AN ASSESSMENT OF AGROFORESTRY PRACTICES IN GWARZO LOCAL GOVERNMENT AREA, KANO STATE, NIGERIA.

BY

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BEING A DISSERTATION SUBMITTED TO THE SCHOOL OF POST GRADUATE STUDIES THROUGH THE DEPARTMENT OF GEOGRAPHY,BAYERO UNIVERSITY KANO. AS A REQUIREMENT FOR THE AWARD OF A MASTERS DEGREE IN LAND RESOURCE M.Sc LAND RESOURCES (DEVELOPMENT)

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CERTIFICATION

This is to certify that this thesis has been read and approved as meeting the requirement for the award of a Masters Degree in Land Resource (Development) M.Sc Land Resources.

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APPROVAL PAGE

This is to certify that this thesis titled An Assessment of Agroforestry Practices in Gwarzo Local Government Area, Kano Nigeria, has been read and approved as meeting the requirement for the award of a Masters Degree in Land Resources (Development) M.Sc Land resources.

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DEDICATION

This piece of work is dedicated to my Parents, Husband and children for their support towards the actualization of my dreams to this level.

ACKNOWLEDGEMENT

All Praise is due to the Sustainer (GOD) “Glory is to you. We have no knowledge except what you taught us. Verily is you the All Knower The Wise” (Quran 2:32).

I am particularly delighted to express my gratitude to the efforts of my Parents and Husband who provided the financial, moral, religious and intellectual support to meet up the social standard I am today. Thanks, I am very proud of you.

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ABSTRACT

Availability of trees in farmlands is very important especially in semi arid areas. It provides different products such as fodder, food, fruits, fuel to mention a few. This study attempts to assess the Agroforestry practices in the area, by determining the type of agro forestry practise in the area, identifying the availability of nitrogen fixing tree species on farmlands in the area, determine the factors that are hindering agroforestry practices, assess the level of knowledge of agroforestry among the farmers and to determine the contribution of agroforestry to the livelihood of the inhabitants of the area. Reconnaissance survey and detailed field work were employed, which includes the use of ranging poles and measuring tape in other to get the sizes of the farmlands. Simple random sampling was used to selected 50 farmlands from the list of agroforestry farmers in the study area which was provided by the Kano State Afforestation Project unit (KNAP). Tree species in the selected farmlands were physically identified and also nitrogen fixing trees species were physically identified through an inventory. A checklist was prepared and administered; also an interview was carriedout with some farmers. The results indicated that there are many types of agro forestry practices in the area such as Farmed Parkland, multipurpose trees on cropland, Shelterbelts, Nurseries, Live Hedges and Home gardening involving animals. Also there is the availability of three (3) nitrogen fixing species in the area which are *Faidherbia albida, Acacia nilotica and Parkia biglobosa*. The problems of agro forestry practices in the study area are shortage supply of water after the rainy season, poverty, poor seeds, low knowledge of the practice and shortage in seed supply. The study also reveals that farmers in the area have a fair knowledge of the practice and its importance in soil conservation and improving the standard of living. Government projects on agroforestry sites in the study area were visited also. Recommendations were also made on how to improve agroforestry practices in the area.

1.0 CHAPTER ONE

1.1 INTRODUCTION

Agroforestry is said to be a new term for an old concept. There has been a consistent proposal among scientists that agroforestry holds the magic wand or the ability that can stem the tide of land degradation and even restore lost quality of land. Agroforestry is said to be a crucial bridge between forestry and agriculture. Essentially, agroforestry is about the role of working trees into agricultural landscape particularly on but not limited to small scale farmers (Garrity, 2011).

Agroforestry (AF) which is a dynamic and ecologically-based natural resource system consist of land use practices such as (a) agrisilvicultural (for food crop and tree production e.g alley cropping) (b) agrosilvopastural (food crop, tree and livestock e.g agricultural poultry) (c)Silvopastural(for tree and livestock production e.g fodder bank). These systems are developed for different ecological zones for boosting food production, wood, and livestock production, optimum use of land and at the same time conserving and improving the soil fertility. Agroforestry in the broadest sense encompasses a wide range of production systems, from forest to crop monoculture. In terms of composition, structure, management practices, and production functions well marked variations exits among these systems. Within the current context, it is a suitable land-management system that increases total production, combines agricultural crops, tree crops, forest plants and or animals simultaneously or sequentially and applies management practices compatible with the cultural patterns of the local population (Bene et al., 1977).

Planting trees on agriculture land or the Practice of agroforestry can protect forest by making tree products such as firewood and fodder easily available to farmers, can restore fertility of land by decreasing soil erosion, adding nutrients through decomposition of leaf

litter and nitrogen fixation, recycling leached-down nutrients and helping breakdown of nutrients in the subsoil by means of deep roots. Problems such as shortage of forest resources have been reduced by the mid hill farmers through retaining or keeping trees in various parts of their farmland along with crops for centuries despite having limited landholding (Shrestha, 1995). However, in the different ecological zones of Nigeria, agrosilviculture and Silvopastural have been recognised with the farmer gaining more attention. Azeez, (2002) observed that the prevailing land use practices in south-western Nigeria are crop rotation and shifting cultivation. The problem of too much 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 maximising the uses of agricultural land in different parts of the world. Under this high demand of land, the system of shifting cultivation and crop rotation which has been practiced from time immemorial can no longer support the need of our farmers. Food according to sheik Nuruddin Wali (quoted from Hoskins, 2004) will last so long as forests do. This shows or is a pointer to the indispensible role of forestry in improving the present and future world food security, most especially in developing part of the global village

However, in recent years there has been growing concern over the importance of agroforestry to sustaining agriculture practices and food security and some efforts are being made to promote agroforestry at the farm level. However, the role of farm trees for biodiversity conservation and meeting rural household needs has received little attention and was therefore the focus of this study.

Agroforestry is a farming system that integrates crops and/or livestock with trees and shrubs. The resulting biological interactions provide multiple benefits, including diversified income sources, increased biological production, better water quality, and improved habitat for both. Agriculture system in Gwarzo local government area is an integration of crop production and livestock rising. Other components of ecosystem affecting agriculture are the

quality and constancy of water supply, the stability of soil fertility and existence of forests, which constitute an integral part of farming system. Subsistence agriculture demands a continuous supply of the forest products. Poverty and lack of economic opportunities are the principal reasons of converting forests for cultivation and cultivation of marginal lands. Exploitation of natural resources with primitive farming system has obviously intensified the bio-physical and environmental damages which manifest in several forms; high rate of deforestation, decline in soil fertility and crop productivity and drying of water resources. In order to meet the demands of growing population for basic needs and to conserve from ecological collapse, proper planning, management and utilization of natural resources (i.e. land, water, forest etc.) is mandatory and obligatory. These can all be achieved by the effective practice of Agroforestry in the area.

Improving soil fertility is a key entry point for achieving food security, reducing poverty and preserving the environment for small holder farms in sub-Saharan Africa (FAO, 2007). As noted by (Stoorvogel et al 1993), land degradation and declining soil fertility are being viewed as the critical problems affecting agricultural productivity. Sustaining soil fertility has therefore become a major issue in agricultural research and crop production. Since sub-saharan Africa is the home of the world poorest people of whom 90% leave in villages and rely on subsistence agriculture (Bationo and Buenkert, 2001), sustaining soil fertility must be based around affordable practices which attempts to achieve the result of having higher crop production at low cost. One good example of such a system is Agroforestry as noted by (Gnankambary, 2007).

This study would seek to assess the agroforestry practises in Gwarzo local government area by determining the types of agroforestry practices that are carried out in the area and what are the problems associated to it and to determine the contribution of agroforestry to the rural livelihood.

1.2 STATEMENT OF RESEARCH PROBLEM

The high rate of population growth has resulted in intense pressure on land in the high potential areas as attested by Labode et al (1996), which has led to a decline in soil fertility and also decline in crop yield. The problems of too much 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. Under this high demand of land, the system of shifting cultivation which has been practiced from time to time immemorial can no longer support the need of our farmers. Northern part of Nigeria is witnessing significant environmental changes leading to increase aridity and degradation.

Until relatively recently, the problems of agricultural production and deforestation were viewed separately. Thus, inadequate food production was seen to result from shorter fallows, inadequate use of improved technical packages, lack of incentives due to artificially depressed food prices, and so on. Deforestation, on the other hand, was thought to result from excessive cutting of wood for fuel. A growing consensus, however, now considers food and tree problems to be intimately related. For example, it is understood that most trees are not cut to provide fuel, but to clear land for planting crops. More important is the recognition that deforestation is an important reason for declining food output. It is hardly coincidence that many famine areas are those where trees and shrubs have largely disappeared.In Africa, for example, production over the long run depends almost as much on trees as on seed, fertilizer, and other conventional inputs. Traditionally, most African farmers have cleared land, used it until fertility began to decline, and then moved on to another land. Trees were important throughout this cycle. While the land was being used to produce food, for example, surrounding areas of tree cover served to prevent wind and soil erosion.

Though series of studies have been conducted on agroforestry, most of which was on the type of practices, regulation of micro climate i.e. the work of Schroeder (1994) on Agroforestry system: Integrated land use to restore and conserve carbon, pest dynamics. He said agroforestry is a promising land use practice to maintain or increase agricultural productivity while preserving or improving fertility. From the perspective of climate change and the global carbon cycle, agroforestry practices are attractive for 2 reasons: they directly store carbon in tree components, and they potentially slow deforestation by reducing the need to clear forest land for agriculture. An extensive literature survey was conducted to evaluate the carbon dynamics of agroforestry practices and to assess their potential to store carbon. Data on tree growth and wood production were converted to estimates of carbon storage. Surveyed literature showed that median carbon storage by agroforestry practices was 9 t C ha-' in semi-arid, 21 t C ha-' in sub-humid, 50 t C ha-l in humid, and ***63*** t C ha-' in temperate eco regions. The limited survey information available tended to substantiate the concept that implementing agroforestry practices can help reduce deforestation.

Saminu Ado (2012), conducted a study on the assessment of agroforestry practices in gezawa local government area kano state Nigeria. The study was necessitated by the new approaches to agroforestry as opposed to the traditional systems. From the extensive participants observations and farmers responses to general questions, seven agroforestry systems were identified (alley cropping, border line planting, scattered planting, woodlot, windbreaker, orchard and home garden) were identified and assessed. The study reveals that small scale farms (0.01- 3.99ha) constitute majority (92%) of farm holding in the study area. Furthermore inheritance and purchase were the predominant methods of land acquisition. The farmers perception on agroforestry was assessed, it also appears there is a disconnection between extension development efforts and the interest in/or acceptance of certain practices by farmers in the study area. The implication of the findings is that agroforestry presents huge

opportunities for raising food production and developing forestry practices in the study area. Tree growing alongside agricultural crops is part and parcel of traditional farming system in gezawa local government area of kano state. All the above features make agroforestry development not only a possibility but a necessity.

1.3 AIM AND OBJECTIVES

The aim of the study is to assess Agroforestry practices in Gwarzo Local Government Area, Kano.

The aim will be achieved by the following objectives:

1. To determine the types of agroforestry practices in the study area;

2. To identify the availability of nitrogen fixing trees on farmlands in the study area;

3. To determine the factors that hinders agroforestry practices in the area;

4. To assess the level of knowledge and attitude of farmers on agroforestry in the study area and

5. To determine the contribution of agroforestry to the livelihood of the inhabitants of the area.

1.4 JUSTIFICATION OF THE STUDY

The justification of this research can be seen under the following considerations;

Although the forest ordinance stipulated that 25% of Nigeria s 91.2million hectares should be kept as forest, it has been suggested that reserving 15% of land in each state may suffice, (Yakasai et al 1990). Kano state with a total land area of 43,083sqkm has a total forest area of only 2080sqkm. This figure represents 2.5% which is by far short of the 15%.

Yakasai et al, (1990) described Kano state as a farming community with high level of subsistence farmers. However with the introduction of mechanized farming few years back in the state, tree crops and other vegetative covers were removed exposing the area to desertification. Kano state is an area described with abundance of maize, millet, rice and cotton. This is as a result of forest destruction by our farmers. As the population multiplies, the food and shelter demand increases, forest area decreases and as such more open lands are created thus enhancing and encouraging encroachment of dessert-like conditions in the area (Yakasai et al, 1990).

Having discussed the background of the problem in Kano state of which Gwarzo L.G is also prone to, it is justified to harness the tree planting culture through community and individual participation especially in terms of Agroforestry perspectives so that sustainable land use management practices could be achieved. And this could only be done by finding out the extent of knowledge the farming community has on the concept i.e Agroforestry and the problems they encounter. This research is particularly concerned with the contribution of agroforestry farming practices in the area.

1.5 LITERATURE REVIEW

1.5.1 CONCEPTUAL FRAMEWORK

The concept of land degradation is said to be the most severe and wide spread environmental problems globally but its impact is more severe in dry lands which represent a total of 47.62% of the land surface or 39.7%, excluding the climatic dessert (UNEP 1992); Le Houerou 1996, Dregne 2000). Land degradation is the persistent decrease in the productivity of vegetation and soil(Agnew and warren 1996, maigari 2002; stocking 2004). Land degradation is said to be severe in dry lands region (Dregne 2000, Olofin 2006) said that in dry lands, land degradation processes which have more severe impact on land productivity

include deforestation, water erosion, wind erosion, Salinization, alkalinisation and soil compaction. Over one billion people-about one in every five on earth do not get enough food to lead productive lives fully.

Reported by Kang et al (2000), One fifth of this people live in Africa where food production is 25% less than required. Therefore increase in productivity is highly required in this part of the globe. The traditional system of shifting cultivation and bush fallow requires more land which is not available. Also, the use of high external input technologies has not been generally successful because of soil, climate and socio economic incompatibility (lal, 1997). Evans and Alexander (2004) linked serious decline in biodiversity associated with farmland with intensified farming practices. Against this backdrop, a sustainable land use system, that maintains the long term biological and ecological integrity of natural resources, provides economic returns to individual farmers and farm related industries, contributes to the quality of life of rural population and strengthens the economic development of tropical countries.

In drought prone areas, low soil moisture makes crops unable to meet evaporative demands resulting in the decline of crop yield (Mortimore, 1989). In marginal and especially semi-arid lands, trees and shrubs are vital to sustain biological productivity. Trees protect the environment by reducing wind erosion, stabilize and enrich the soil through litter fall and thereby provide arable land of good production. Azeez (2002), opined that tree litter fall assist farmers to realize good and economically friendly crop yield. Agroforestry as an improvement over the traditional farming systems is fast receiving international acceptance. (Leakey,1996). In economic terms, agroforestry land use systems, when compared to non-agroforestry land use systems, have a higher value of output at a lower resources level and cost and/or have the same value of output at a lower resource level and cost (Akinsami, 2002).

Sustaining soil fertility has therefore become a major factor issue in agricultural research and crop production. Sub Saharan Africa is the home of the worlds poorest people, of whom 90% live in villages and rely on subsistence agriculture (Bationo and Buerkert, 2001), sustaining soil fertility and improving living standard most be based around affordable practices, which result in higher crop production at low cost. One example of such a system is AGROFORESTRY.

1.5.2 MEANING OF AGROFORESTRY

Agroforestry is a land use system that involves socially and ecologically acceptable integration of trees with agricultural crops and/or animals, simultaneously or sequentially, so as to get increased productivity of plants and animal in a sustainable manner from a unit of farmland, especially under conditions of low level of technology inputs and marginal lands (Nair 1999).

Agroforestry is a land use system (a) in which woody perennials and herbaceous crops are grown together in mixtures, zonally and/or sequencially, with or without animals, and (b) which provides greater benefit for the following: sustained soil fertility, soil conservation, increased yield, diminished risk of crop failure, ease of management, pest and disease control, and /or greater fulfilment of the socio-economic needs of the local population.

Therefore, agroforestry is not any one system, but a principle common to many potential and existing systems which:

1. Display ecological and economical durability by virtue of their biological architecture including short cycle plants, long cycle plants and animals;

2. Warrant social acceptability by breaking up long-term ecological cycles in a sequence of easy-to-understand daily and seasonal activities moulded upon local tradition but conceived so as to increase efficiency;

3. Aim at complete use of all inorganic resources in all available niches for useful plants and animals, as long as recycling of these resources is maximized;

4.Diminish risks for the individual farmer by means of a wide variety of useful plants and animals species enlarging the range of products, providing a self-protecting system and enhancing the quality of the daily environment.

Okafor and Obam (2002) 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. They further stated that in agroforestry system, the tree provide fuel wood, food, shelter, drug, cash income, raw materials and improvement of soil fertility for crop growth. In threatened areas like arid and semi-arid regions and degraded lands, agroforestry increases soil fertility and land productivity for food and fuel wood production. Agroforestry practices offer practical ways of applying various specialized knowledge and skills to the development of sustainable rural production systems. In addition stated that agroforestry should be recognised as a land use option in which trees provide both products and environmental services.

Maydell (2000), stated that the term agroforestry covers a variety of land use systems combining forestry with agriculture or range management on the same land. Agroforestry aims at solving the problems of rural development, predominantly in the tropics, by:

a. Increasing and improving the yields of food production

b. Safe guarding local energy supply

c. Production of timber and variety of other raw materials for the farmers subsistence, for industrial use and if applicable- export

d. Protection and improvement of the production potential of a given site and environment; increasing the human-ecological carrying capacity;

e. Safeguarding sustainability through appropriate intensification of land use;

f. Improving social and economic conditions in rural areas by creation of jobs and income and reduction of risks;

g. Development of land-use systems which make optimal use of modern technologies and traditional local experience and which are compatible with the cultural and social life of the people concerned.

In view of the above definitions by different individuals; ICRAF after an in house discussions and the following definition was suggested:

Agroforestry is a collective name for land use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc) are deliberately used on the same land management units as agricultural crops and/or animals, in the same form of spatial arrangement or temporal sequence. In agroforestry systems there are both ecological and economic interactions between the different components.

This definition implies that:

1. AF normally involves two or more species of plant(or plants and animals), at least one of which is a woody perennial;
2. An AF system always has two or more outputs;
3. The cycle of an AF system is always more than one year; and

4. Even the most simple AF system is complex, ecologically (structurally and functionally) and economically, than a monocropping system.

   It can be said that agroforestry is all centred towards Productivity, Sustainability and adaptability. The sustainability criterion is to reconcile conservation objectives of land use with the farmer's production objectives. The adaptability criterion implies that the technologies to be adopted must not call upon resources which the farmers are not likely to possess (eg excessive capital, machinery or labour requirements) nor require forms of management the farmers are unable or unwilling to adopt.

1.5.3 AGROFORESTRY PRACTICES AND SYSTEMS

Agroforestry is classified in to the following practices due to the criteria that AF has three basic components that are managed by man (woody perennials, herbaceous plants and animals), the logical first step to classifying AF is based on the nature of these components, namely;

i. Agrisilvicultural Systems;
ii. Silvopastural Systems, and
iii. Agrosilvopastural Systems.

i. AGRISILVICULTURAL SYSTEMS: this involves the combination of crops including shrubs, vine, tree crops and trees on the same piece of land. Types of Agrisilvicultural system include:
   a. Improved fallow
   b. Taungya
   c. Alley cropping
   d. Multiple layer tree gardens

e. Multipurpose tree on crop lands
f. Plantation crop combinations
g. Home gardens
h. Trees in soil conservation and reclamation
i. Shelterbelt and windbreakers, live hedges
j. Fuel wood production

ii. SILVOPASTURAL SYSTEMS: This is the combination of trees and pastures and/or animals on the same piece of land. It includes practices like:

a. Trees on range land or pastures
b. Protein banks
c. Plantation crops with pastures and animal

Although some form of Silvopastural management has been practiced for centuries, Silvopastural as an agroforestry practice is specifically designed and managed for the production of trees, tree products, forage, and livestock. Silvopastures results when forage crops are deliberately introduced or enhanced in a timber production system, or timber crops are deliberately introduced or enhanced in a forage production system.

As a Silvopastural, timber and pasture are managed as a single integrated system. Silvopastural systems are designed to produce a high-value timber component, while providing short-term cash flow from the livestock component. The interactions among timber, forage, and livestock are managed intensively to simultaneously produce timber commodities, a high quality forage resource, and efficient livestock production. Overall, Silvopastures can provide economic returns while creating a sustainable system with many environmental benefits. Well-managed Silvopastures offer a diversified marketing opportunity that can stimulate rural economic development. Integrating trees forage, and

livestock creates a land management system to produce marketable products while maintaining long-term productivity. Economic risk is reduced because the system produces multiple products, most of which have an established market. Production costs are reduced and marketing flexibility is enhanced by distributing management costs between timber and livestock components.

Comprehensive land utilization in Silvopastural systems provides a relatively constant income from livestock sale and selective sale of trees and timber products. Well-managed forage production provides improved nutrition for livestock growth and production. Potential products of the tree component include: saw timber, veneer logs, pulpwood, firewood, pine straw, posts and poles, harvested game, nuts, fruit, ornamental flowers and greenery, maple syrup, mushrooms, organic mulches, and other secondary products.

Grazing can control grass competition for moisture, nutrients, and sunlight, thereby enhancing tree growth. Well managed grazing provides economical control of weeds and brush without herbicides, maintains fire breaks, and reduces habitat for gnawing rodents. Fertilizer applied for forage is also used by trees. In addition, livestock manure recycles nutrients to trees and forage. Some forage species tend to be lower in fibre and more digestible when grown in a tree-protected environment. Trees that provide shade or wind protection can have a climate-stabilizing effect to reduce heat stress and wind-chill of livestock. Protection from trees can cut the direct cold effect by 50% or more and reduce wind velocity by as much as 70%. Livestock require less feed energy, so their performance is improved and mortality is reduced.

Silvopastures can increase wildlife diversity, and improve water quality. The forage protects the soil from water and wind erosion, while adding organic matter to improve soil properties. Silvopastures provide an attractive landscape with an aesthetically pleasing “park-like” setting. In contrast to concentrated livestock operations, silvopastoral systems are less

likely to raise environmental concerns related to water quality, odors, dust, noise, disease problems, and animal treatment.

iii. AGROSILVOPASTURAL SYSTEMS: This system combines the production of crops, trees and pasture/animals on the same unit of land simultaneously or sequentially. It includes:

a. Home gardens involving animals
b. Multipurpose woody hedgerows

Other practices of agroforestry include:

iv. Apiculture with trees
v. Aqua forestry.

(a)IMPROVED FALLOW: This is the practice where woody species are either planted and/or left to grow on farm holdings when soil fertility as declined as a result of continuous cropping. After two or more years, the woody species are cut for firewood and the area cleared and farmed ones more until fertility drops and the cycle is repeated. An example of a plant species that are used is acacia Senegal; it adds nitrogen and other nutrients to the soil litter decay. Improved fallow is also known as enriched fallow. When established with only leguminous trees and/or shrubs, it could be called Leguminous fallow. That is, Leguminous fallows are natural fallows enriched with planted legumes to improve soil fertility.

(b)TAUNGYA: According to Tufuor (1981), the word taungya was coined in Burma in 1806 where it was commonly practised. It was introduced in to Nigeria in 1928 in a silvicultural experiment at sapoba in Edo state (Kennedy, 1930). Since then it has become more widely adopted in the rainforest and the derived savannah zones than in the drier savannah. The system is essentially the traditional shifting cultivation and has been modified in various parts of the tropics (Taylor, 1962). The farmers raise food crops for at least one year in the forest

land, which usually is a part of forest reserve. The successive areas are then converted into plantations and the farmers progressively shift their farming activities to the new reforestation areas as the trees on their farm holding begin to close canopy. Thus by the time the entire area is reforested, the entire land space would have served the dual purpose of providing food on the short term and forest products on the long term. The process can be repeated when the forest trees have reach merchantable and logging is progressively carried out from the first established plantation to the last, the farmer leaving each harvested plantation as coppice regrowth or replanted species close canopy.

The *Taungya* system essentially consists of growing annual agricultural crops along with forest tree species during the early years of establishment of the forest plantation. In order words, t*aungya* system is a forest plantation establishment system in which forest crops are raised in combination with temporary cultivation of field or agricultural crops. The *taungya* system can be considered as another step in the process of transformation from shifting cultivation to agroforestry. Shifting cultivating is a sequential system of growing woody species and agricultural crops, whereas *taungya* consists of simultaneous combinations of the two components during the early stages of forest plantation establishment. Although wood production is the ultimate objective in the *taungya* system, the immediate motivation for practicing it, as in shifting cultivation and other smallholder systems, is food production. As we've said earlier it was introduced to Nigeria in 1928 in a silvicultural experiment at Sapoba (Edo State). It is now a widely adopted agroforestry practice in the rainforest and derived zones of Nigeria. The system which has been modified in various parts of the tropics is essentially an adaptation of the traditional shifting cultivation whereby the farmers are able to raised food crops for at least one year in a forest land, usually a part of a forest reserve. The successive areas are then converted into plantations as the farmers shift their farming activities progressively to new reforestation areas.

At least THREE forms of *taungya* system have existed in Nigeria:

1. The '**traditional *taungya***' which called 'own your crop'type. In this type, each farmer is allocated one or more plots and a plot area is about 0.5ha. Under this system, the farmers are responsible for site preparation for the tree planting, and in return for their labour, they are allowed to grow some food crops. E. g. maize, yams, cassava, etc; till the forest trees such as *Gmelina arborea, Tectonagrandis, Terminalia* species interplanted by the Forestry Department close their canopy. Planting of the food crops can continue up to 3 years depending, among other things, on the species raised. This type of *taungya* is the most commonly practiced in the former Western Region (principally at Ogun,Ondo, Ekiti, Oyo, Osun, Edo and Delta States).

2. The second type of taungya known as **Departmental *taungya*** which is also called 'farming for pay", has been extensively practiced in the high forest areas of Cross River and Akwa Ibom states. Under this system, farming is practiced by the Forestry Department. The major difference between the two systems is that under the traditional *taungya*, the local farmers own only the food crops, whereas under the Departmental taungya, both tree and food crops belong to the government or the Forestry Department.

3. The third type of taungya is the, 'hybrid' version of the two systems which had been tried in the old Bendel state (Edo and delta) implies that the local farmers under the traditional *taungya* assist the Forestry department in planting the tree crops.

(c) ALLEY CROPPING (hedgerow intercropping): Alley cropping as described by (CTA, 2003) is a system in which strips (or alleys) of annual crops are grown between rows of trees or shrubs. In the system, hedgerows of fast growing, nitrogen fixing trees or shrubs are first established and in between the hedges (alleys) food crops are grown annually. The hedges which prevent wind damage to crops and prevent erosion are pruned to reduce shading effect on the food crops, thus providing sticks for firewood. The foliage can also be worked in to

the soil as green manure, use as mulch to improve soil water retention and prevent water or wind erosion. Tree species such as *Leucaena Leucocephala, Gliricidia Sepium, Acacia spp, Sesbania spp, Prosopis spp etc.*

Alley cropping is a simultaneous agro forestry system where arable (food) crops are grown between hedgerows of planted shrubs and trees, preferably leguminous species, which are pruned periodically during the crop's growth to provide green manure (which, when returned to the soil, enhances its nutrient status and physical properties) and to prevent shading of the growing crop(s).

The hedgerows are allowed to grow freely to shade the inter-rows when there are no crops. Alley cropping retains the basic restorative attributes of the bush fallow through nutrient recycling, fertility regeneration and weeds suppression and combines these with arable cropping so that all processes occur concurrently on the same land, allowing the farmer to crop the land for an extended period.

Trees used in alley cropping must have:

(i) Deep roots; so that they do not compete with food crops for water and nutrients.

(ii) They should be fast growing

(iii) They should be able to re-sprout easily after pruning, Coppicing or pollarding.

(iv) They should ideally be multipurpose, i. e capable of producing poles, wood, food, fodder, medicinal and other products.

(v) They should preferably be leguminous; able to fix their own nitrogen, so they provide protein rich leaves for livestock and nitrogen-rich organic matter for the soil.

Pruning-This is the process of cutting back growth of plants, including roots, but more particularly, side branches of trees, or the sides and tops of hedges.

Coppicing – the process of cutting broadleaved trees close to the ground level to produce sprouts or re growth. Trees are also coppiced if they are damaged.

Pollarding – Cutting back in more or less systematic fashion the crown of a tree but leaving a main trunk to 1.5m or so, with the object of harvesting small wood and browse, of producing re growth beyond the reach of animals or of reducing the shade cast by the crown.

Trees and shrubs in the alley cropping system have the following benefits:

(a). Provision of green manure or mulch for companion food crops. In this way plant nutrients are recycled from deeper soil layers,

(b). Provision of pruning's, applied as mulch, and shade during the fallow to suppress weeds.

(c). Provision of favourable conditions for soil macro- and microorganisms,

(d). When planted along the contours of sloping lands, provide a barrier to control soil erosion,

(e). Provision of pruning for browse (to feed livestock), staking materials and firewood, and

(f). Provision of biologically fixed nitrogen to the companion crop(s).

The major advantage of alley cropping over traditional shifting cultivation and bush fallow systems is that the cropping and fallow phases can take place concurrently on the same land, thus allowing the farmer to crop for an extended period without returning the land to bush fallow.

Other beneficial effects that have been claimed for alley cropping include:

(a). Improved crop performance due to the addition of nutrients and organic matter to the soil/plant system,

(b). A reduction of the use of chemical fertilizers,

(c). an improvement in the physical nature of the soil environment.

The addition of mulch can lower soil temperatures, reduce evaporation, and improve soil fauna activity and soil structure resulting in better infiltration, reduced run-off and improved water use efficiency.

(d). on sloping land, the tree rows act as a physical barrier to soil and water movement, resulting in significant reductions in erosion losses.

(e). The provision of additional products such as forage, firewood or stakes when a multipurpose tree legume is used as the hedgerow,

(f). An improvement in weed control. During the fallow period shading of the interspaces may reduce weed growth, while in the cropping phase, the mulch may inhibit germination and establishment of weeds.

By integrating small ruminant production with alley cropping, the International Livestock Centre for Africa (ILCA) project in Ibadan, Nigeria developed the ALLEY FARMING concept in which pruning from the hedgerows provides high-quality supplementary fodder. So, ALLEY FARMING can be defined as the planting of arable crops between hedgerows of woody species that can be used for producing mulch and green manure to improve soil fertility and to produce high quality fodder.

(d) PARKLAND (SCATTERED TREES): Parklands are characterised by well grown trees on cultivated and recently fallowed land (CTA, 2003).These parklands develop when crop cultivation on a piece of land becomes permanent. As crop cultivation intensifies there are usually fewer trees. These trees are chosen for their general usefulness, providing multiple products such as fodder, fruit, timber, fuel wood, and medicinal products. The trees are arranged randomly in a park-like manner so that they do not compete with their neighbours. However, species like Parkia biglobosa, and P. Filicodea, Mangnifera indica are very gregarious and are widely seen in almost all the ecological zones. Trees scattered haphazardly or according to some systematic patterns on bunds, terraces or plot/field boundaries, crop lands, pastures and rangelands. Some of the trees grow naturally from seed dispersed by birds and other wildlife. Such trees are retained by farmers during land preparation for agriculture, and are often randomly dispersed on the land. In the Sahel region of West Africa, scattered

trees on cultivated or recently fallowed land form a characteristic land-use system commonly referred to as 'Parklands'.The most important and dominant tree species in the parklands of the Sahel region include *Faidherbia albida* (syn. *Acacia albida*), Shea butter tree (*Vitellaria paradoxa*), *Parkia biglobosa, Adansonia digitata* (the baobab tree), and *Tamarindus indica*. *Acacia tortilis* and *Prosopis* species are also often scattered on the farmlands. Through horticultural techniques, improved accessions of some of these species have been produced. These accessions mature faster and produce higher-quality products than the existing natural populations in the parklands. Trees scattered on cropland offer a variety of benefits and these, together with the limitations of this agroforestry practice are listed below:

Benefits of scattered trees on farmland include:

(a). Farmers consider such trees not to be competitive against food crops. *Faidherbia albida* is an example of such trees.

(b). Trees, such as *Faidherbia albida*, provide shade for livestock during intense heat of the long dry season.

(c). The trees diversify farmers' products and increase crop production, and the duration of cropping the land without fertilizer use.

(d). Control of wind erosion when tree canopies in parklands intercept wind-blown soil.

(e). Sale of non-timber products, such as charcoal, firewood, gum Arabica, wine, oil and fruits significantly increases income.

Limitations

(a). Scattered trees are often not at the optimum density that would confer maximum benefits to the environment and crop production.

(b). Reliance on naturally regenerating trees makes it difficult to improve the system through use of better germ plasm.

(c). Trees found in parklands, such as *Faidherbia albida*, are slow growing and so, benefits take long to accrue.

(d). The trees are often browsed by livestock that are allowed to graze crop residues during the dry seasons.

Faidherbia albida, which is a prominent tree species in the parklands in the Sahel region of West Africa, exhibits reverse phenology. **Phenology** is the partitioning in time of the events of a plant's life-cycle: seasonal changes in leaf bearing, leaf shedding, growth processes, flowering and seed production. The reverse phenology exhibited by *Faidherbia albida* in the Sahel region of West Africa has made the species indispensable in the welfare of rural people in the Sahel. The species develops fresh green leaves during the dry season when other livestock feeds are very scarce in that region. Therefore, the green leaves produced by the species during the dry season are the major source of protein-rich fodder for the livestock of the Sahelian people during that season. When *Faidherbia. albida* sheds its leaves during the rainy season; evapo transpiration and competition for water and light with the understory agricultural crops will be reduced; at a time when the crops need these resources most. The leaves will decompose and also improve the soil nutrient status for the growing crops. This will subsequently contribute to an increase in the crop yield.

(e). WINDBREAKERS AND SHELTERBELTS: Shelterbelts are strips of trees/shrubs composed of one or more species planted across prevailing wind directions to protect the landscape and wind erosion by its effectiveness at reducing wind speed. Rochealeau et al (2001) defined a windbreak as a row of trees or tall shrubs planted across the direction of prevailing wind. According to Obiaga, (2005), Shelterbelt is a strip of planted trees across the direction of the prevailing wind.it consist of at least three parallel rows of trees, shrubs and grasses. The trees and shrub are ever green or species that do not shed all their leaves during

the windy season. Grasses and other plants are sometimes planted to prevent the wind from blowing the soil away from around the base of the trees and shrubs.

Wind is air mass in motion. There are all kinds of winds. Some are local whereas others build up over great distance; they are hot or cold depending on the circumstances; they carry varying amounts of water vapour; they blow at altitude or, on the contrary, near the ground. They could be gentle or strong. From the farmer's point of view, gentle winds are advantageous in that they can contribute to pollination of crops and seed dispersal. Strong winds, on the other hand, are damaging and could be detrimental to agricultural crops, human life and properties. Below are some of the effects of strong winds on crops:

(a). Wind may increase transpiration rate, and this may exacerbate soil moisture deficits.

(b). It can spread pests and diseases because disease-causing spores and insects are dropped whenever wind speed is reduced.

(c). It can deform plants, cause crop lodging and/or affect carbon dioxide circulation.

(d). It can increase loss of top-soil through rill erosion, which may impair seedling growth especially in semi-arid areas.

(e). It can cause drifts during herbicide and insecticide spray; hence, leading to wasteful application and ecotoxicity.

Windbreaks

Windbreaks are narrow strips of trees, shrubs and/or grasses planted to protect fields, homes, canals, and areas from wind and blowing sand. Where wind is a major cause of soil erosion and moisture loss, windbreaks can make a significant contribution to sustainable production.

Shelterbelt

A shelterbelt is a wide strip of vegetation that slows wind speeds, thereby reducing wind erosion, evaporation and damage to towns, villages and adjoining farmlands by the wind. It is sometimes referred to as windbreak, although the latter often implies a single strip of trees

and other vegetation. A shelterbelt presents a mechanical barrier to the impact of the wind, and separates two zones; the windward and the leeward zones. The windward zone refers to the side from which the wind blows, whilst the leeward zone relates to the side where the wind passes. As a rule of the thumb, a belt protects a distance up to its height on the windward side and up to 20 times its height on the leeward side.

Suitable species for shelterbelt establishment should as much as possible have the following characteristics:

i. Adaptability,

ii. Growth rate,

iii. Crown formation,

iv. Increased land productivity.

(f) LIVE FENCE: these are composed of dense hedges or thickets of shrubs established around boundaries of farms, water bodies and compounds where food crops and animals are reared, however they are composed of trees only and need not be dense. They serve as property markers and often plants species such as *Moringa alfeira*, *Acacia Nilotica*, *Newboldia Leavia Euphorbia*,etc. are used in the savannah areas to delineate farm holdings. Fence supported by livestakes: Anika et al (2003) stated that some woody plants can be propagated by very large cutting; if poles are the sizes of fencing posts cut and planted they strike root and leaf out. Once they are growing they can support barbed wire or a lattice made from local materials, such as slit bamboo.

(g) MULTIPURPOSE TREES ON CROPLAND: This system consists of a mixture of tree plantations of conventional forest species and other commercial perennial tree crops, especially tree species, lending a managed mixed forest appearance. As opposed to home gardens which surround individual houses, these tree gardens are usually away from houses, and are typically found on communally owned lands surrounding villages with dense clusters

of houses, as in Indonesia (Java and Sumatra). The multispecies, multilayer dense plant associations are with organized or no organized planting arrangements. The major group of components are different woody components of varying forms and growth habits and some perennial tree such as fruit trees.

(h) FUELWOOD PRODUCTION: It has been estimated that in the early to mid 1970s not less than 1.5 billion people in developing countries derived at least 90% of their energy requirements from wood and charcoal, and another billion people meet at least 50% of their energy needs this way. As a result of consistent harvesting of natural forests and woodlands for fuelwood and poles; these essential resources are seriously threathened, and the developing world is facing a critical firewood shortage as serious as the petroleum crisis.

Today there are alternative sources of fuel such as kerosene, gas and electricity. However, these require cash inputs and are not available to everyone. Every year about 3000 million cubic metres of wood are harvested and used all over the world. Of this amount, slightly more than half is burned as fuel for heating and cooking, most of it directly but some in form of charcoal. In the last 20 years or more, fuelwood supplies have come under increased pressure in many parts of the world. Several measures have been recommended to address this problem, the most significant being the promotion of tree planting for fuelwood production. Rural people are been encouraged to integrate tree production for fuelwood into existing farming practices. Such fuelwood species can be interplanted on/or around agricultural lands.

In Ghana, tree species such as *Albizia* species and *Celtis* species are good sources of fuelwood and poles in the forest zone. While in the savanna areas, species such as *Pterocarpus erinaceous*, *Daniella oliveri* and *Isoberlina doka* constitute the bulk of the fuelwood and materials for poles. In northern Nigeria (especially Kano area), *Dalbergia sissoo* is a good fuelwood species.

1.5.4 AGROFORESTRY RESEARCH IN NIGERIA

A paper was presented on Tree Integration in Homestead Farmers in South Eastern Nigeria: Proposition and Environment carried out by environment and development research group, Department of Geography, Lanchester University, Lanchester November 2004, contributes to wider debates on the dominant factors determining the emergence and sustainability of intermediate systems of forest management in developing countries. The theoretical framework and propositions for analysing tree integration in homestead farms are presented, with reference to southeast Nigeria. The paper argues that, first, at the household level, livelihood strategies constitute the main determinant of the decision to integrate trees in homestead farms. Secondly, induced innovation has a wider and more significant role at the community level than at the household level in encouraging the integration of trees in farms. Thirdly, the sustainability of observed patterns of tree integration is influenced by the interaction of environmental, ecological, political, economic and social factors. Based on these propositions, the research analyses the internal (household) and external (wider community) factors influencing tree integration in homestead farms in southeast Nigeria. Generally, it has been found that shelter belts increases the yield of agricultural crops, but their influence varies with so many factors such as the type of crops, the year of investigation, the experimental site and so on (Adegbehin and Iniobugo, 1996).

Another study on Agroforestry was carried out in Ondo state, Nigeria by Adekunle on the Contributions of Agroforestry practice in Ondo State, to environmental sustainability and sustainable agricultural production. The area is situated in the tropical rainforest ecological zone. Data were collected with pre-tested questionnaires administered to 300 farmers -household heads, randomly selected from four Local Government Areas (LGAs). Information was gathered on farmers' awareness of and involvement in Agroforestry systems, willingness to plant, retain or take care of trees planted, farm location and sizes, tree

species commonly retained/planted on farmland, major causes of deforestation, extension education in Agroforestry and other information relevant to the study. Results revealed that the primary occupation of the majority of the respondents (80%) is farming. Land is mainly obtained through lease from landowners (52%). This is followed by those who inherited land (26%). Very few respondents (6%) have their farms on government land through Agroforestry (Approved Taungya System). Most farmers (67%) were willing to plant, retain and take care of trees on their farmland to provide shade for crops, for edible fruits, timber and firewood, erosion and leaching control, biodiversity conservation, reduction of global warming, and increased crop yield. Average yearly crop yield (cassava and maize) from agroforestry farms was 750 kg/ha against 630 kg/ha for non-agroforestry farms. Agroforestry is a means of increasing food production and at the same time, it makes wood available to rural dwellers. However, there is a need to improve both formal and informal agroforestry education among the rural communities for agroforestry to become more widely accepted by local populations. Ujah (1982), investigated the possible effects of shelterbelts on wind speed, soil moisture, soil temperature and crop yield. He observed that the major effects of shelterbelts are that of surface wind reduction. Other changes such as changes in the air and changes in the soil temperature, in soil water content, plant growth are mostly due to the reduction of wind speed. He found out that although the yield is generally very poor, below 100 tonnes/hr there is evidence of higher yield in the protected areas than in the open fields. It is therefore probable that the main effects of shelterbelt on yield is mostly due to reduced wind speed and minimized losses of the stored soil moisture. Investigation shows that the arable cultivation is more sustainable than irrigation. On the other hand, arable cultivation is more sustainable than irrigation when trees are integrated in the farming system in form of planting of leguminous plant such as Acacia albida on farmlands, planted fallow and shelterbelts. On the other hand, arable cultivation is more sustainable when trees are

integrated in the farming system inform of planting of leguminous plant such as *Acacia albida* on farmlands, planted fallow and shelterbelts.

Another research was conducted by Dantata James (2013), Influence of shelterbelt-distance on productivity of pearl millet (Pennisetum glaucum) in the Arid area of Bauchi state were Field experiments were conducted in the shelterbelt plantation located at Azare, northern part of Bauchi State (Latitude 11^0 40' N, Longitude 10^0 40'E, 609. 45m above sea level) in the Sudan savanna ecological zone of Nigeria during the 2003, 2004 and 2005 raining seasons. The objective of the study was to determine the appropriate planting distance from the shelterbelt for maximum growth and yield of pearl millet. Millet *Gero variety* an early maturing was used in all the three years of experiment. Treatments consisted of six distances (-5, 5, 15, 25, 35 and 45m) from the shelterbelt. These treatments were arranged both at the leeward and windward sides of the shelterbelt in a randomized complete block design with four replications. Treatments perpendiculars to the shelter on the windward side of the belt serve as the control, out of which one, randomly picked was designated as -5m. Results after data analysis, showed that distance significantly (P = 0.05) influenced the growth attributes and grain yield of millet. Close (5 - 15m) to the shelterbelt, plant height, number of leaves, number of tillers and grain yield were reduced. The result also showed that these parameters increased significantly (P = 0.05) with sowing at 25m- distance. Beyond 25m however, these measured growth and yield parameters declines as the influence of the shelterbelt diminishes. Of all the distances studied, maximum growth and yield of millet was obtained at 25m-distance.

Mustapha et al (2012), conducted a study which analyzed farmers' perception of effects the of gum Arabic agroforestry on livelihoods in the Sahelian zone of Borno state, Nigeria. Data for the study were obtained mainly through primary sources. Multi stage, purposive and random sampling techniques were employed to select 321 respondents that was

used for this study. The study revealed that the most important (30.25%) farm information by respondents was radio. This was closely followed by friends and relatives representing 29.91% of the respondents in the study area. However extension agents were the least important (9.34%) source of farm information among respondents in the study area. The study indicated that the most important (29%) reason for planting gum Arabic tree was for economic reason. The result showed that the respondents' perception on improved environmental situation and improved socio-economic status had a mean score of 2.68 and 2.63 respectively implying that the respondents had an agreed perception on the effects of gum Arabic agroforestry on livelihoods. The results in also indicated that all the constraints identified by respondents had a mean score of > 2.56, implying that they had agreed to have encountered problems in the adoption of gum Arabic agroforestry in the study area. The study recommends that awareness creation should be mounted through extension education approach to enlighten the public on the skills, knowledge, techniques and benefits of the adoption of gum Arabic agroforestry in the study area. Farmers in the study area should also be encouraged to form gum Arabic agroforestry cooperatives as this will enable them to take advantage of government and non-governmental programmes, such as provision of credit facilities and technologies etc.

Nzegbule et al (2013), conducted a study on Plant species richness, composition and standing state of soil nutrients were compared between a 35-year old cashew plantation and a natural forest in Isuochi area of south Nigeria. Six sites each in cashew plantation and natural forest were sampled. Vegetation sampling was done using belt transects and soil analysis involved random soil sample collection using soil auger from 2 soil depths (0 - 15 cm, 15 - 30 cm) and levels of N, P, K, organic matter (OM) and pH were determined. One square meter quadrats were laid randomly for collection of leaf litter to study the nutrient contents such as N, P, K, OM and pH. Species Richness Index (SRI) was 0.415 in the cashew plantation and 1.073 at control site. In the cashew plantation, nutrients in the soil were generally higher than

in the litter indicating decreased mineralization on the floor. However, fertility index for crop production was higher in the cashew plantation than in the control area; indicative of possibility for rapid growth and comparatively better chances of performance for crop plants on plantation soils. This can serve as a pre-test on lands for choice of crops in a land re-conversion project. Although biodiversity and nutrient pool within the cashew plantation can be improved by partial or total introduction of new and adaptable species in the area, there are opportunities for introduction of agroforestry practices within the area to enhance livelihood a broaden management objective.

Adesoji et al (2013) conducted a study on the Influence of Incorporated Short Duration Legume Fallow and Nitrogen on Maize (Zea Mays) Growth and Development in Northern Guinea Savannah of Nigeria. Field experiments were conducted from 2005 to 2007 wet seasons at the Research Farm of the Institute for Agricultural Research, Ahmadu Bello University, Zaria, to evaluate the influence of incorporated short duration legume fallow and nitrogen on Maize (*Zea mays* L.) growth and development in northern Guinea Savanna of Nigeria. The treatments consisted of two maize varieties (SAMMAZ 12 and SAMMAZ 27) and five rates of nitrogen (0, 30, 60, 90 and 120kg N ha 1) in the main plots, while three green manure crops (Lablab (*Lablab purpureus*), Mucuna (*Mucuna pruriens*) and Soybean (*Glycine max* (L.)Merrill)) and a weedy fallow were accommodated in the sub-plots. The treatments were laid out in a split-plot design with three replications. SAMMAZ 12 and SAMMAZ 27 were similar in growth attributes except days to 50% tasselling and silking where SAMMAZ 27 exhibited significant reduction in days to 50% tasselling and silking. Nitrogen fertilization significantly increased plant height, number of leaves, total dry weight and leaf area index but significantly reduced days to 50% tasselling and silking. Incorporation of mucuna, lablab and soybean significantly increased plant height, number of leaves, total dry weight and leaf area index of maize but significantly reduced days to 50% tasselling and silking compared with

weedy fallow. However, maize plants grown on plots without applied Nitrogen and weedy fallow were short and stunted with lowest values of all the measured growth parameters with exception of days to 50% tasselling and silking where zero N and weedy fallow delayed flowering.

Bankole et al (2013) 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. There are 10 wards in the local government and 4 wards were randomly selected with an average of 25 women farmers randomly interviewed in each of the selected wards giving a total sample size of 100 respondents. Data were collected from the respondents using opened-end questions administered as interview schedule. The results showed that majority (86.0 %) of the respondents were within the age of 20 and 49 years. Sixty-five percent of respondents have no formal education while 64.0% of the women were engaged in farming activities. Ninety-six percent of the women were married. Ninety-one percent have family size ranging from 3 to 10 persons within their households. Also, majority of the women had access to land. High numbers of respondents are aware of shifting cultivation (92.0%), pastorium (79.0%), household garden (78.0%), border planting (74.0%) and apiculture (61.0%) while few are aware of alley cropping (15.0%), taungya (31.0%) and green fences (33.0%). The systems of agroforestry most of the respondent are still practicing are pastorium (64.0%), while few still practice household garden (24.0%), border planting (20.0%), taungya (7.0%) but none of the respondents is practicing green fences. There was significant relationship between the number of practices the women were aware of and the

number of practices they use (r=0.285, p<0.05). There was no significant relationship between education acquired, marital status, family size and the level of utilisation of agroforestry by women. Although, there was a significant relationship between age and the number of practices utilized (r=0.279, p<0.05), age, marital status, education, family size had no significant relationship with awareness of agroforestry possessed. Based on the result of the study, it can be inferred that the level of agroforestry practices used are determined by the number of practices the women are aware of or exposed to. Also, the older people used fewer practices while the younger ones used more. Therefore, information about agroforestry should be effectively extended to women.

1.5.5 THE ROLE OF AGRICULTURAL DEVELOPMENT PROJECT (ADP) IN PROMOTING AGROFORESTRY PRACTICES IN NIGERIA.

Going by the policy guiding the activities of the ADP with regards to the National Agricultural Technology Support Programmes (NATSP), it would promote the following in other to encourage agroforestry farming practices among farmers;

a) Promotion of low cost technologies suitable for small holder farmers.
b) Use of agroforestry species for alley cropping.
c) Development of wind breakers and contour hedging.
d) Promotion of fruit trees for establishment in fadama and land areas.
e) Use of vertiver grass along contours to stabilise soil, control erosion and conservative moisture.
f) Promoting the education of women farmers in agricultural production activities.

Even though the above mentioned policy guidelines does not specify targets to attained for each of the stated objectives, the ADP had started implementing the programme with seedlings at both departmental and community nurseries in 1995.

Also another study was on Participatory Planning and Extension: An Agroforestry Case Study from Plateau State, Nigeria was carried out By Barry Wayne Hunter (1991 and 1992). The project was aimed at creating agroforestry vision and building agroforestry capacity within the Plateau Agricultural Development Programme (PADP), a Nigerian State institution. The project consisted of a series of participatory workshops, which focused on agroforestry techniques, participatory extension and operational planning. Since agroforestry is a diverse discipline involving crops, trees and livestock, it requires integrative approaches and is well suited to participatory methods.

The project provoked the following questions. "If agroforestry is best accomplished using participatory methods, can it be integrated into an established bureaucracy?" and "What can be learned about a participatory development approach related to the institution in which it is employed ?". These questions form the basis of the dissertation. In 1993 the author re-visited the agroforestry section of the PADP with the intention of answering these questions. This evaluation formed the basis for a case study. The review methodology included semi-structured interviews, detailed interviews, file and record reviews and a backstopping workshop. Further, a detailed literature search on rural development, extension, agroforestry and the Nigerian situation was completed to provide a framework for analysing the PADP case study. Results indicated that the project goals of "vision creation" and "capacity building" were only partly achieved because PADP extension methods were not altered; middle level staff were better informed than lower and upper level staff cadres; and PADP resources were not mobilised to address agroforestry concerns. However, technical agroforestry activities within the PADP increased as a partial result of the project. The

original project goals were likely too ambitious. These goals were not shared or fully adopted by the organisation because inadequate attention was paid to PADP's organisational culture when formulating and implementing the project. Further, the weak links between staff levels and between the technical section and extension section of the PADP posed serious constraints to the fill adoption of the agroforestry extension project.

2.0 CHAPTER TWO

STUDY AREA

Gwarzo Local Government area is among the first local government to be created in Kano state in 1976, Gwarzo is in Kano closed settled zone KNCSZ which is defined as Rural Areas around the Kano city with very high population density and farming intensity (Yusuf, 2001) it is about 75km from Kano city and about 580m above sea level.

2.1 LOCATION AND POSITION

2.1.1 LOCATION: Gwarzo Local Government is located in the western part of Kano state. To the West; it is bordered by katsina state, to the north by Shanono local government and to the south by Karaye local government. It has an area of 420sqkm with ten wards.

2.1.2 POSITION: Gwarzo local government area is located between latitude 11^0 33`N and $11^0$ 40` and longitude 7^0 56`E and $7^0$ 58`E.Aas shown in figure 1

2.2 GEOLOGY

The study area lies within the basement complex which is underlain by granite, schist, gneiss of the pre Cambrian origin which consists of metamorphic and igneous rock. Because granite dominates the structure, it is referred to as rock of the basement complex.

2.3 CLIMATE

2.3.1 RAINFALL: The area is experiencing tropical climatic condition with distinct wet and dry seasons. In the normal year, the mean annual rainfall is 1000mm (Olofin 1987). The rain normally starts in May and ends in September, which results in the beginning of dry season. The annual rainfall recorded in 2008 and 2009 are 1083.6mm and 1145mm respectively. (Source: KNARDA OFFICE GWARZO).

2.3.2 TEMPERATURE: The area is warm and hot throughout the year with a slightly cool period in November. The mean annual temperature is about 26^{o} and 21^{0} are recorded in the coolest months (December to January). Temperature reach up to 31^{0} in the hottest months (April –may) (Olofin 1987)

2.4 SOIL: The soil of the study area is of the tropical ferruginous soils or Alfisols according to FAO/UNESCO soil taxonomy. These soils are developed under mean annual rainfall of 1000mm. These soils are highly weathered and markedly laterised by loss of silica. Majority of these soils were from the parent materials overlying quartz rich geological formations such as the crystalline rock of the basement complex (Harris, 2000). Though the precise character of the soils is dependent on factors such as topographical relation and anthropogenic modifications, a common feature of these soils is the downward movement of clay within the profile, a process which tend to produce a sandy surface soils, rather low in organic matter and base exchange capacity and compact subsoil where the clay has accumulated (Yakubu, 2002).

The colour ranges from dark grey to greyish brown in the top soil to yellowish red or yellowish brown in the subsoil. The soils are predominantly sandy and have a depth of 150cm. They are sticky and plastic when wet. Moist Sub soil is generally friable and loose but they may be partially firm if they have higher clay content. These soils tend to be slightly sticky and moderately plastic in lower horizons when dry (Kano State Ministry of Land and Survey, 2008).

2.5 VEGETATION AND AGRICULTURAL LAND USE

2.5.1 VEGETATION: The area can be described as a savannah type which comprises of scattered trees over an expense of grass land which is usually characterized by broad canopies that are hardly taller than 25m. Grasses hardly grow taller than 2m at maturity except in

favoured spots (Tanko, 2001). The vegetation consists of woody growth which varies with the anthropogenic modifications such as the intensity of cultivation. With exclusion of exotic species such as *Azadirachta indica* (Bedi) and *Eucalyptus camaldulensis* (Turare), the dominant indigenous tree species found in Gwarzo area include *Faidherbia albida* (Gawo), *Parkia biglobosa* (Dorawa), Adansonia *digitata* (kuka), *Tamarindus* indica (Tsamiya), *Khaya Senegalensis (*Madaci), *Diosphyros mespiliformis* (Kanya), *Acacia nilotica* (Bagaruwa). The common fruit trees found on the area include *Magnifera indica* (Mangwaro),A*narcadium accidantale* (Shazawa). The common grasses and shrub species include: *Moringa Oleifera* (Zogale), *Cassia tari* (Tafasa), *Ziziphus mauritiana* (Magarya), *Calotropis procera* (Tumfafiya), *Annona senegalensis* (Gwandar Daji) etc.

The trees characteristically grow long tap roots, broad canopies and thick barks that make it possible for them to withstand the long dry season and bush fires.

2.5.2 AGRICULTURAL LANDUSE: Agricultural land use is characterized by smallholder cultivation. The cultivation comprises of wet and dry cultivation or season, where crops like maize (zea mays), sorghum (sorghum bicolar), cotton (gossypium hirsatum), cowpea (vigna anguiculata), rice (orizo sativa), and soya bean e t c. are cultivated in the wet season and are managed in small and widely scattered farm plots. Dry season crops includes, wheat, tomato, pepper, sugar cane, onion e t c. Livestock management is also a common practice in the area , which possesses a large livestock population mainly made up of cattle, sheep and goat. Aside farming, livestock keeping is the second most important agricultural activity within the study area. Traditionally, Fulani herdsmen either settled or semi normadic undergo seasonal movements to the south at the beginning of every dry season and move back trekking along paths (Burtali) with the arrival of the rains. It is important to state that encroachment into these paths is now leading to conflicts between farmers and herdsmen.

The source of energy in the study area is only fuel wood. Besides Energy sources, trading of the products provide an alternative or supplementary source of income for the many households in the study area. Excessive fuel wood exploitation is putting greater pressure on woodland resources. Tree species like *Anogeicarpus* (Marke) and *Khaya senegalensis* due to increasing demand are Fast disappearing (Musa,1994). Human activities have greatly impacted on the environment; this results to land degradation through soil erosion and excessive cultivation.

2.6 ECONOMIC ACTIVITIES: The economic activities of the area include farming, blacksmithing, local wood and calabash curving, weaving, carpentry, fishery, trading among others. The primary activity of the area is farming, but also the presence of other infrastructures such as higher institution i.e School of Environmental Studies, Banks, Companies, Shops e.t.c. The Gwarzo, Getso and Garo markets attracts many people were sales of local commodities particularly farm products and animal products. The area consist s of tribes such as Hausa and Fulani.

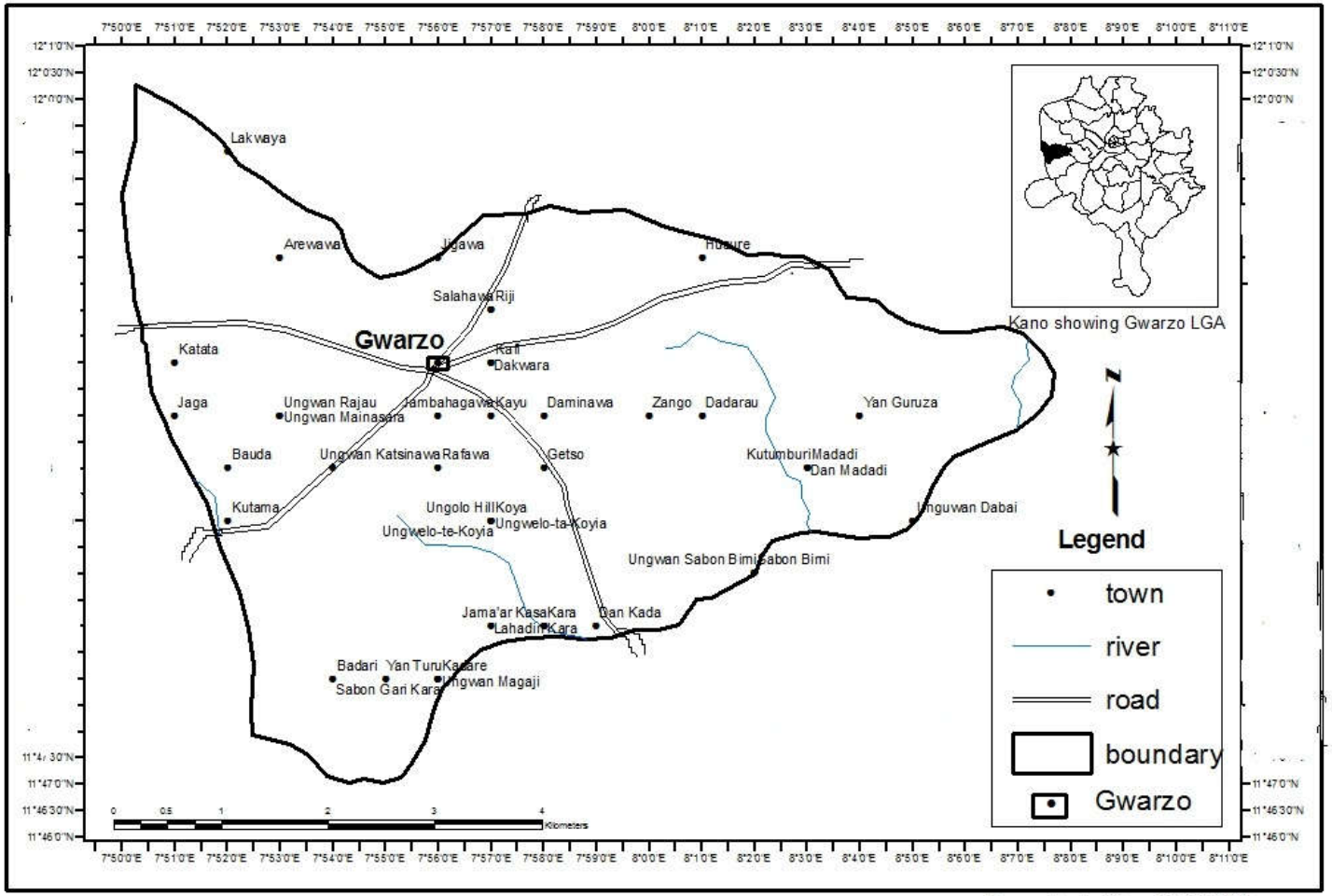

FIGURE1.1: MAP SHOWING THE STUDY AREA (GWARZO LOCAL GOVERNMENT AREA).

3.0 CHAPTER THREE

RESEARCH METHODOLOGY.

3.1 TYPES OF DATA REQUIRED: The data types required for the success of these work are of three types: (i) data on types of agroforestry practices practiced, (ii) data on diversity of trees species and (iii) data on the factors that affect agroforestry practices in the area.

Practically, determination of tree diversity on the field is somewhat a straight forward exercise which involves the identification of trees types and enumeration of their numbers directly in the field. Determining the type of agroforestry practices that is carried out and the factors that are affecting the practices was by identification of farming systems and factors affecting them.

3.2 SOURCES OF DATA

The data required are mainly obtained from the field by measurements, direct identification and interviews with the farmers. A checklist was prepared which was used for the interview with the farmers in their villages. Interviews were conducted on a one basis and on a group of 5 farmers that were met in the farms/insitu. The assistance of two extension agents was employed.

3.2.1 Field Survey: A reconnaissance survey was carried out in other to familiarise the researcher with the area and the farming community in the area that practice agroforestry and to obtain a synoptic view of the vegetation resources in the area. Visits were made to the village head, Sarkin Noma and other selected local people considered competent enough to provide information on the tree species type in the area.

3.3 SECONDARY DATA: the secondary data used for this research were obtained from textbooks, journals, EBook's and publications of Kano State Ministry of Agriculture, Kano State Ministry of Environment Forestry Department, Kano State Afforestation Project Office (KNAP), Kano State Agricultural and Rural Development (KNARDA), publications such as bulletins, annual reports, project manuals were all used which are all relevant to agroforestry practices. Other information were obtained from Gwarzo Local Government Area

3.4 POPULATION: The study population covers the entire farming population of Gwarzo Local Government Area with at least a unit of farmland.

3.5 SAMPLING PROCEDURE

3.5.1 SAMPLING FRAME: A list of agroforestry farmers in Gwarzo Local Government Area was used as sampling frame which was provided by the Kano State Afforestation Project unit (KNAP). The list consists of names and location of farmers that do practice agroforestry in the study area with at least a unit of farmland.

3.5.2 SAMPLING TECHNIQUE: Simple random sampling was used. 5 farmers were selected randomly from the 10 selected villages making a total number of 50 farmers and the checklist was administered to the farmers met insitu (in their villages). The villages are Badumawa, Lakwaya, Riji, Nassarawa, Mainika, Getso, Dakwara, Koya, Karkari and Salahawa which were used as the representative of the study area. The farmers were selected from the villages listed above because Kano State Afforestation Project Unit gave preference to those villages using the Agroforestry contact farmers' medium. Also an interview schedule was carried among 5 farmers in Badumawa village.

3.6 MEASUREMENT OF VARIABLES

(i) Number of tree species: The tree species were identified physically on the field through an inventory.

(ii) Nitrogen fixing species: These trees were identified on the field with their local names. The botanical names were later identified from text books.

3.7 DATA ANALYSIS: The data obtained from the field was subjected to statistics. From the various identifications, checklist administration and interview schedule carried out, computations were made.

4.0 CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.0 RESULTS AND DISCUSSIONS:

This chapter presents the finding /results of the interview schedule and the checklist administered to the farmers including all the observations/investigation conducted in the field. Tables are used to summarise findings of the various data collection exercise conducted.

4.1 TYPES OF AGROFORESTRY PRACTICES.

In view of the research findings, nine (9) different types of agroforestry technologies are carried out in the study area which is presented in Table 4.1 below, it is revealed that most farmers (respondents) choose different agroforestry practices depending on their needs and the output to be gotten from the investment. Most of the farmers are after the agroforestry practice that its output is in monetary terms e.g. fruits which would be sold in markets and fuel wood production. As it is revealed that almost all the respondents in the 10 villages are practising the fuelwood production, parkland and live hedges. Local nurseries are found in Badumawa, riji, mainika and dakwara in their farmlands which are all source of income to the individual farmers but as opined by the farmers it consumes time and money.

TABLE 4.1 AGROFORESTRY TECHNOLOGIES BEING PRACTICED

Agroforestry practices	Parkland		Orchard		shelterbelt		Fuelwood prdtn		Live hedges		nurseries		Tress on rangeland		Home garden	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Badumawa	3	60	3	60	-	0	1	20	3	60	1	20	-	0	1	20
Lakwaya	2	40	1	20	1	20	2	40	2	40	1	20	-	0	-	0
Riji	1	20	-	0	1	20	1	20	1	20	2	40	-	0	-	0
Nassarawa	2	40	-	0	-	0	1	20	2	40	-	0	-	0	-	0
Mainika	-	0	-	0	1	20	1	20	1	20	1	20	1	20	-	0
Getso	1	20	-	0	-	0	1	20	2	40	-	0	-	0	1	20
Dakwara	2	40	1	20	1	20	1	20	2	40	1	20	1	0	2	40
Koya	2	40	-	0	-	0	2	40	2	40	-	0	-	0	-	0
Karkari	1	20	-	0	-	0	1	20	1	20	-	0	-	0	-	0
Salahawa	1	20	-	0	1	20	1	20	2	40	-	0	-	0	1	20

Source: Field Work 2012.

4.1.1 PARKLAND: This is the most common practice in the area, where trees especially the exotic species are planted in farmlands. They are used as source of income (i.e fruits and firewood) to the farmers. Trees such as Azadirachta indica (Bedi), Magnifera indica

(mango) were found on farmlands.

Plate 4.1: Farmed Parkland with *Azadirachta Indica* in Dakwara village.(Dated 10th May, 2012).

These agroforestry practice is very useful to the soil and to the farmer, (multiple products) it provides fodder, fuel wood, medicinal products and at the same time prevents the soil form agents of erosion and it also serves as windbreakers.

4.1.2 BOUNDARY PLANTING/LIVE HEDGES: Live hedges were found in some farmlands were dense hedges or thickets of shrub are used around farm boundaries. Live fence are used in some farmlands to divide the farmlands into portions.

Plate 4.2: Boundary Planting/Live Hedges in Lakwaya. (Dated 10th may 2012).

Live hedges in the study area serves as property markers and also helps in storing water in the farmland i.e prevents water from moving down to the nearest stream. In other way it helps prevents erosion. It is also used in the area to divide the farmland in to portions for mixed cropping and cultivation of other economic trees such as *Moringa Oleifera, jetropha* because of the excessive campaign for its use as food, medicinal, water purification among other things by the extension workers of the forestry units of various government agencies. It is also a species that studies indicated that it is very rich in Ascorbic acid (Vitamin C) in addition to other nutritional value (Agroforestry Today, volume 8 no 3 of 1996).

4.1.3 SHELTERBELTS/WIND BREAKERS: Shelterbelt was found in the study area. A shelterbelt is a strip of planted trees across the direction of prevailing wind. It consists of several parallel rows of tree species Eucalyptus camaldulensis (Turare). These trees are planted near a dam to prevent sedimentation and at the same time prevent the soil from blowing away around the base of the trees; also *Eucalyptus camaldulensis* is planted in the area because it helps in salination. The shelterbelt is a State Government project which was constructed at the time the dam was constructed during Gov. Audu Bako regime (1967). Also farmers plant some trees species in their farmlands to serve as wind breaker e.g *Azadirachta indica (dalbejiya).*

Trees species such as *Eucalyptus cameldulensis* are not favoured on boosting crop yield (Young, 1989), because of its large uptake of water, thereby impacting negatively on adjacent crop yield conversely, *Eucalyptus camaldulensis* has been employed to lower water table and so reduce salination. The binding effects of tree roots help curb menace of escalated erosion which could be in form of sheet erosion as a result of non-concentrated runoff which removes topsoil substantially (Jeje1987). This ultimately leads to loss of productivity of farmland.

Plate 4.3: shelterbelt/windbreakers of *Eucalyptus cameldulensis* species in Santar Boka Lakwaya. (Dated 10th may, 2012).

The wind breakers are very important and are planted in the right environment (i.e it is located beside a Dam) because it will reduce the level of sedimentation in the dam, reduces salination and at the same time serves as a wind breaker to the surrounding farmland. Some farmers plant some trees in their farmlands in the study area to serve as windbreakers. The general effects of windbreaks on crop production (increased and sustained yields) and soils (increased organic content and nutrients) are well documented (Hintz and Brandle 1986). The windbreak protects crops directly by shielding them against the scouring and drying effect of wind and indirectly by preventing erosion. In addition, soils under the tree canopy are enriched by micro organic life that thrives in the shade of the tree canopy and by the nutrients that are added to the soil as the fallen tree leaves decay. Where leguminous species are used for the windbreak, the nitrogen fixed by the tree roots further enriches the soil. Although frequently used in many countries, windbreaks are rare in the Sahel (Hagen l987). A common belief is that the dry and arid conditions of the region and the existing land and tenure systems make it difficult to grow trees as shelterbelts. However, experiments in several countries have demonstrated that windbreaks can indeed be established in the region, and at relatively low cost.

4.1.4 Nurseries: A nursery was found in the study area. It is a place where plant propagation is carried out. They are grown there and taken care of until they reach to usable size, then they are transferred.

Plate 4.4: a nursery with *Jethropha and Eucalyptus (bini da zugu)* species in (Santar Boka), Lakwaya (Dated 10th May,2012).

A nursery was seen under the supervision of the Federal ministry of Environment Ecological Funds Office. The study revealed that the nurseries are not well managed; most of the trees are over grown and are not transferred or sold, also the trees species grown are the exotic species leaving the indigenous species, which are experiencing genetic erosion; which are more important to the farmlands because they help in soil conservation (i.e through nitrogen fixation). Trees species found in the nursery include *Eucalyptus Cameldulensis (turare), Jethropha (bini da zugu), Azachithra Indica (Bedi).*

Plate 4.5: A Local Nursery in a Farmland (*moringa olfeira*) at Badumawa.(Dated 10th may, 2010).

Local nurseries were found in the area understudy were trees species like *Moringa oleifera* were grown locally by farmers in their farmlands. From the respondent's reaction, assistance in terms of technical services was gotten from government for private nursery to be raised in various farm sites. They opined that, the private nursery save a lot of resources and at the end, the cost of production was reduced significantly.

4.1.5 Fuel wood production: Trees are planted around settlements and agricultural land which are planted purposely for fire wood and such trees species grow fast such as *Azadirachta Indica (Bedi).*the most interesting thing here is that about 60% of the respondent do practice AF for fuel wood production. They fell the trees they planted but

purposely for that reason (i.e fire wood). At least they have knowledge of the value of such trees species and that is why they planted against. But it is alarming because felling down of trees for firewood is rampant in the area. Discussions were carried out with the respondents and they keep on emphasizing that it is the cheapest and affordable source of energy.

A study was carried out by Ado 2008, he compared the usage and cost of cooking energy in 3 local government areas in Kano state, it came out that Firewood is preferred to Gas, Kerosene and Electricity as energy, simply because of the costs of investments (appliance) and then the subsequent management cost.

4.1.6 Trees on pastures/Rangelands: here, trees are planted irregularly on rangelands (i.e were animals are reared). Most of which provide fodder and shade to the animals and in some cases protection. Example of such species includes Parkia biglobosa (Dorawa). This species also helps in soil conservation.

Plate 4.6: Trees on pastures/Rangelands in Dakwara.(Dated 10th may, 2012).

4.1.7 Multipurpose trees on cropland: Among the selected farmlands, five (5) farmlands planted some multipurpose trees on their farmlands under the supervision of KNARDA.

These trees were planted in a systematic pattern and consist of trees species such as: Mango, Guava, Lemon and Sugarcane together with food crops in the rainy season such as Rice, Maize, millet and Sorghum.

Plate 4.7: Multipurpose trees (*magnifera indica species*) on cropland in Badumawa (Dated 10th may, 2012).

Plate 4.8: Multipurpose trees (Guava) on cropland in Badumawa. (Dated 10th may, 2012).

This system consists of a mixture of tree plantations of conventional forest species and other commercial perennial tree crops, especially tree species, lending a managed mixed forest appearance. As opposed to home gardens which surround individual houses, these tree gardens are usually away from houses, and are typically found on communally-owned lands surrounding villages with dense clusters of houses, as in Indonesia (Java and Sumatra).The multispecies, multilayer dense plant associations are with no organized planting arrangements. The major group of components are different woody components of varying forms and growth habits. Herbaceous plants are usually absent; but the shade-tolerant ones are sometimes present. This agroforestry practice is adaptable to areas with fertile soils, with good availability of labour, and high human population pressure.

Plate 4.9: multipurpose trees (Lemon and Sugarcane) on cropland in Badumawa.(Dated 10th may 2012).

Fruits trees were planted in croplands such as Mango, Guava, Lemon, sugarcane.

4.1.8 Home gardens involving Animals: this is mostly practiced by women at home. Vegetable, fruits and few crops are planted together with animal rearing. Most of the crops are shade tolerant. It provides products such as fruits, vegetables such as spinach (alayyahu), tomato, pepper and crops to the farmer. It also serves as soil surface protection.

4.1.9 Improved Fallow: improved fallow is practiced by some farmers were some farmlands are left to fallow for some years, till it regains its fertility. In this practice, they cut and burn relatively small forest plots and produces crops in the burned-over, taking advantage of the nutrients in the ashes of the burnt plants. After 2-3 years, the nutrients are depleted and weeds become a problem; so the farmers abandoned the plots for 10-20 years, permitting the re-growth of forest species. They move on to another forested plot, which they slash and-burn and then crop for 2-3 years before this plot is abandoned as before. A farmer may shift in turn to 5-10 such small plots before returning to clear and burn trees in the first one that was idled (fallowed) 10-20 years previously. The steps are then repeated until another cycle is completed. This agricultural system is termed ‘shifting cultivation’, indicating the moving from one plot to another, or ‘slash-and-burn referring to the means of destroying the forest lands. Over a long period of time, as population pressure has steadily increased; fallow periods have become shorter and shorter. Consequently, farmers have returned to abandoned fields before they have had enough time for fertility to be sufficiently restored. Today’s shorter fallow period is one of the reasons for a decline in per capital food production in Africa during the past decade. Most of the countries in Africa are faced with the problems of food and fodder shortage, degradation of non-renewable resources, and decreasing access to fuel wood supplies.

TABLE 4.2: *INVENTORY OF TREE SPECIES FOUND IN THE SELECTED FARMLANDS.*

Botanical names	Local names	Location									
		BDM	LKY	RIJ	NSR	MNK	GTS	DKR	KOY	KKR	SLH
Anogessium leocarpus	*Marke*			✓		✓					✓
Faidherbia albida	*Gawo*	✓		✓		✓	✓	✓		✓	
Parkia biglobosa	*Dorawa*		✓		✓		✓	✓	✓		✓
Tamarindus indica	*Tsamiya*	✓			✓			✓			✓
Azadirachata indica	*Dalbejiya*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Diosphyros mesipiliformis	*Kanya*		✓		✓		✓		✓	✓	
Eucalyptus cameldulensis	*Turare*		✓								
Magnifera indica	*Mangwaro*	✓	✓					✓			
P.guajava	*gwaiba*	✓	✓				✓	✓			

Citrulus aurantum	*Lemon tsami*	✓					✓	✓			
Acacia sisso	*Dakwara*				✓			✓			✓
Ziziphus Mauritania	*Magarya*		✓		✓			✓			
Ficus platyphalla	*Gamji*	✓		✓	✓	✓					
Vitellaria paradox	*Kadanya*			✓		✓			✓		
Piliostigma reticulatum	*Kalgo*		✓			✓			✓		
Ficus thonningii	*Chediya*	✓									
Adansonia digitata	*Kuka*	✓		✓		✓	✓				✓
Acacia nilotica	*Bagaruwa*								✓		
Saccharum officinarum	*Rake*	✓	✓								
Anarcadium occidentals	*yazawa*							✓			

SOURCE: FIELD WORK 2012.

KEY:BDM:Badumawa, LKY:Lakwaya, RIJ:Riji, NSR:Nassarawa, MNK:Mainika, GTS:Getso, DKR:Dakwara, KOY:Koya, KKR:Karkari, SLH:Salahawa.

4.2 AVAILABILITY OF NITROGEN FIXING SPECIES.

There are only three (3) species of nitrogen fixing trees in the selected farmlands which are:

1. *Faidherbia Albida (gawo);*

2. *Acacia Nilotica (Bagaruwa*) and

3. *Parkia Biglobosa (Dorawa).*

And also, *Faidherbia Albida* constitutes about 50% of the Nitrogen fixing trees in the study area. The Interview schedule conducted with the farmers shows us that the farmers are fairly aware of the importance of trees on their farmland and it helps in the maintaining an increase in crop output but are not aware that Nitrogen fixing trees helps in maintaining a relative increase in crop yield. The exceptional role of *Faidherbia Albida* tree species in promoting higher crop yield has been discussed by (Kho et al 2001;Ajayi, 2008), observed that increases in Maize (*zea mays*) and Guinea corn(*sorghum bicolor*) by at least 50% close to the trees canopy. *Faidherbia Albida (gawo)* promotes enhancement of soil fertility through Nitrogen fixation and increases Phosphorous availability and also enhances water holding capacity of soil.

Nitrogen fixing trees are major components of Agroforestry systems. These nitrogen fixing trees provides many things to agroforestry such as: fibre, wood provision, shade, fruits, animal fodder and increased soil moisture through the condensation of mist on leaves. At the same time they enrich the soil with nitrogen fixation by root nodule forming bacterial symbiosis. The fixed nitrogen is released to the soil by decomposition of nitrogen rich tree litter and sloughed roots. It has nutritious and palatable leaves and pods. It produce pods during the hot dry season when fodder from grass and other shallow-rooted plants is insufficient for livestock. In addition, unconsumed leaves and pods are left to decompose in

the fields and enrich top soils with organic matter and nutrients. In contrast to other tree species, faidherbia albida trees shed their leaves just before the annual rainy season, when the crops are grown. Therefore, their canopies do not compete with crops for light. Thus, intercropping with faidherbia albida provides many benefits within the farming system. During the dry season, the trees provide livestock with shade, and the animals feed on the leaves and pods of the trees. The top soils under the tree canopy are enriched by the organic matter contained in the fallen leaves, animal droppings, and nitrogen fixed by the tree roots. (Birds that use the trees to roost also contribute droppings to the soil.) As the rainy season begins, the trees stop growing, becoming practically dormant throughout the period when crops thrive on the enriched soils under the leafless canopy of the trees. In short, the trees provide the farmer with a reliable and cheap source of fertilizer and fodder. The process is similar to that of the common herbaceous agricultural legumes capable of symbiotic nitrogen fixation; *Faidherbia Albida* is a leguminous nitrogen fixing tree, widely distributed in Africa. The tree occurs throughout the Sahelian and Sudanese zone of West Africa, with annual rainfall ranges between 500 and 1500mm. it is found in eastern and southern Africa (Baffa 1999). The tree produces wood, medicine, animal fodder and edible fruits. It sheds its leaves during rainy season and retains it in the dry season (Wickens, 1969).this phenology is ideal for agro forestry because it minimizes competition with associate crops for light nutrients and water.(Payne et al, 1998).

Plate 4.10: *Faidherbia Albida* trees (nitrogen fixing tree species) on farmlands in Dakwara (Dated 10th may, 2012).

4.2.2 Acacia Nilotica:

Acacia nilotica is a multipurpose nitrogen fixing tree legume naturally widespread in the drier areas of Africa, from Senegal to Egypt and down to South Africa, and in Asia from Arabia eastward to India, Burma and Sri Lanka. Acacia Nilotica belongs to the Leguminosea family and Mimosoideae as the sub family. It grows to 15-18m in height and 2-3m in diameter. It mostly occurs as an isolated tree and rarely found in patches to a limited extent in forest. *Acacias* are established as very important economic plants since early times as source of tannins, gums, timber, fuel and fodder. They have significant pharmacological and toxicological effects In Africa and the Indian subcontinent; *Acacia nilotica* is extensively used as a browse, timber and firewood species (Gupta 1970, Mahgoub 1979, New 1980). The

bark and seeds are used as a source of tannins (Shetty 1979, New 1980) the species is also used for medicinal purposes. Bark of *Acacia nilotica* has been used for treating hemorrhages, colds, diarrhoea tuberculosis and leprosy while the roots have been used as an aphrodisiac and the flowers for treating syphilis lesions (New 1980). The gum of *Acacia nilotica* is sometimes used as a substitute for gum Arabic (obtained from *Acacia senegal*) although the quality is inferior (Gupta 1970). Indian Gum is sweeter in taste than that of the other varieties and is used in paints and medicine. The species is suitable for the production of paper and has similar pulping properties to a range of other tropical timbers (Nasroun 1979). The dark brown wood is strong, durable, nearly twice as hard as teak, very shock resistant and is used for construction, tool handles and carts. It has a high calorific value of 4950 kcal/kg, making excellent fuel wood and quality charcoal. It burns slow with little smoke when dry. It has a25% more shock resisting ability than teak.

It was reported that *Acacia nilotica* improves soil fertility under its canopy by reducing proportion of sand with simultaneous increase in clay particles, mainly due to protection of soil from the impact of raindrops. Higher nutrient concentration under canopy compared to canopy gap. It is mainly a consequence of increased above and belowground organic matter input, nutrient cycling through leaf litter and protection of soil from erosion (Pandey et al.2000, Nair 1993 Palm 1995).The decrease in nutrient concentration towards the canopy edge compared to mid canopy position is mainly due to relatively low inputs of leaf litter as the canopy of *Acacia nilotica* is thin towards canopy edge (Pandey et al 1999).

Acacia. nilotica is reported to be well nodulated with *Rhizobium* species (Dreyfus and Dommergues1981).This nodulation behaviour help in biological nitrogen fixation which help to meet the nitrogen requirement in nutrient-poor soils. In addition, this species form symbiotic associations with naturally occurring soil fungi called vesicular arbuscular mycorrhizae (VAM) (Kaushik and Mandal 2005). This association assists the roots to exploit

more soil volume and to gain improved access to available nutrients especially phosphorus under stress and also makes the unavailable forms of nutrients into utilizable forms (Bowen 1973).

In the Central plain of Indian subcontinent *Acacia nilotica* grow naturally in the agricultural fields and forms an important agroforestry system (Pandey et al. 1999). It was reported that *Acacia nilotica* generally reduced crop yield under its canopy and this reduction varies with distance from the tree trunk (Pandey et al. 1999, Bargali et al.2004). In an experiment Bargali et al (2004) reported that gram yield increased with increasing the distance from the tree trunk and decreased with increasing the age of the tree. In the Mitchell grasslands of northwest Queensland Australia, *Acacia nilotica* suppresses pasture production by 50% at 25-30% tree canopy cover or 2 m2 basal area per hectare. It dramatically alters the ecological balance of grasslands and thereby threatens biodiversity. Pandey and Sharma (2005) reported that crop production depend upon distance from tree trunk and tree canopy size. Reduction in grain yield was maximum (30%) under the large tree canopy and lowest (12%) under the small tree canopy due to decreased availability of light by 44 to 62% under the canopy that resulted in slow photosynthetic rates and growth (Pandey et al.2000). Pandey et al (1999) suggested that the gradient of the incident light was the principal factor governing the gradient of grass biomass under developing canopies of all tree plantations. However, when the tree is felled after the completion of rotation cycle (>12 years) grain yield increased 126% for the first cropping season and 30 % for the fifth cropping season at 1 m distance from the tree stump and declined with distance (Pandey and Sharma 2005). These results suggest that the crop may exploit the greater amount of nutrients to increase productivity, if the tree canopy is open to facilitate greater light availability.

Acacia Nilotica (bagaruwa) was among the nitrogen fixing trees found in the farmlands understudy but are not much in number. It increases productivity among crops grown around young acacia Nilotica.

4.2.3) *Parkia Biglobosa (Dorawa): Parkia biglobosa* belongs to the Leguminosae family and Mimosoideae sub family. It is a perennial, deciduous tree reaching 7-20m in height. The crown or canopy is large and wide spreading with low branches on a stout bole. Its fruit is or seedpod is most widely used and economically important part of the pod. The pods when young are green, fleshy and pliable and are sometimes eaten by humans after roasting (Daddawa). Parkia biglobosa has a wide distribution ranging across the Sudan and Guinea savannah ecological zones. The tree and its products are very important for rural communities and villages. The traditional uses of *parkia biglobosa* can be defined as Non Timber Forest Products which includes wood energy (fuel wood and charcoal), food, medicine, glazes, animal fodder, soil amendments, dying and curing of leather. The tannins in the bark and husk of pod of parkia biglobosa are used in dyeing and curing of leather (Camphell-platt 1980). Sabitti and Cobbina (1992) investigated parkia biglobosa and compared the nutritional value to the other savannah species and found the leaves had a high amount of crude protein and high energy level.

Parkia biglobosa has broad umbrella shaped canopy and retention of the leaves through the dry season offers shade in a hot and harsh climate. The livestock escape the heat by standing in the shade. Cattles and goats urinate and defecate under the trees enriching the soil. Leaf fall also contributes adding organic matter to the soil. Other non timber forest products derived from parkia biglobosa are fish poisons, a source of fiber, soap making and indigo dyeing (Campbell-Platt 1980). In small low flow Rate Rivers or streams a small section can be dammed and crushed, pods are added to the water. The stunned fish are harvested and with no adverse effect to humans consuming the fish. Also the strong fibres on

the pods are used to attach arrow heads to the shaft weaving nets for fish, strings for musical instruments and basket weaving. The wood ash resulting from burning *parkia biglobosa* is used both for soap making and for dyeing the traditional indigo cloth (Hall et al 1997).

4.3 PROBLEMS OF AGROFORESTRY PRACTICES IN THE STUDY AREA.

Many prevailing factors affect or hinder agroforestry practices in the area some of them are: poverty, shortage of water supply.

TABLE 4.3: FACTORS THAT HINDERS AGROFORESTRY PRACTICES IN THE STUDY AREA.

Problems of Agroforestry			Areas									
	BDM	LKY	RIJ	NSR	MNK	GTS	DKR	KOY	KKR	SLH	TOT	%
Poverty	1	2	1	1	1	3	1	2	1	3	16	32
Low knowledge of the practice	1	1	1	1	2	2	2	1	1	3	15	29
Poor seeds	2	-	1	2	1	3	1	-	-	-	10	20
Short supply of seeds	1	2	-	3	-	1	1	1	1	1	11	22
Short supply of water after rainy season	-	-	1	3	1	3	1	2	2	-	13	26
TOTAL	5	5	4	10	5	12	6	6	5	7	65	

SOURCE: FIELD WORK 2012.

From Table 4.3 above, it can be seen that poverty and low knowledge of the practice affects Agroforestry practices in the study about 32 and 29% of the respondents are of

such opinion respectively, almost all the respondents in the 10 villages opined that it hinders agroforestry practices in the area.

CASE STUDY: During the course of the study, a farmer (respondent) Mal Muhammadu whose farm was among the selected farmlands in badumawa village, said: (Na sayarda bishiyar gawo akan kudi naira dubu uku bara) that he sold a *Faidherbia albida (gawo)* tree at the cost of #3000. It can be seen clearly that poverty affects agroforestry in the area; the farmer also does not have the knowledge of the importance of such tree (*ie Faidherbia albida*) on his farmland. The respondent was emphasizing that money of the *faidherbia albida* tree was used for domestic activities. Also, Poor seeds and shortage supply of seeds affects agroforestry. Most of the seeds supplied by the government are in small quantity and sometimes not of good quality. Some seeds are purchased by the farmers from the market. Shortage of water after the rainy season affects agroforestry more especially for those that practice the multipurpose trees on cropland. The fruit trees production declines due to shortage of water.

4.4 ATTITUDE AND LEVEL OF KNOWLEDGE OF FARMERS ON AGROFORESTRY.

In assessing farmers' knowledge of agroforestry practices in Gwarzo local government area, from the interaction with farmers it can be said that the farmers have a positive perception on agroforestry; they agreed that agroforestry increases soil fertility and crop income. They agreed that the production of fodder and crops simultaneously increases income and reduces uncertainty risk in the house. The respondents were very much aware of the economic benefits of agroforestry and have a little perception of its environmental/conservation benefits to the soil.

Furthermore, in assessing the attitude of farmers on agroforestry in Gwarzo local government area, the study revealed that the farmers prefer tthe following practices: Multipurpose trees on cropland/orchards, fuelwood production, home gardening, parkland. The farmers prefer the above practices because of the benefits they derive from such practices and also such practices as revealed by the respondents do not consume much of their time, energy and money. They derive benefits such as: increase in income, provides fodder, fruits, vegetables, animals and source of energy. The study revealed that only a few of the respondents have local nurseries in their farmlands. The respondents opined that nurseries require extra care because it is a place where plants are propagated until they reach a usable size. Therefore, extra time and money is needed for such practice only 10% of the respondents have nurseries. The study reveals that some farmers do not like planting Faidherbia Albida tree, as opined by the respondents it is a tree that attracts animals and they don't want animals coming in to their farmlands because of their crops, this tells us that the farmers are not aware of the benefits that the animal droppings will add to the soil.

The respondents agreed strongly that agroforestry practices maintained and improve condition of farmlands. And also they disagree with the statement that agroforestry practices take a long time before farmers get an income from it.

Plate 11: The researcher conducting an interview with some farmers in Riji. (Dated 20 march, 2012).

It was revealed that the farmers have knowledge of the importance of trees on farmlands it provides shade in the farmland, reduces the rate of soil erosion, adds nutrients to the soil through its litters, use for boundary marking and also serves as source of energy i. e fuel wood. It also provides income in monetary terms and also fruits from the trees are sold in markets, it increases livelihood.

Plate 4.12: Checklist administered to women farmers in Nasarawa. (Dated 20th march, 2012).

Female farmers play an important role in boosting agroforestry as well as improving livelihood in the study area through vegetable farming such as tomatoes, onions, lettuce and little maize. Then livestock rearing of sheep's, goats and poultry such as chicken, ducks and fowls.

4.5 CONTRIBUTION OF AGROFORESTRY TO THE LIVELIHOOD OF THE INHABITANTS OF THE AREA.

TABLE 4.4: Contribution of agroforestry to the respondents

Types of contribution	Areas											
	BDM	LKY	RIJ	NSR	MNK	GTS	DKR	KYA	KKR	SLH	Total	%
Increase in crop yield (per yield)	5	5	3	3	2	2	3	-	3	3	29	58%
Increase in income	5	3	3	2	4	3	4	2	5	5	36	76%
Firewood availability	4	4	2	3	1	2	3	2	2	3	26	52%
Soil improvement	2	4	1	1	1	1	-	1	2	3	16	30%
Increased savings	2	1	-	-	-	1	1	-	1	-	06	14%
Significant food security	3	3	3	2	2	3	-	2	3	-	21	42%
Other benefits (specify).	4	5	2	3	3	-	-	-	-	5	22	44%

SOURCE: FIELD WORK 2012.

From Table 4.5 above, it is revealed that agroforestry has contributed towards the livelihood of the inhabitants of the area. About 58% of the respondent said that they have noticed an increase in their crop yield (increase in number of harvested bags/Dami), 76% are of the opinion that there is an increase in income as a result of agroforestry practices most of which are the farmers that practice Multipurpose trees on crop land, fruits of such trees are sold in markets to generate income. 52% of the respondents said that there is the availability of firewood due to the growing of trees in farmlands which are replaced after cutting down. Among the respondents, 30% are of the opinion that they have seen an improvement in the soil, 42% among the respondents are said that they have noticed a significant food security i.e the food they produce before does not usually reach the next year but now due to increase in crop yield the crop reaches the harvest period. Others include the increase in number of wives because there is an increase income and savings, were 44% of the respondents are of such opinion.

The inclusion of indigenous fruit trees (IFTs) on agricultural land in southern Africa has been highlighted by various authors (Ngulube et al. 2006; Kalaba et al. 2008) In Zambia, Kalaba et al. (2009) reported that rural households intentionally retain fruit trees on their fields, by leaving trees standing in agricultural land. In Malawi, Ngulube et al., (2006) highlighted the prevalence of cultural-religious restrictions governing the use and exploitation of indigenous fruit trees. For example, during woodland clearing prior to cultivation or settlement, important fruit trees such as *Parinari curatellifolia*, *Strychnos cocculoides*, are customarily left uncut and scattered around homesteads or crop fields. Pack ham (1993) has reported similar cases for Tanzania, Zambia and Zimbabwe where *Parinari curatellifolia* and *Uapaca kirkiana* are left deliberately in cultivated fields. The integration of IFTs in agricultural production systems has been reported to reduce the risks inherent to monocultures of staple food crops, such as susceptibility to pests and diseases, soil nutrient

depletion (Hughes and Haq, 2003). This also improves the landscape mosaic which ultimately reduces the risks of monocrops while increasing agro biodiversity in the landscape.

Rural communities in southern Africa are faced with high poverty levels. In Zambia, Kalaba et al. (2009) revealed that over 90% of rural households experience regular hunger periods during the rainy season between November and April. Similar findings have been reported for Malawi, Zambia and Mozambique (Akinnifesi et al., 2004). This implies that most households suffer from food insecurity, offering enough evidence of the high prevalence of rural poverty. Rural households are characterized by low literacy and lack inadequate skills and training, such as production and marketing skills. Given the profitability of agroforestry technologies (Franzel et al., 2002; Ajayi et al., 2007) and the impact that they have on households and the environment(Ajayi et al., 2004; Kwesiga et al., 2005), efforts are being made to scale up the adoption of the technology and enhance its acceptability among many more potential farmers who could benefit from the technology. Results of studies conducted in the southern African region show that farmers do appreciate agroforestry and its potential linkage to food security and household welfare indicators, but they face some challenges to the widespread uptake of agroforestry including land constraints, property rights and availability of seeds and knowledge-intensive nature of the technology.

Agroforestry promotes the social and economic needs of farmers in the area under study, it reduces poverty and deforestation, it enhances rural health, contributes to the conservation of the natural habitat; the practice of improved fallow replenishes the soil, parklands supplies indigenous fruits and supply of herbal medicine. Garrity 2004 said that 80% of the population utilise herbal medicine.

4.6 SIZE OF FARMLAND

TABLE 4.5: SIZES OF SELECTED FARMLANDS.

Sampled Villages	Below 1ha	1-2ha	2.1-3ha	3.1-4ha	4.1ha above	Total
Badumawa	3	1	-	1	-	5
Lakwaya	2	2	-	1	-	5
Riji	4	1	-	-	-	5
nassarawa	3	2	-	-	-	5
Mainika	2	2	1	-	-	5
Getso	2	1	2	-	-	5
Dakwara	2	-	-	2	1	5
Koya	2	2	1	-	-	5
Karkari	2	3	-	-	-	5
Salahawa	1	2	2	-	-	5
	23	16	06	04	01	50

SOURCE: FIELDWORK, 2012.

Sizes of farmlands varies from one another in the study area, it ranges from below 1ha to 4.1ha and above. It can be seen from the table above, twenty three (23) of the respondents farmlands fall below 1ha, here, and one has to be very careful with the land space before recommending any type of agro forestry technology to be adopted. It should be the type that would not consume much space and not compete with the arable crops.

Following this are farmlands with sizes 1-2ha and about 16 of our farmers have farmlands that fall to this category, they are of much advantage as they have more space and farmers can conveniently practice various aspect of agro forestry technologies.

About six (6) farmers have farmlands with sizes 2.1-3.0ha, the can practices different type of agro forestry technologies such as Boundary Planting. Others are 3.1-4.0ha and 4.1 and above ha which are few only four (04) and one (01) respectively the farmland of about 4.1ha is located in Dakwara which is an orchard that consist of Mango, guava, cashew and lemon trees. These farmers have vast farmlands and can practice different type of agroforestry technologies such as multipurpose trees on cropland e.t.c.

4.7 PORTION OF FARMLAND USED FOR AGROFORESTRY.

TABLE 4.6: PORTION OF FARMLANDS USED FOR AGROFORESTRY.

Sampled villages	Acreage										
	0.1-0.5a		0.6- 1.0a		1.1 - 1.5a		1.6 - 2.0a		2.1a above		Total
Badumawa	2		-		2		1		-		5
Lakwaya	1		2		1		1		-		5
Riji	3		2		-		-		-		5
Nassarawa	4		-		1		-		-		5
Mainika	3		1		1		-		-		5
Getso	5		-		-		-		-		5
Dakwara	1		2		1		1		-		5
Koya	3		1		1		-		-		5
Karkari	4		1		-		-		-		5
Salahawa	4		1		-		-		-		5
Total	30	60%	10	20%	07	14%	03	06%	00	00%	50

SOURCE: FIELD WORK, 2012.

In view of the Table above it can be said that only 06% of the farmers are practicing various agroforestry technologies as 1.6-2.0a of their farmlands is dedicated to agroforestry such farmlands are in Badumawa, Lakwaya and Dakwara. And about 60% of the farmers dedicated 0.1-0.5a of their farmlands to Agroforestry.

It can be said that all portions that were dedicated to agroforestry practices were performing well and are used as models by the extension officers from Kano State Afforestation Project Unit (KNAP) and KNARDA Kano Agricultural and Rural Development Authority.

4.8 INCREASE LAND PRODUCTIVITY

From the checklist administered Farmers were asked if they noticed an increase in productivity of their farmlands. Table 4.7 below shows us the farmers' responses.

TABLE 4.7: FARMERS EXPERIENCE ON INCREASE IN LAND PRODUCTIVITY.

Farmers experience	Do you realise	% Response	Do not realise	% Response
Reduce surface erosion	15	30%	35	70%
Increased farm yield	07	14%	43	86%
Increased land productivity	23	46%	27	54%
None of above	00	00%	50	100%
Others (specify)	05	10%	45	90%

SOURCE: FIELDWORK, 2012.

From Table 4.7 above, it can be seen that increase land productivity is seen clearly in different ways as opined by the farmers. About 46% of the farmers were saying that they

have notice an increase in land productivity while practicing agro forestry. About 30% of the farmers said the presences of trees in their farmlands have reduced the rate of soil erosion and 14% were of the opinion that it increases farm yield and 10% said that it increases in land productivity in other forms.

4.9 SOURCE OF SEEDS

Seedlings are very important for the success of any Afforestation project and they have to be readily available and from a good source.

Agro forestry farmers in Gwarzo local government are getting their seedlings from the following sources:

1. Government forestry nurseries-i.e under the Kano State Afforestation Project Unit (KNAP) and (KNARDA) Kano State Agricultural and Rural Development Authority.
2. Farmers local nurseries/raised their own seedlings
3. Other sources.

The interview and checklist administered has revealed that about 42% of the respondents get their seedlings from the Government nurseries, 28% of them get their seedlings from the market/seedling vendors.

From the farmers response, assistance from the government resource personnel's (especially KNARDA staffs) who provide technical services and advice helps them a lot as local nursery production is encouraged by them. They opined that private nursery saves a lot of resources and reduces the cost of production

Table 4.8: SOURCES OF SEEDLINGS

Sampled villages	Government nurseries		Private/local nurseries		Buy from the market		Other sources.		Total	
Badumawa	2		2		1		-		5	
Lakwaya	3		1		-		1		5	
Riji	2		-		2		2		5	
Nassarawa	1		1		1		1		5	
Mainika	1		1		-		-		5	
Getso	1		2		1		1		5	
Dakwara	3		1		1		-		5	
Koya	2		1		2		-		5	
Karkari	3		1		1		-		5	
Salahawa	3		-		2		-		5	
	21	42%	10	20%	14	28%	05	10%	50	

SOURCE: FIELDWORK, 2012.

4.10 TREE PLANTING AWARENESS

The idea for tree planting was adopted by the farmers under study through the following sources:

a. Extension officers in the area;
b. Advertisements (i.e radio and television advertisements for enlightment and awareness);
c. All Farmers Association Kano State Chapter (AFAN).
d. Through Village Head and Religious leaders.

4.11 GOVERNMENT INTERVENTION

The Federal and State government have carried out some projects on agroforestry in the area. The federal government in its contribution to agroforestry in the area, has two places as follows:

(i). A Nursery and

(ii) Natural Herbal Garden.

i. Nursery: the nursery is located in mainika, Gwarzo local government. The project was carried out by the federal ministry of environment, ecological funds office. It is created for the purpose of tree nurseries development and raising of seedlings. The nursery consists of few tree species most of which are the exotic ones with only *Moringa Olfeira* among the traditional species. The nursery is not well managed, the trees are over grown, some are not properly taken care of and only few species were seen.

ii. Natural Herbal Garden Project: it is located in Getso, Gwarzo local government. Created by the Ministry of Culture and Tourism. The garden is divided into two sections the Exotic species and Traditional species.

Plate 4.13: Exotic tree species (*Musa sepientum Ayaba*) in the Natural herbal garden in Getso town. (Dated 10th May 2012).

Various tree species are found in the garden as shown in the table below:

TABLE 4.9: INVENTORY OF TREE SPECIES FOUND IN NATURAL HERBAL GARDEN PROJECT IN GETSO.

S/N	BOTANICAL NAME	LOCAL NAME
1.	*Sterculia setigera*	*Kukkuki*
2.	*Clerodendrum capitatum*	*Masheyi*
3.	*Ficus capensis*	*Bera*
4.	*Calitropis procera*	*Tumfafiya*
5.	*Monstes kerstingii*	*Hantso*
6.	*Commophora Africana*	*Dashi*
7.	*Diospyros mespiliformis*	*Kanya*
8.	*Bombay costatum*	*Gurjiya*
9.	*Euphorbia balsemifara*	*Alyara*
10.	*Euphorbia poissonli*	*Tinya*
11.	*Acacia ataxacantha*	*Sarkakkiya*
12.	*Acacia seyel*	*Dushi*
13.	*Securinega virosa*	*Tsugwigwan*
14.	*Borasius aethiopum*	*Giginya*
15.	*Anona senegalensis*	*Gwandar daji*
16.	*Ficus glumosa*	*Kawari*
17.	*Eugenia uniflora*	*Fitanga*
18.	*Morus mesozygia*	*Tut*
19.	*Anarcardium occidentals*	*Yazawa*
20.	*Musa sepientum*	*Ayaba*

21.	*Citrulus auratum*	*Lemon tsami*
22.	*Magnifera indica*	*Mangwaro*
23.	*Psidium guajava*	*Gwaba*
24.	*Faidherbia albida*	*Gawo*
25.	*Parkia biglobosa*	*Dorawa*
26.	*Tamarindus indica*	*Tsamiya*
27.	*Vitellaria paradoxum*	*Kadanya*
28.	*Hyphaene thebaica*	*Goriba*
29.	*Phoenix dachylifera*	*Dabino*
30.	*Ficus plataphylla*	*Ganji*
31.	*Eucalyptus cameldulensis*	*Turare*
32.	*Balanite aegyptiaca*	*Aduwa*
33.	*Proposis Africana*	*Kirya*
34.	*Securidaca longependunculata*	*Uwar magunguna*
35.	*Launea acida*	*Faaru*
36.	*Anogeisus leocarpus*	*Marke*
37.	*Ceiba pentendra*	*Rimi*
38.	*Adansonia digitata*	*Kuka*
39.	*Azadirachata indica*	*Bedi*
40.	*Khaya senegalensis*	*Madaci*

SOURCE: FIELD WORK 2012.

The natural herbal garden too is not well managed as some trees dry up in the dry season due to lack of water and poor maintenance by the Local and Federal Government. Such as Lack of funds for proper maintenance.

4.11.1 STATE GOVERNMENT INTERVENTION.

The state government in its contribution to agro forestry has provided the farmers with materials such as seeds, plants, and other working materials under the supervision of KNARDA (Kano state agricultural and rural development), the programme is called the Poverty Alleviation scheme. Loans were given to farmers of materials such as seeds, water pumping machines, local wells were constructed in some selected farmlands, fruit trees were all given to the farmers and some resource personnel's assisted in planting and other advice on how to manage the farm most of them are people from KNARDA. These programme helped a lot in practicing agroforestry in the area and it helps economically (i.e in monetary terms) we can say it increases rural livelihood.

5.0 CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION.

INTRODUCTION

This chapter presents the summary and conclusion of the study, recommendations are also made on the process of improving Agroforestry practices, how to tackle the factors affecting it and possible ways of improving the practice i.e. improving the knowledge and awareness of Agroforestry in the study area.

5.1 SUMMARY

The study was carried out in other to assess the contribution of Agroforestry to the livelihood of the inhabitants of Gwarzo Local Government Area. In other to ascertain the aim of the study and the set objectives, certain methodologies were adopted ranging from a Reconnaissance survey, Literature review and Field Work which entailed Sampling from the population. A total of 50 farmers were selected from the 10 selected villages, interview schedule was carried out, a checklist was also administered to both male and female farmers 5 respondents from each village were selected using the Random sampling.

The results obtained in the course of the research showed that:

1. Different agroforestry practices are carried out in the area such as:
    i. Parkland;
    ii. Boundary planting/ live hedges;
    iii. Improved fallow;
    iv. Shelterbelts;
    v. Nurseries;
    vi. Fuel wood production;

vii. Multipurpose trees on cropland and

viii. Home gardens involving animals.

2. In all the selected farmlands, only 3 nitrogen fixing trees were found out of a total of 20 trees species inventoried in the area. They are: 1. *Faidherbia albida (gawo)* 2. *Parkia biglobosa (dorawa)* 3. *acacia nilotica (bagaruwa).*
3. Factors that hinder agroforestry practices in the area are: poverty, poor seeds, low knowledge of the practice, short supply of seed and shortage of water supply after rainy season.
4. It can be said that the farmers are fairly aware of the fact that trees on farmlands are very essential in making them maintain a relative increase in crop output.
5. It can be said that agroforestry has contributed to the livelihood of the inhabitants of the area.
6. The government intervention projects are good as it improves living standard but are directed towards the monetary benefits not on soil conservation.

5.2 CONCLUSION

The results obtained in this study are supportive of the following conclusions.

There are different types of agroforestry practices in the study area. Such as the multipurpose trees on cropland, boundary planting/live hedges, parklands, shelterbelts etc. It is also revealed that Faidherbia albida, parkia biglobosa and acacia nicolita are the dominant nitrogen fixing trees found in the selected farmlands in the study area.

The study also tells us that the farmers have a fair knowledge and awareness of Agroforestry as a whole and also there are some factors that hinders agro forestry practices in the area.

5.3 RECOMMENDATION

In view of the conclusion reached in this study, the following recommendations should be considered:

1. There is need for agroforestry to be part of the integrated rural programme so as to achieve an effective improvement in the living standard of the rural inhabitants..
2. Local farmers should be involved in land use planning by sharing their knowledge of traditional farming practices and contributing it to the protection and restoration of natural habitats.
3. The local farmers have been known to have effective resource management to some extent. In this respect, incentives should be initiated to make farmers plant and maintain trees diversity on farmlands.
4. Government projects should emphasize on conservation rather than only the monetary benefits.
5. Government, NGOS, and communities should encourage the planting of indigenous trees species rather than the exotic species only and also continues researches should be encouraged.

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QUESTIONNAIRE

DEPARTMENT OF GEOGRAPHY

BAYERO UNIVERSITY KANO.

AN ASSESSMENT OF AGROFORESTRY PRACTICES IN GWARZO LOCAL GOVERNMENT AREA, KANO.

DEAR SIR/MA,

This questionnaire is purely designed for academic purpose. It is a research on the above topic, which constitute part of the requirement for the award of a Master s Degree in Land Resources (M.Sc Land Resources). Kindly assist me with maximum cooperation by completing this questionnaire, which will serve as your contribution towards the success of this project.

QUESTIONNAIRE

BIODATA

1.Age of respondent:-------

2.Sex a. male:----------

b. female:----------

3. No of children:----------

4. No of wives:----------

5. Educational qualification:

SEED-PRODUCTION

6. From where do you get your seeds?

a. we raise them ourselves

b. from the government

c. we buy from the market

d. others, state source ;----------

7. If the seeds are sourced from the Government,do you buy it from the government or is it given free by the government?

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8. Are the seeds of good quality?

DEVELOPMENT OF AGROFORESTRY

9.How do you own your farm?

a. mine

b. rent

c. heritage

d. mortgage

10. What is your farm size?

a. Below 1 ha

b. 1- 2.0 ha

c. 2.1-3.0ha

d. 3.1- 4.0ha

e. 4.1 and above ha

11. What portion of the farm is used for agro forestry?

a. 0.1-0.5a

b. 0.6- 1.0a

c. 1.1 – 1.5a

d. 1.6 – 2.0a

e. 2.1a and above

12. What type of agro forestry practices do you acquire?

a. fuel wood production

b. home gardening

c. multipurpose trees on cropland

d. riparian buffers

e. wind breakers

f. alley cropping

g. boundary planting

h. scattered trees in farmlands

13. what type of agroforestry technologies do you prefer?

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14. why do you prefer them?

---

15. why don't you prefer the ones that you don't practice?

---

16. What type of tree species do you use for agroforestry?

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17. do you have a Nitrogen fixing species in your farmland?

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18. if the answer to the question above is Yes name the tree species.

HARVESTING

19. Have you started harvesting from agro forestry?

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20. What have you started harvesting?

a.----------

b. ----------

c. ----------

21. Does agroforestry contributes to your livelihood?

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22. If it does contributes to your livelihood, in what way?

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23. What are the likely problems you encounter while practicing AF?

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24. How do you see agro forestry generally?

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25. Do you notice a great difference in crop output between farmlands that do practice Agroforestry and those that don't?

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26. What are the benefits or otherwise of Agroforestry in the area?

THANK YOU.