultural loan scheme through joining farmers association and community agroforestry groups which give direct link with government or the agent responsible for loan disbursement. The majority of the respondents 74.7% do not have access to agricultural loans scheme.

Table 4.5: Opinion on the Impact of Agroforestry

Responses	Frequency	Percentage
Whether Agroforestry Practice Protect Environment		
Yes	140	93.3
No	10	6.7
Total	150	100
Ways In Which Agroforestry Practice Protect Environment		
As a Wind Break	48	34.3
Check Erosion	28	20
Improve Soil Fertility	30	21.4
Reduce Harsh Climate	12	8.6
Conserve ecosystem	13	9.3
Reduce carbon monoxide	9	6.4
Total	140	100
Impact of Forest Establishment		
Provision of Fodder	24	17.1
Wastage of Farmland	14	10.0
Shelter from wind	55	39.3
Stopping the risk of crop failure	41	29.3
Others (specify)	6	4.3
Total	140	100

Sources: Field work (2014)

From the (Table 4.5), the result indicates that 93.3% of the respondents have the opinion that agroforestry practice in the study area provides maximum protection for crops and trees from wind damaged, soil erosion and drying. While 6.7% do not support the

practice of agroforestry in their farmland as a strategy for environmental protection because some farmers have the opinion and perception that the trees do disturb their crops and lodging birds during farming. The species of trees are mostly planted to accommodate the birds are Acacia species and other thorny tree species which includes *Balanites aegyptica*, *Ziziphus spinochristii*, *Ziziphus absynica*, *Faidherbia albida* etc.

As from (Table 4.5), majority of the respondents indicates that (34.3%) planted trees in their farmland through agroforestry practice to establish wind break with the purpose of protecting their farmlands from desiccating wind. The species of trees normally planted by the farmers includes *Azadrachta indica, Moringa oliefera, Acacia nilotica*, *Eucalyptus species* and *Acacia senegalensis*. While (21.4%) of the respondents indicates that the litter obtained from the tree stands improve the soil nutrient of the study area. The micro climate within the farm is modified and minerals are recycled through natural processes that include organic matter from dead leaves, branches and manure from livestock (Adedire, 1992).

Agroforestry practice can also help in checking erosion in the study area because about 20.0% of the respondents reveals that a mixture of tree and annual crops of different heights provide a more complex ground cover, which helps to protect the soil from erosion and make a maximum use of available sunlight. The last and the least percent having (6.4%) the opinion that agroforestry practice reduce carbon dioxide content of a place. It was further stated that the tree cover can also help to moderate extreme temperature, prevent rapid heat loss from the soil at night and protecting crops from extensive heat during the day (Anon, 1988).

From (Table 4.5), majority of the respondents have two major opinions on the impact of forest establishment in the study area i.e.(39.3%), opined that establishment of

forest through agroforestry create shelter from wind and (29.3%) views that agroforestry practice stops the risk of crop failure. Other opinions on the impact of forest establishment which fall in the minority are provision of fodder (17.1%), and wastage of farmland (10.0%).

Table 4.6: Laws and policy against felling of Trees

Responses	**Frequency**	**Percentage**
Is there any Law against Felling of Tress		
Yes	136	90.7
No	14	9.3
Total	150	100
Is there any Policy against Felling of Tress		
Yes	133	88.7
No	17	11.3
Total	150	100
How Effective the Law is against Felling of Trees		
Very effective	23	16.9
Effective	32	23.5
Ineffective	50	36.8
Need review	31	22.8
Total	136	100
Application of Tree Planting Campaign in Farmland		
Yes	104	69.3
No	46	30.7
Total	150	100

Sources: Field work (2014)

From the (Table 4.6), it was generally accepted that over ninety percent (90.7%) of the respondents agreed that there were forest laws on the war against felling of trees in the study area, while only 9.3% of the respondents were not aware of the existence of the law against felling of trees. The result also indicates that 88.7% of the respondents agree that there is policy existing which encourage farmers to plant trees in their farmland through agroforestry practices. The integration of trees with crops will protect the crops planted against strong wind and serve as a wind break which helps in preventing desert encroachment in the study area. While 11.3% of the farmers in the study area are not aware of any policy that encourage them to plant trees, so a lot of farmers cut down trees for fuelwood or sell to make money. These attitudes have negative impact to the environment leading to environment degradation.

From (Table 4.6), it was indicated that majority of the respondents with 36.9% opined that the law is ineffective, 23.5% effective while 22.8% of the respondents were of the view that the laws were old and needs to be reviewed to conform to the current needs of the society.

Table 4.7: Soil degradation

Responses	**Frequency**	**Percentage**
Problem Of Soil Degradation In The Study Area		
Yes	109	72.7
No	41	27.3
Total	150	100
Types Of Soil Degradation		
Soil erosion	25	22.9
Soil infertility	45	41.3
Sand dune	19	17.4
Soil erosion/infertility	13	11.9
Soil erosion/sand dune	7	6.4
Total	109	100

Strategies Adopted To Combat Soil Degradation		
Afforestation	38	34.9
Contour terracing	17	15.6
Shifting Cultivation	20	18.3
Bush fallow	14	12.8
No effort (strategy)	09	8.3
Afforestation/shifting	06	5.5
Bush fallow/shifting	05	4.6
Total	109	100

Sources: Field work (2014)

From the (Table 4.7), majority (72.7%) of the respondents opined that there is problem of soil degradation. It can also seen that soil erosion and soil infertility are the major degradation problems identified by the respondents as 22.9% and 41.3% respectively in the study area.

On further field assessment, it equally revealed that part of the study area like Matara- uku area, which slopes down, and most of its rainwater drains down at Hadejia-Nguru river valley. So this among other things has contributed to the soil erosion of some of its area. It was further noticed that areas with available trees and other shrub cover have little or no of soil erosion.

Generally, the study area has not significantly experienced small portion and presence of sand dune accumulation which is 17.4% as identified by the farmers within their farming areas.

According to (Table 4.7), it reveals that 34% of the respondents employ afforestation as a means of combating soil degradation, while contour terracing, shifting cultivation and bush fallow are employed at lesser degrees.

From the study carried out, it was realized that majority of farmers adopt afforestation practices in their farmland, because it is the best method that encourage farmers to plant trees so as to protect crops from wind damage, wind erosion and drying.

From the table above, majority (72%) of the respondents opined that there is problem of soil degradation in the study area. It is also revealed that soil erosion and soil infertility are the major degradation problems identified by the respondents as 36% and 36.7% respectively. Furthermore, the study area has not significantly experienced any presence of Sand dune accumulation. It is only 6% of the respondents identified and has experience sand dune accumulation within their farming areas.

On the other hand, when asked on the issue of strategies adopted to combat soil degradation, half of the respondents employ Afforestation as a means of combating soil degradation, while contour terracing, shifting cultivation and bush fallow are employed at lesser degrees and 18.0% of the respondents have no response. This show, that majority of farmer adopt afforestation practices in their farmland, because it is the best method that encourage farmers to plant trees so as to protect crops from wind damage, wind erosion and drying.

Table: 4.8 Yield of crops in farm, marketing of product/problem and need for agroforestry unit

Responses	**frequency**	**Percentage**
Farm with high yield of trees	138	92.0
Farm without trees	12	8.0
Total	150	100
Local market	95	68.8
Selling to company	20	14.5
Sell to the Government	13	9.4
Export	10	7.2

Total	138	100
Distance to market Insecurity Cost of transportation Poor road network Price fluctuation	44 15 20 23 36	31.9 10.9 14.5 16.7 26.1
Total	138	100
Need for establishment of Agroforestry unit in the area Yes	150	100.0

Sources: Field work (2014)

It can be seen from the table (4.8) that most of respondent having 92.0% opined that there are difference in yield of crops between farms with trees and those without trees. This is obviously because of the nutrients accumulated as a result of leaf fall and turn to organic matter through decomposition of leaf to enrich the soil nutrients of their farmland. It has also revealed majority of the respondents market their farm produce of agroforestry at the local market having to about 68.8%, the reason is that, the market is closer to them with less cost of transportation, while the remaining respondents sell their products to companies and the government for high price of the commodities and profit.

Moreover, that during the marketing of product, respondents face a number of problems among which price fluctuation (26.1%) and distance to market (31.9%) is more common. Other problems that are faced are insecurity, cost of transportation and poor road network.

It can be seen from (Table above); all the respondents opined that there is a need to establish an agroforestry unit in the study area.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

The study was aimed at assessing the nature of agroforestry practices and its impact among smallholder farmers in Birniwa L.G.A of Jigawa state. The specific objectives were to examine the nature of agroforestry, its impact in meeting the basic needs of food, shelter and environmental protection, identify the constraints to the practice of agroforestry and recommend the structural organization for rural agroforestry development in the study area. Structured questionnaire was the main instrument used for the collection of data. Multi-stage sampling techniques were used to select a sample of 160 agroforestry farmers. The returned questionnaire (150), were analysed using descriptive statistics.

The finding indicates that 91.3% of the respondents were male and the majority of the respondents were between the age range of 40-49 and 50 and above years. It further indicates that over sixty five percentage (65%) of the farmers adopt the agrosilvicultural system, and five (5) different agroforestry technologies were practiced (1) Alley cropping (18.0%) (2) Scattered planting (13.3) (3) Woodlot (16.0%) (4) Orchard (25.3%) (5) Natural tree regeneration (25.3%) within the study area.

Furthermore, the finding also reveal the key factors militating against the practice of agroforestry in the study area such as; land tenure system, perception of fuelwood and its usage among the household energy requirements, long gestation period of trees, and low representation of women as a result of religious believe and lack of a sustained agricultural finance. Lastly, organizational structure for rural agroforestry development was recommended for greater achievement.

5.2 CONCLUSION

On the basis of the research findings, the following conclusion was drawn by the study:

Agroforestry practice in the study area was male dominated activity and the study revealed that respondents within the age bracket of 50 years and above have better and well managed agroforestry plot than those below them. The educational status of the respondents is often used as one of the social/economic indicators to ascertain the stage of development of agroforestry project in the study area. The major chief source of seedling to farmers is Jigawa State Afforestation Programme (JIGAP).The finding further confirms that agroforestry practice have improved fuel wood supply and soil productivity in term of nutrient supply, erosion control and the living standard of rural populace and that of the environment. Lastly, the key factors militating against the practice of agroforestry where highlighted and organizational structure for rural agroforestry development where recommended for greater achievement in the study area.

5.3 RECOMMENDATIONS

One of the objectives of agroforestry is the provision of great-benefits for the land use than agriculture or forestry alone. The benefits derivable from the system include soil fertility, soil conservation, increase yield, and reduce the risk of crop failure, pest/diseases control and socio-economic needs of the rural population. This is a pointer to the indispensible role of forestry in improving the present and future world food security, more especially in the developing part of the global village.

Inspite of the benefits that will accrue to farmers when the agroforestry practice is incorporated in to farming systems in rural areas, there are some challenges which need the immediate attention of government and individuals. Therefore, based on the field work,

interviews with the responding farmers and practitioners, the following recommendations are made:

1. To be truly effective in improving living standard of the people, agroforestry should form part of the integrated rural programme;
2. Technical assistance should be provided by government to facilitate the spread and adoption of agroforestry within rural farming;
3. Government should provide economic incentives to agroforestry farmers as a way of encouragement. This will assist towards massive adoption of shelterbelt, woodlot plantation establishment for specific uses including fuelwood, poles, conservation and protection of settlement and agricultural lands;
4. Non-governmental organization (NGOs) should participate in agroforestry development. Frantic attempts have to be made to get people participate collectively. This will also provide avenue for the NGOs to realize their objectives;
5. Farmer managed Natural Regeneration System (FMNRS) should be inculcated to the minds of the farmers. It is a practice involving the management of natural regeneration of indigenous plant species by farmers in their field;
6. To ensure efficiencies on the side of staff, facilities such as vehicles, equipment and audio visual material should be made available to extension unit for effective performance and wider coverage on their job. This will attract and make more people to embark in agroforestry practice;
7. The three tiers of government (Federal, state and local) should intensify efforts through unified agricultural extension system in enlightening and educating the

general public on the importance of agroforestry, environmental conservation and management and afforestation.

Organizational structure recommended for rural agroforestry development in the area

In making this plan, government development agencies should be or are at the apex of the structure. It is proposed to form the:

Directorate for Agroforestry Research, Monitoring and Planning (DAFRMP) is to be established in the state level. The directorate can report directly to the governor on the state agroforestry practices.

At local government level, the model proposed the establishment of local government agroforestry development committee (LGAFDC) which reports to the development agency concerned. The LGAFDC uses general guidelines issued by the agencies to formulate local government policies on agroforestry for rural communities (AFARC). The local government Chairman should be the chairman of the committee in the various local government areas.

The next level at local government is the proposed Agroforestry Agency for Rural Communities (AFARC). This is the implementing body for all the policies agreed upon and passed from Local Government Agroforestry Development Committee (LGAFDC). AFARC should be headed by a Director who is assessed by departmental heads. Where no associations exist, the local government council will seek to the formation of one community development agencies such National Orientation Agency (NOA), DFRRI, information department offices, etc is to be involved in the organization of such association.

At district level, the District Agroforestry Development Committee (DAFDC) will liaison with the Village Agroforestry Extension Agencies (VAFEA). The two bodies will provide input advice on what policy makers need to consider before taking decisions. The overall flow of the structure is shown.

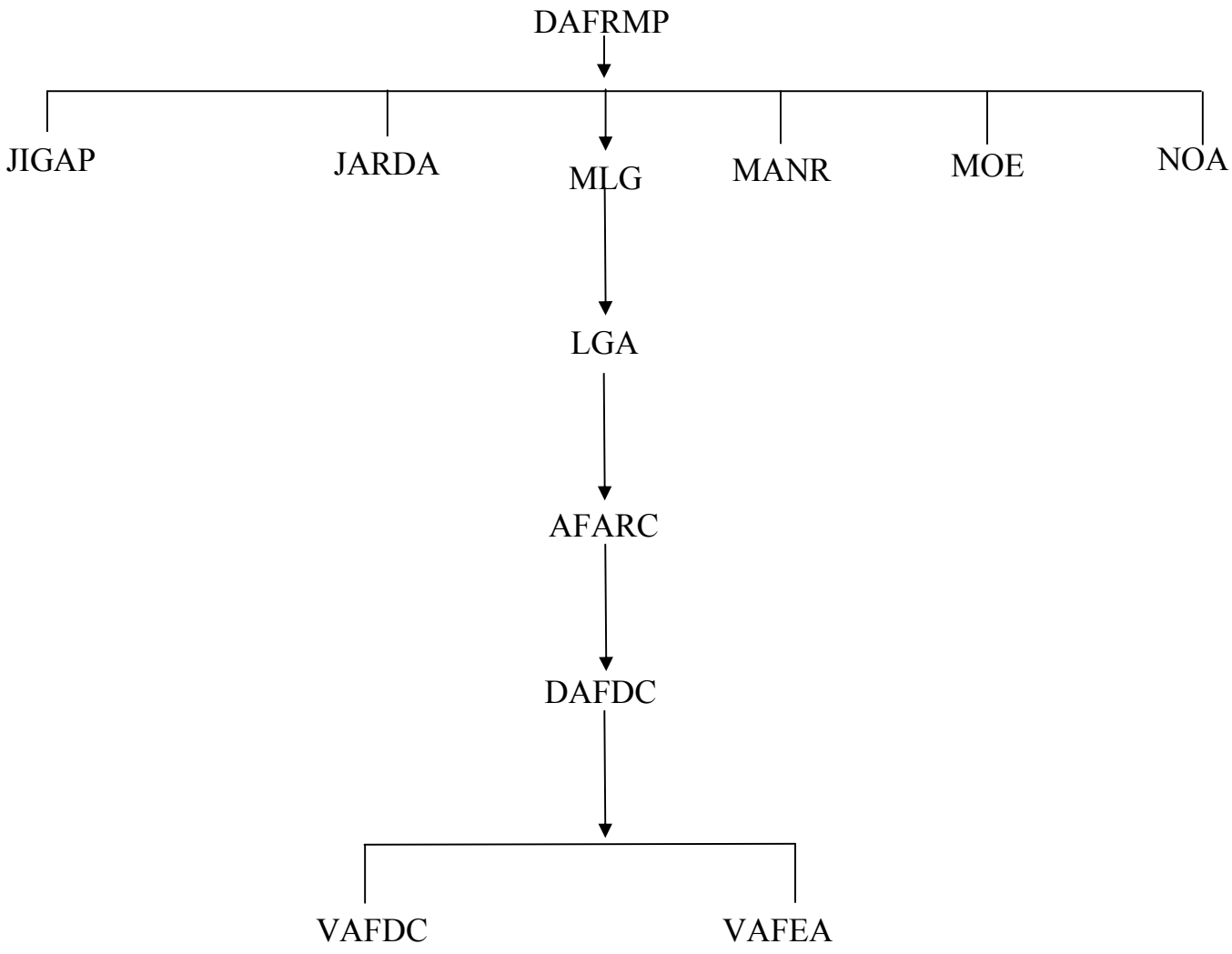

Fig.1 Structure for Rural Agroforestry Development

However, this study cannot claim to have exhausted all aspects of agroforestry and their applications. There is the need for further research into all aspects of Agriculture in the study area.

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Appendix

QUESTIONNAIRE

AN INVENTORY OF AGROFORESTRY PRACTICES AMONG SMALLHOLDER FARMERS IN BIRNIWA LGA, JIGAWA STATE

Department of Geography,

Bayero University Kano,

P. M. B. 3011, Kano Nigeria.

Dear Mallam/Alh/Malama

I am a postgraduate student of the above named institution conducting a research work on Agroforestry practices among smallholder farmers in Birniwa LGA of Jigawa State. The exercise is purely academic and part of my Postgraduate training at Bayero University Kano.

The purpose of this questionnaire is to help me to collect information about nature of agroforestry practices and its impact to rural populace in the study area. All information given will be treated as confidential, please feel free to answer all the questions as applicable to you.

I will appreciate it, if you can spare time and answer each question sincerely by ticking or fill in the appropriate places provided for the following questions.

SECTION A (GENERAL)

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

2. L.G.A----------

3. Gender (a) Male ( ) (b) Female ( )

4. Age (a) 20-29Yrs ( ) (b) 30-39Yrs ( ) (c) 40-49Yrs ( ) (d) 50 and above ( )

5. Marital Status (a) Married ( ) (b) Single ( )

6. Occupation

(a) Farming ( ) (b) Fishing ( ) (c) Rearing ( ) (d) Farming/fishing ( )

(e) Fishing/rearing ( ) (f) Farming/rearing ( ) (g) Civil-servant ( )

7. Educational Status

a) Primary level ( ) b) Secondary level ( ) c) Tertiary level ( ) d) Non formal. ( ) e) None ( )

SECTION B AGROFORESTRY

8. Do you own farms?

a) Yes b) No

9. If yes, how many do you have?

a) 1-2 b) 3-4 c) 5-6 d) 7 and above

10. What is the size of your farm?

a) Less than 1ha b) 1 – 2ha c) 3 – 4ha d) 5ha and above

11. Do you have knowledge of Agroforestry?

a) Yes b) No

12. If yes, do you practice it?

a) Yes b) No

13. What portion of your farm land do you designate for Agroforestry?

a) Less than 1ha b) 1 – 2ha c) 3 – 4ha d) 5ha and above

14. What system of Agroforestry do you practice?

a) Agrosilvicultural system b) Silvopastoral system c) Agrosilvopastoral system d) Agrosilvicultural/ Silvopastoral system

15. What model or design of Agroforestry do you adopt?

a) Alley cropping b) Scattered planting c) Woodlot d) Orchard e) Natural tree regeneration f) Woodlot/ Orchard

16. Where was your source of seedlings?
    a) JIGAP b) JARDA c) IFAD d) State forestry sector
    e) Self-Raising f) JIGAP/JARDA g) JARDA/IFAD h) JIGAP/Forestry
17. Does Agroforestry practice improve your Nutritional status?
    a) Yes b) No
18. Does Agroforestry practice protect your Environment?
    a) Yes b) No
19. If yes, in what way?
    a) As a wind break b) Check erosion c) Improve soil fertility d) Reduce harsh climate
    e) Reduce carbon monoxide
20. Do you get the services of Agroforestry extension staff?
    a) Yes b) No
21. If yes, how frequent do they visit your farm?
    a) Weekly b) Fortnightly c) Monthly d) Seasonally
22. Do you have access to Agricultural loan scheme?
    a) Yes b) No
23. If yes, how favourable is it to Agroforestry farmers?

……

24. Are you aware of any law governing felling of trees?
    a) Yes b) No
25. If yes, how effective is the law?
    a) Very effective b) Effective c) Ineffective d) Need review
26. Is there any policy that encourages farmers to plant trees in their farmlands?
    a) Yes b) No
27. If yes, is it applied to all farmers?
    a) Yes b) No

28. What is your view about forest establishment in your village?

a) Provision of fodder b) Wastage of farmland

c) Shelter from wind d) Stopping the risk of crop failure e) Others (specify) ……...…

29. What is your view on bush burning?

a) Good because it provides bush meat b) Bad because it may lead to fire disaster

c) Bad because it destroys vegetation d) Others (specify……

30. Do you have problem of soil degradation?

a) Yes b) No

31. If yes, what type of soil degradation?

a) Soil erosion b) Soil infertility c) Sand dune d) Soil erosion/infertility e) Soil erosion/sand dune

32. What strategy do you adopt to combat soil degradation?

a) Afforestation b) Contour terracing c) Shifting cultivation
d) Bush fallow e) No effort (strategy) f) Afforestation/shifting
g) Bush fallow/shifting

33. Do you notice any difference in yield between your farm and adjacent farms with no trees?

a) Yes b) No

34. How do you market your products?

a) Local market b) Selling to company c) Sell to the Government d) Export

35. What is your problem in marketing your products?

a) Distance to market b) Insecurity c) Cost of transportation d) Poor road network e) price fluctuation

36. Is there need for establishment of Agroforestry unit in the area?

a) Yes b) No

Thank for your usual cooperation**.**

Yours Faithfully,
Ballama Muhammad
SPS/11/MGE/00041