DEPLOYMENT OF EMERGING TECHNOLOGIES FOR SUSTAINABILITY OF AGRICULTURE (A CASE STUDY OF ADAMAWA STATE)

BY

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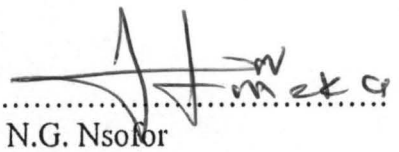
PROJECT THESIS
(PGD IN ENVIRONMENT MGT)

DEDICATION

This project is dedicated to Nafisa, Tasiu, Rakiya Tasiu and Mustafa Tasiu.

APPROVAL PAGE

This is to certify that this thesis was originally written by Tasiu Idi, PGS/PGD/GEO/1999/2000/088 as partial requirement for the award of Postgraduate Diploma (PGD) in Environmental Management by Department of Geography, Federal University of Technology, Minna.



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All praise be to Allah the Lord and sustainer, the most gratious the most merciful. May His benediction, peace and blessing be on His Messenger, Prophet Muhammad (P.B.U.H) together with his households, companions and all those who follow his teachings.

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ABSTRACT

The concept of sustainable development brings bear on the present generation the burden of the survival of figure generation while meeting the needs of the present.

The question is how prepared are we to reconcile the imperatives of environmental conservation with that of food production in Nigeria? There is no doubt that histor owe oil larges responsibility for the restoration of agro-based pre-oil economics of the 1960s.

Climate change and he depletion of natural resources posed challenged to science and technology. New technologies are emerging that substitutes natural resources with synthetics, provide various means of communication and hold promise for the sustainability of human development.

This thesis examine the level of adoption of emerging technologies in the sustainability of agriculture, assess the reasons for stagnation in the sector and profer solution to problems of the conservation of agricultural and environment resources. However the success of conservation strategies is in the creation of an interdisciplinary professional society committed to the maintenance of environmental integrity in addition to the creation of national environmental policies that are people oriented, consistent complementary.

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CHAPTER ONE

1.0 INTRODUCTION

Development in the search for causes of global climate change reveals that chief among anthropogenic factors responsible is the use of fossil fuel. This, coupled with recent unpredictable nature of oil price politics in the world market may likely divert the attention of oil consumers to alternative sources of energy. Lessons from oil embargos and the continuous relevance of oil cartels in global energy crisis have triggered measures to simulate the auto industry to produce more fuel-efficient cars and make alternative, renewable source more viable. Nigeria's oil dependent future may wallow into the labyrinth of uncertainty unless a well orchestrated means of getting back to the economies of the pre-oil era of agriculture is derived.

These challenges call for an interdisciplinary and interagency approach in order to collectively reconcile the imperatives of feeding a growing population and exports against the background of shrinking land resources without compromising the potentials of today's resources in the future. A concept referred to as sustainable development.

Of the 98.321 million hectares of land available in Nigeria about 75.30% may be regarded as arable land while 10.00% is under forest reserves and the remaining 14.70% is assumed to be made-up of permanent pastures built-up areas and uncultivable waste.

Despite Nigeria's enviable bio-diversity and agricultural resource endowment, most food crops, livestock and fisheries are produced by subsistence farmers

who are unmindful of the need to conserve the resource base, which is further depleted. There is an urgent need to replace this destructive cycle with an economically viable ecologically stable and environmentally friendly systems. Such systems should be designed to maintain the resources at stake while increasing and sustaining food production. This can be achieved more effectively through strategies devised to explore the full advantages of the opportunities created by emerging technologies in the following areas:-

(i) Land conservation and reclamation

(ii) Agro-climatology

(iii) Bio-technology/Genetic engineering

(iv) Environmental monitoring and assessment

(v) Information technology.

Tropical Africa is the only region in the world where food production per capital has declined over the past two decades. This is due mainly to the increasing environmental degradation and the adoption of non-sustainable agricultural practices (Eiehe, Brown and Wolf, 1985). The resources at stake therefore have to be clearly defined, developed, conserved and sustained in order to reverse the trend.

1.1 RESOURCES AT STAKE

1.1.1 PHYSICAL RESOURCES

(i) The land available for cultivation is threatened by erosion, land-use change, land tenure changes and conflicts.

(ii) The soil is threatened by decline in soil organic matter, nutrient deficiency, toxicity, acidification, Stalinization, compaction and ground water contamination.

(iii) Water resource is threatened by global and local climate changes, physical characteristics of soil, permeability, water holding capacity e.t.c

1.1.2 **BIOLOGICAL RESOURCES**

(i) The crop ~~genoplasm~~ germplasm, the fingerling and other genetic resources are subject to genetic erosion and narrowing of genetic base

(ii) The soil organism; the fauna and the microflora responsible for decomposition, nitrogen fixation soil organic matter formation and physical structure maintenance commonly suffer loss in biodiversity under crop and soil management.

(iii) Weed, pest and pathogen populations which may reach epidemic proportions as a result of genetic change immigration of new species or races or a reduction in natural enemies.

1.13 **ECONOMIC RESOURCES**

(i) Market; elements of sociological and economic profitability are access to market, access to credit and the price of commodities. Unfortunately this is the least appreciated aspect of agricultural research, and one that researchers have not yet seen as relevant and/or necessary for a truly wholistic approach to research in agriculture.

The development of agricultural economic resources depends on micro and macro economic policies that include fiscal, tax, monetary, trade and wage policies, commodity marketing and pricing policies.

(ii) Purchased input:- Necessary and highly needed modern farm inputs and storage facility are currently on a low level of application and use. Cost of machinery and equipment are unbearably high and increase the cost of agricultural production thereby making investments in agriculture unprofitable and unattractive to the enterprising and energetic work force in the country.

(iii) Government Policy:- Policies have direct bearing on social conditions that may result to high or low productivity or poor related reward to all factors of production especially labour put into agriculture. People's culture and believe on the other hand can affect the ability to adopt to new ideas and methods.

1.2 AIMS AND OBJECTIVES

This thesis has attempted to incorporate emerging technologies to form a scientific means of reconciling the conflicting imperatives of the concept of sustainable development with that of agricultural development.

It has further attempted to close the gaps between agricultural institutes and the farmer and between Nigeria's agricultural and the rest of the world.

Therefore the objectives of this thesis are:-

(a) To assess the level of adoption of emerging technologies necessary for the development of physical, biological and economical agricultural resources for the benefits of sustainable development of agriculture particularly in Adamawa State of Nigeria.

(b) To provide a policy proposal for the deployment of a suitable and low cost ~~objective~~ effective means of achieving sustainable agriculture through a broad and specific application of the principles of current established methodologies for improving food production.

(c) To recommend cost-effective ways of bridging the existing confidentiality and language barriers that separate the farmers and the research institutes in the country and the gaps in collaboration between research institutes within the country and other institutes, which is responsible for farmer's ignorance of existing possibilities and extentionists' dissemination of in appropriate information to the target groups.

1.3 STATEMENT OF THE PROBLEM (HYPOTHESIS)

(1) The concept of sustainable development is not well incorporated in agricultural policies and practices.

(2) Communication gap between research institutes and farmers is a major factor in farmer's lack of knowledge of existing possibilities in agricultural practices.

(3) Lack of people oriented policies and research framework are the major reasons why despite Nigeria's enviable biodiversity and agricultural

resource endowment, most food crops, livestock and fisheries are produced by subsistence farmers who are unmindful of the need to conserve the resource base which is further depleted.

(4) There are little or no structures for the full deployment of emerging technologies necessary for the sustainability of agriculture especially in Adamawa State of Nigeria.

1.4 IMPORTANCE OF THE STUDY

This study attempted to make the environment a valued community asset by drawing attention on strategies for conserving it while deriving its benefits through agriculture. The project was set to equip people with knowledge of agricultural resources at stake and the need for their conservation.

One of the importance of this study was the recommendation of cost-effective ways of bridging existing confidentiality and language barriers that separate farmers and research institutes. The study lastly assessed the level of adoption of agric technologies and techniques for the sustainability of agriculture specifically in Adamawa State in areas of land conservation and reclamation, agro-climatology, agroforestry, biotechnology/genetic engineering, environmental monitoring and assessment and information technology.

1.5 LIMIT AND SCOPE

The basic fact that there is paucity in textbooks that deal directly on the subject under discussion, the researcher was made to use mainly papers

presented at seminars, symposium, lectures and workshops for literature review.

Furthermore, owing to certain constraints, mainly financial and time, the study was conducted only within Adamawa state of Nigeria.

1.6 ORGANISATION OF THE THESIS

This thesis was organized in five chapters. Chapter one contains an overview of the problems and challenges facing the sustainability of Nigeria's agriculture, opportunities created by new technologies, an overview of agricultural resources at stake and the aims and objectives of this thesis. The chapter further outlined the statement of the problems, discussed the importance of the study and gave reasons for the limitation and scope of the project.

Chapter two reviewed the opinions of authors on similar research on the sustainability of agriculture and emerging technologies. Chapter three enumerated the research methodologies, instruments/tools used in data collection, sampling and analysis.

Chapter four analyzed the data collected based on the methods outlined in the proceeding chapters while, chapter five summarized the findings and gave recommendations for solutions to the problems listed in chapter one.

CHAPTER TWO

2.0 LITERATURE REVIEW

The Brundtland Commission Report 'Our Common Future', defined the concept of sustainable development as "development which meets the needs of the present generation without compromising the ability of the future generations to meet their own needs" (Brundtland, et-al, 1987, quoted in Bukar, 1989).

Goodland and Ledec (1987) also define the purpose of development planning as:

" A pattern of social and structural economic transformation which optimizes the economic and other societal benefits available in the present without jeopardizing the likely potential for similar benefits in the future".

In essence therefore, this concept as it applies to agriculture brings to bear on the present generation the responsibility of ensuring not only its own survival and well-being but also the survival and well being of generation yet unborn through processes of judicious agricultural resources utilization.

In effect, general emphasis is placed on development strategies that are geared towards the proper management of natural and human resources as well as physical assets for "increasing long-term wealth and well being" but rejects policies and practices" that support current hiring standards by depleting the productive base including natural resources, and then leave future generations with poorer prospects and greater risks than our own (ibid).

According to Anthony (1994), problems of the Nigeria's agricultural sector may

be classified into five broad categories namely:- Technological, socio-economic, organizational, institutional and natural climatic (FMA, 1988).

In the same vein Anthony (1991) further enumerated the challenge of Nigeria's agricultural sector as follows:-

1. To provide foreign exchange earnings to the country as it did in 1960s thereby diversifying the country's economy.
2. To create rural employment opportunities for the country's growing labour force so that the rural-urban drift of young and adolescent Nigerians can be stemmed.
3. To provide enough basic food commodities demanded by Nigerians to the extent that it could be said that the country has attained self-sufficiency within an acceptable time limit.
4. To provide sufficiently high quantities and qualities of desirable agricultural raw materials that will meet the growing needs of an expanding agro-industrial sector and cut down on the importation of it.

Dirk, et-al (1994) posit that, given the current concern all over the world for the sustainability of development, Nigeria's agricultural policies will have to be considerably refocused to accommodate this concern.

Similarly, Joseph (1994) said that the long-term sustainability of agricultural development in Nigeria depends on how well policies address the nexus of problems relating to population pressure, stagnating agricultural productivity, over exploitation of natural resources as well as environmental degradation. These, therefore constitute some (though not all) of the requirements for

sustainable agricultural development, which appropriate policies, should seek to address. Population pressure puts pressure on land and other natural resources and in the final analysis, leads to the over exploitation of these natural resources. Given a stagnant production technologies, under pressure on natural resources tends to lower resource productivity, accentuate poverty problem and impair the quality of the environment.

Together, resource over exploitation, diminished productivity and environmental degradation inhibit the sustainability of development and lower the quality of life.

Joseph (1994) further stated that, generally therefore, the overall objectives of policies for sustainable agricultural development should be the maximization of their net economic, social and environmental benefits. This implies that policies should be designed to promote the type of economic growth and development, which is compatible with natural resources conservation and environmental protection. However, not all policies can achieve the objectives of economic growth while at the same time promoting natural resource conservation and environmental protection. But the subset of policies which are capable of achieving all these need to be given priority consideration. Even where policy conflicts exist between economic growth and environmental protection/natural resources conservation, those policies, which minimize trade offs between them, should be favoured.

Shaib, et. al (1997) posits that Nigeria with its abundant natural resources, has a large agricultural production potentials. The country has a diverse climate,

which ranges from semi-arid in the North to humid in the South. This enables farmers to produce a wide variety of food and agricultural raw materials. The federal government has divided the country into five major agricultural zones viz north west, north east, central, south west and south east.

These were further divided into sub-zones based on ecological variation. Bukar (1997) pointed out that ecological and socio-economic conditions within each sub-zone largely determine the farming systems and specific constraints to agricultural productivity faced by the producers.

Agricultural research in Nigeria is primarily the responsibility of 18 national agricultural research institutes, which are located in different regions of the country. Each institute has a mandate for a specific commodity or field of activity. Five of these together with the agricultural development project (extension services) of the relevant states in each zone are responsible for farming system research and research/extension linkages for the dissemination of new technologies (Shaib, et al (1997).

They were also of the opinion that while the national agricultural research institutes have generate a number of technologies that have been successfully adopted by farmers, their capacity to meet future challenges is impared by poor infrastructural facilities, inadequate and uncertain funding, and lack of a well articulated long-term research plan. This however led to the formation of the national agricultural research strategy plan for the fifteen year period 1996-2010 by the Federal Ministry of Agriculture with the assistance of the World Bank (FMA, 1995).

The plan has three broad components:-

1. Background information on the agricultural resource base, government's macro-economic and sectoral policies, the current status of agricultural research and extension in the country and the performance of various agricultural sub-sectors in relation to the country's development goals.
2. The second component outlines strategic research objectives, long-term research goals, and high priority research themes.
3. The third component deals with strategies for implementing the research programmes.

2.1 EMERGING TECHNOLOGIES

2.1.1 LAND CONSERVATION AND RECLAMATION

The greatest challenge to sustainability of agriculture is the shrinkage and depletion of agricultural lands. However, techniques are evolving for vertical expansion through substitution. Carrying capacity of ecosystems decline with increasing aridity and soil degradation in most parts of Nigeria.

Gondie A.S (1990) opined that land conservation and reclamation must include both erosion prevention and control measures. Erosion prevention is often more effective than control. Erosion preventive measure involves cultural practices that enhance structural stability of soil, reduction of raindrop impact or implore infiltrability. Techniques that control or reduce erosion (both due to wind or water) involves management of surplus water and moving wind.

Overland flow can be directed to safe disposal at low velocity or for impoundment in irrigation systems.

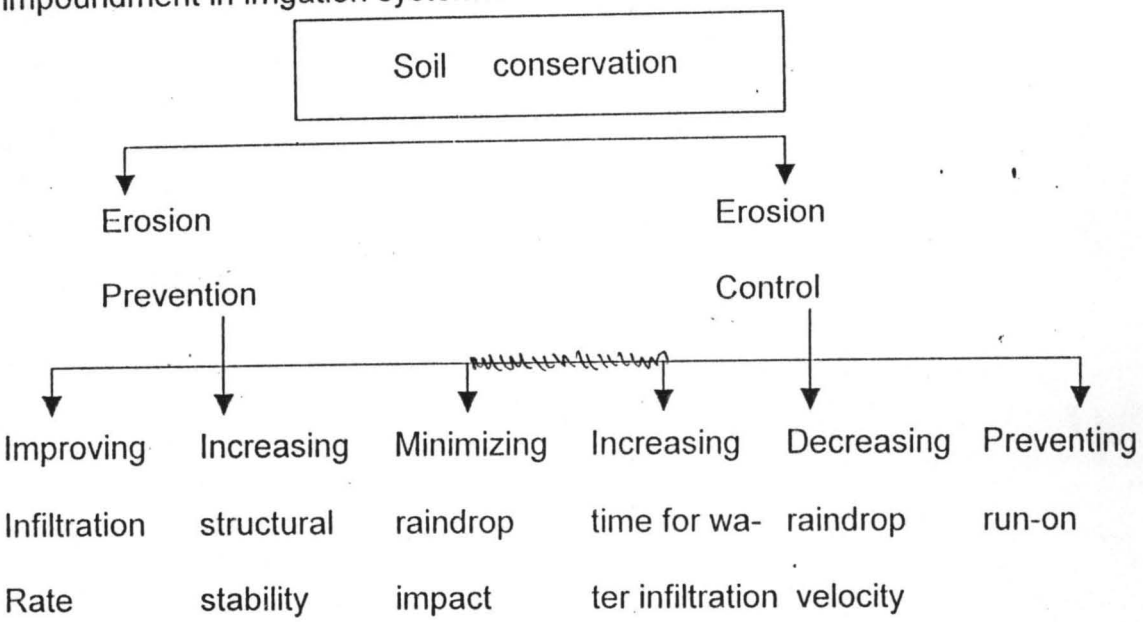


Table II a Erosion prevention versions control measures

(source: Goudie A.S. (1990). PP 178.

Reclamation involves restoration of degraded land, which must be a priority in arid regions. An important step according to Goudie (1990) towards restoring ecosystem is a forestation. Arido-active species adaptable to xerophylic conditions are used for better water use efficiency.

2.1.2 AGRO-CLIMATOLOGY

Climate and weather variability play overriding role in determining the amount of physical productivity of agricultural crops, livestock, forest and fisheries as well as the risk of failure. The 19th session of the conference of Food and Agricultural Organization (FAO) in Rome 1977 recognizing the significance of Agro-climatologic in agriculture urged all member nations as quoted in Tripp R

(1991) to make full use of all available meteorological information and services in their agricultural planning and operation.

Defined as the application of meteorological knowledge information and data to weather sensitive problems in agriculture (W.M.O. 1980 as quoted in Tripp 1991), agroclimatology provide weather data and the effects of its variability on land use, crop donation and bio-meteorology which provide assistance for long term planning, formation, funding, execution of agricultural development and investment projects, research and investigation on crop animal weather modeling and sceneries control of pest, disease and other factors affecting crop and animal production.

2.1.3 AGRO-FORESTRY

International Council for Research in Agroforestry, defined agroforestry as a collective term for systems and technologies of land use where perrinial woody plants (trees, bushed shrubs, scrubs and by assimilation palms and bamboos) are deliberately cultivated on ground otherwise used for crops and/or stock rearing in a spatial and temporal arrangement and where there are interactions at once ecological and economic between the woody plants and the other components of the system (Baumer, (1990). The future holds promise for agroforestry in the solution of global warming through the sequestration of carbondioxide. A ~~member~~ number of Carbon Forestry Projects have been initiated in Bolivia, Mexico, Costa-rica and Ecuador under a pilot phase programme of the UN framework convention (UNEP 1999) as quoted in capturing forest carbon '2000').

2.1.4 BIOTECHNOLOGY/GENETIC ENGINEERING

Thottaphilly et. Al (1995) echoed the suitability of biotechnology for the sustainability of agriculture in developing countries in the closing remarks of a seminar on biotechnologies held at the International Institute for Tropical Agriculture, Ibadan when they said:

"The new-born fascination in biotechnology and genetic engineering is undoubtedly satisfied by he wide range of applications and by rather short time required to obtain results. Biotechnology therefore offer after encouraging prospects for agriculture in the developing world enabling the countries to develop a more autonomous and economical agricultural system which require fewer imported inputs and hence achieving greater food security with less damage to the environment".

However the development of agricultural biological resources for the sustainability of agriculture involves genetic resource conservation. Burril et. Al (1958) as quoted in Attere et al (1991) expressed the need for Geographic Information System (GIS) technology which could provide an ideal means of integrating, analyzing and managing genetic resource data, and the establishment of an international database could provide a valuable tool for establishing global priorities and working towards the overall goal of the optimal preservation of genetic diversity.

2.1.5 ENVIRONMENTAL MONITORING & ASSESSMENT

Man's use of the environment has modified it in directions, which lessen its ability to adopt. Problem such as global warming, depletion of ozone layer,

loss of biodiversity, drought, desertification, deforestation etc make environmental management necessary. This however involves monitoring and assessment of the various components of the environment to ensure sustainable development.

Okhimamhe (1999) posit that one of the major factors in environmental degradation is agricultural activities. Direct disruption of the ecological system of soil, vegetation, water and atmosphere of particular importance are agricultural practices and production methods. Using the technologies of remote sensing and GIS (geographic information system) agricultural lands can be inventoried, mapped and monitored; crop inventory and crop hectare assessment can be conducted and crop yield can be estimated; early detection of crop disease is possible, in addition, crop conditions can be monitored along with the use of weed, herbicides and fertilizer misapplication; food security arrangement farm planning and plot layout can all benefit from the use of remote sensing.

2.1.6 INFORMATION TECHNOLOGY

The chambers dictionary (2000) defined information technology as a technology related to the gathering, recording and communication of information by electronic or computerized means. Information systems play a fundamental role in activities of organizations collaborating groups and individuals. 'Information systems not only serve as repositories of vast amounts of the means of communication, The importance of it in the effective running of government, industry and commercial enterprise is an undisputed

fact. It is increasingly becoming so much a part of everyday lives that the welfare of individuals, competitiveness of business concerns and effectiveness of public institutions depends on the correct and efficient functioning of this technology. (WEIR, 1996).

Information technology has the capacity to eliminate the constraints on access to agricultural information like, ignorance of existing possibilities, and inadequacy of past and current research, confidentiality and language barriers and inappropriate presentation of information for the target groups.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

Research work of this nature must be supported with an acceptable source of information and a method used in getting data for such information. Therefore, this chapter deals exclusively with the procedures, methods or system, which the researcher employed in the collection of necessary data and information for the research work.

Findings of any research-work will depend on the quality of the information or data collected. In view of this, this research is based on a sound research methods, tools and procedures aimed at making the study relevant to the subject matter.

3.1 SUBJECTS

The subjects used for this research-work were twenty (20) academicians, twenty (20) students of agricultural and environmental sciences, thirty (30) extension workers and ten (10) other employees of ministries of agriculture and environment and ten (10) farmers based in ~~Anambra~~ Adamawa state of Nigeria.

The choice of academicians as subjects in this research is based on the important role they play in both research and the dissemination of knowledge on the fields of agriculture and environmental sciences. It was hoped that they will be in a better position to assess the existing situation and to provide redress based on their knowledge and experience. Therefore academicians from the Federal University of Technology Yola, the Adamawa state College of Agriculture Mubi and the Federal College of Education Yola were more interveiwed.

3.2 RESEARCH METHOD USED

For the purpose of collecting information or data for this research-work, the researcher decided to use the descriptive research method. Descriptive research ~~it could have been~~ method consist of a set of gathered data or information summarized and interpreted along certain lines of thought for the pursuit of a specific purpose of study.

Furthermore, descriptive research method is considered suitable for:

(a) Enabling a researcher prove his hypothesis.

(b) Making specific prediction.

(c) Assessing the performance of a certain policy or practice.

3.3 INSTRUMENT/TOOL USED

The instrument used for information and data collection were:-

(a) Documentary source.

(b) Validated predetermined questionnaire check list.

(c) Face to face (oral) interview.

(a) **Documentary**.

In the case of documentary as an instrument used in this research work, the researcher mainly relies on official documents available from Adamawa State Ministries of Agricultural and Environment as well as the F.U.T Minna library.

(b) Questionnaire

In a validated predetermined questionnaire check list, only the close ended questionnaire were used which requires a definite answer.

In other words the respondent is left to make decision from the suggested alternatives or by merely ticking 'Yes' or 'No'.

(c) Face to face (oral) interview with this method, a face to face or oral interview was conducted to sample opinion of the academicians, farmers, students and extension workers so as to assess the level of adoption of sustainable development strategies for the development of agriculture in Adamawa state particularly in Nigeria generally.

3.4 STATISTICAL TECHNIQUES USED

For the purpose of this research-work, the researcher based the statistical techniques on percentage calculated as

$$\frac{\text{Number of respondents to question x}}{\text{Total number of respondents}} \times 100$$

The use of this percentage was employed for the purpose of data analysis in a tabular form, which are outlined in the corresponding chapter.

Furthermore, the choice of percentage was for easier tabulation and clarity in the analysis of each of the questions from the questionnaire.

3.5 SAMPLING PROCEDURE EMPLOYED

Apart from gathering information or data from the population in question the researcher has taken steps to deal with a selected sample from the entire population from which basic conclusions are drawn by reducing the data into tables to make for easy analysis that will represent the whole population.

As a result, the procedure or methods used in this research work is random sampling where the subjects used have equal chances or probability of being chosen.

CHAPTER FOUR

4.0 DATA ANALYSIS

In carrying out this research work like other research works of this nature, the researcher drew a questionnaire the questionnaire comprise a list of questions to be answered by a group of people in order to get facts or information about their views

In addition, percentages are used to analyze the statistical techniques used in this research work. The response in percentages.

For the purpose of clarity and presentation set of tables would be outlined or drawn with analysis for easy comprehension.

A total number of one hundred and fifty (150) questionnaires were distributed randomly to: -

(a) Staff of ministry of agricultural Adamawa state.

(b) Staff of ministry of environment Adamawa state.

(c) Academicians in the fields of agricultural & environmental sciences.

(d) Students in the fields of agricultural & environmental sciences.

(e) Farmers.

Out of the one hundred and fifty (150) questionnaires distributed only one hundred (100) were answered and returned.

4.2 DATA PRESENTATION AND ANALYSIS

Table 1 showing the age of respondents

AGE	FREQUENCY	PERCENTAGE
19-25 yrs	5	9.6
26-30	13	25.0
31-35	15	28.9
36-40	8	17.3
41 and above	10	19.2
Total	52	100%

Table 1 shows that higher response come from the age brackets of 26-35 yrs. This indicates not only the percentage of young people in the productive sector but their interest in environmental issues as almost all questionnaires sent to this group were returned.

Table 2 showing the sex of respondents

SEX	FREQUENCY	PERCENTAGE
Male	37	71.2
Female	15	28.8
Total	52	100%

It is very interesting to note that one third of the respondents are female owing to the notion that the sectors involved in this research ~~is~~ are a male dominated ~~one.~~

Table 3 showing the qualification of respondents

RESPONSE	FREQUENCY	PERCENTAGE
Primary to O/L	5	17.5
A/L and above	47	82.5
Total	52	100%

The analysis in table III is due to the researchers decision to contact mainly people of professional qualification involved in research policy formulation or decision making in the sector.

Table 4 showing the designation of respondents

DESIGNATION	FREQUENCY	PERCENTAGE
Academicians	5	9.6
Students	15	28.8
Extension workers	22	42.3
Farmers	10	19.2
Total	52	100%

Table 4 shows the number of response received from questionnaires distributed to various groups of subject identified to be relevant to the study.

Table 5 showing response to question two (2); do you think it is necessary to include environmental concerns in agricultural policies?

RESPONSE	FREQUENCY	PERCENTAGE
Yes	50	96
No	2	4
Total	52	100%

The analysis indicates that almost all the respondents agreed that environmental concerns are necessary for the sustainability of agriculture in Adamawa state.

Table 6 showing response to question three (3); what do you think is the pace for the adoption of new technique in agriculture in Adamawa state?

RESPONSE	FREQUENCY	PERCENTAGE
Slow	42	81
Mode rate	10	19
Fast	0	0
Total	52	100%

The above table shows that no respondent agree that there is fast adoption of new techniques in agriculture in Adamawa state.

Table 7 showing response to question four (4); if answer to 3 above is (a), do you think that the reason might be due to farmers lack of knowledge of existing possibilities?

RESPONSE	FREQENCY	PRECENTAGE
Yes	39	93
No	0	0
Others	3	7
Total	42	100%

Table 7 indicates that almost all the respondents to question four (4) are of the opinion that farmers ignorance of existing possibilities created by communication gap between them and research institute is responsible for the slow pace of the implementation of research findings.

Table 8 showing response to question five (5); do you think that lack of people oriented policies and research framework is responsible for the nonchalant attitude towards the conservation of agricultural resources

RESPONSE	FREQUENCY	PERCENTAGE
Yes	45	86.5
No	2	3.8
Others	5	9.7
Total	52	100%

Most respondents believe that lack of people oriented policies and research framework is responsible for lack of concern on the environment. From the analysis in table 8 only 3.8 percent of the respondents said 'N0' to the problems of policies and research.

Table 9 showing response to question six (6) what do you think is the level of awareness on environmental issues among farmers, extension workers, legislators and policy makers in Adamawa state.

RESPONSE	FREQUENCY	PERCENTAGE
Low	48	92.3
Medium	4	7.7
High	0	0
Total	52	100%

Table 10 indicates that none of the respondents believe that there is a high level of environment ~~of agriculture~~ awareness in Adamawa state in pact 92.3 percent believe that it is low.

Table 10 showing the level of adoption of land conservation and reclamation

RESPONSE	FREQUENCY	PERCENTAGE
Low	32	61.5
Medium	15	28.8
High	0	0
N.C	5	9.7
Total	52	100%

Additional information gathered through face to face (oral) interview revealed that traditional ~~snuffing cultural~~ shifting cultivation and crop rotation are the only soil conservation techniques in use by local farmers. The methods of artificial soil nitrogen

fixation are not even known to the farmers. Reclamation is not applied to agricultural land in the area under study. However water resource is conserved for dry-season ~~family~~ farming through irrigation under the upper Benue River Basin Authority. Projects in lake Gerio rice farms in Jimta-Yola, Fadama farms in Dasin and the on-going chouchi irrigation scheme are examples.

Table 11 showing the level of adoption of agroclimatogy

RESPONSE	FREQUENCY	PERCENTAGE
Low	30	58
Medium	12	24
High	0	0
Nil	10	18
Total	52	100%

From the above table 58 percent of the respondents are of the opinion that there is low deployment of existing agroclimatic technology for agriculture in Adamawa state. Interesting enough some respondents acquainted with the advancement in this technology prepare to tick 'Nil'. bearing in mind the need to incorporate remote sensing application, geographic information service (GIS), global positioning system (GPS), early warning systems (EWS), satellite technology and collaboration through information technology between weather stations and with farmers.

Table 12 showing the level of adoption of agro-forestry

RESPONSE	FREQUENCY	PERCENTAGE
Low	17	32.7
Medium	30	57.6
High	5	9.7
Nil	0	0
Total	52	100%

From the above analysis 57.6 percent of the respondent believe that agro-forestry application can be scored medium this, the researcher observed is due to the presence of some forest reserves within close regions of towns and villages coupled with tree planting campaign going on. However large-scales projects meant for the preservation of bio-diversity and the sequestration of carbon dioxide are not available.

Table 13 showing the level of adoption of bio-technology/genetic engineering

RESPONSE	FREQUENCY	PERCENTAGE
Low	30	58
Medium	15	28.6
High	0	0
Nil	7	13.4
Total	52	100%

From the above table 58 percent of the respondent believe that there is low application of bio-technology for the sustainability of agriculture in Adamawa state despite its numerous advantages. Relevant soil, crop, animal and environmental bio-technologies have not being integrated into the agricultural system. However crop and animal genetic resources available in the market in form of hybrid seeds and growth hormones are being used by 'Big time' farmers in the state.

Table 14 showing the level of adoption of environmental monitoring and assessment.

RESPONSE	FREQUENCY	PERCENTAGE
Low	12	23
Medium	0	0
High	0	0
Nil	40	77
Total	52	100%

The analysis on table 14 indicate that 77 percent of respondents believe that there is no proper structure on ground for the monitoring and assessment of small scale or large scale agricultural project at the state level. The state ministry of environment is more concerned about sanitation. Than conducting an insisting on EIA, (Environmental impact assessment), SIA (social impact assessment) or monitoring of agricultural projects as they affect the environment or as a strategy for the sustainability of agriculture.

Table 15 showing the level of adoption of information technology in agriculture

RESPONSE	FREQUENCY	PERCENTAGE
Low	35	67.3
Medium	10	19.2
High	0	0
Nil	7	13.5
Total	52	100%

The above analysis indicates that 35 percent of respondents believe that adoption of information technology in agricultural in Adamawa state is low while 7 percent believe it is not adopted. However there is an indication that most respondents mistook computerization of accounts departments in their establishments as the deployment of it in agriculture.

CHAPTER FIVE

5.1 SUMMARY

This research work highlights the need to adopt strategies for the development and sustainability of agriculture in Adamawa state. The research work assess the level of deployment of emerging technologies for the sustainable agriculture in Adamawa state.

The greatest percentage of the respondents who consist of academicians, students, extension workers and farmers agreed that it is necessary to include environmental concerns in agricultural policies. They also believe that lack of knowledge of existing possibilities for the sustainable development of agriculture is the major reason for the slow pace of the adoption of new techniques in agricultural practices.

Moreso, the research work revealed that virtually all the respondents agreed that lack of people oriented policies and research framework is responsible for the general non-challent attitude towards the conservation of agricultural resources despite the level of environmental awareness among farmers, extension workers legislators and policy makers.

Majority of the respondents agreed that the level of the adoption of emerging technologies for the sustainability of agriculture in the study area is generally low.

Table 5.1 showing respondents average score on the level of adoption of emerging technologies.

TECHNOLOGY		LEVEL OF ADOPTION			
		LOW	MEDIUM	HIGH	NIL
1	Land conservation and reclamation	√			
2	Agro-climatologic	√			
3	Agro-forestry		√		
4	Bio-technology/genetic engineering	√			
5	Environmental monitoring & assessment				√
6	Information technology	√			

5.2 RECOMMENDEATIONS

Nigeria is not short of research institutes but policy relevant and problem – solving agricultural research framework which call for a policy framework that give explicit consideration to the issue of sustainable agricultural development in view of this the following recommendations are hereby given:-

1. There should be a policy structure that inter-connect agricultural resources, technologies, research institutes, information systems, market and farmers (see the scheme in table 5-2). The structure calls for a comprehensive policy of agricultural resource development, specific policies on each of the emerging technologies in the development of these resources, which will form the basis of an agricultural research framework. Collaboration between research institutes within and outside the country agricultural extension and liaison services, dissemination of research findings to the farmers and

access to market, credit and inputs should all be via information technology.

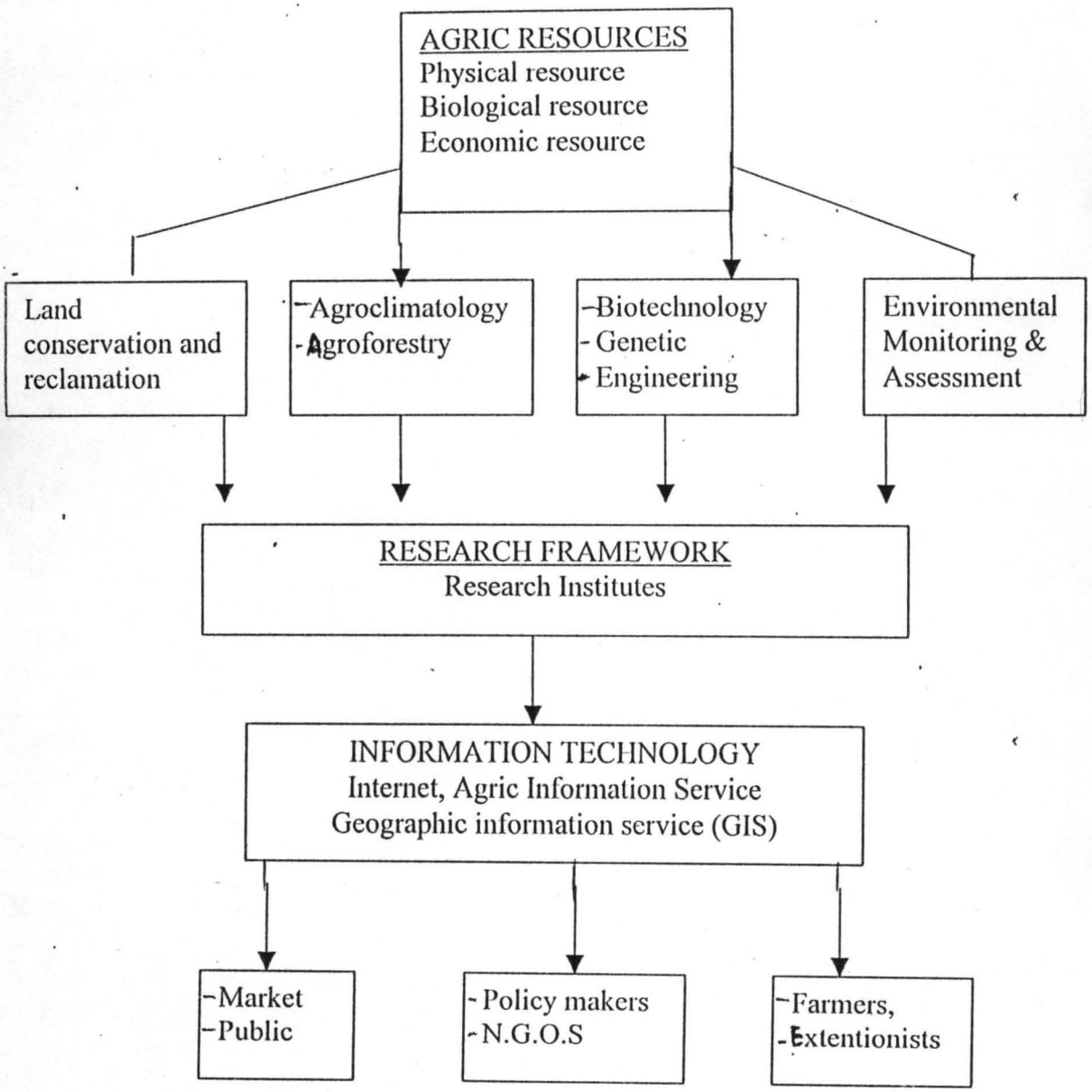
2. There should be a high powered interdisciplinary committee on 'biotechnological revolution' with the main aim of exploring suitable ad low-cost plant, soil, animal and environmental biotechnologies for the benefit of sustainable development in Nigeria's agriculture.

3. There should be a regulatory authority to periodically weigh benefits against the risks on the use of research findings and assess the instances of low, medium and high level risk and enforce appropriate safeguards in respect of environmental applications of genetically engineered organisms.

4. Research institutes should be empowered to enhance research and research collaboration on biotechnology, act as a bridge between advance laboratories and national programmes, take active role in contacting private biotechnology companies to explore the possibilities of these companies making available on humanitarian basis genes, promoters, hypervariable probes and other methodologies.

5. The agricultural and environmental sectors should share-up computerization, ~~internet~~, internet connectivity, have a radio-net and come up with a farmer's only Radio/TV station that broadcast only agro-based programmes, adverts and entertainment.

Table 5.2 Policy Structure Schemer



5.3 CONCLUSION

This research work highlights the need to lay emphasis on agricultural resources at stake and the adoption of strategies for their conservation. This was done through assessing the level of the deployment of emerging technologies necessary for the sustainability of agriculture.

The research attempted to find out the pace of the adoption of new techniques in agricultural practices and to also see if the reason for slow pace of growth in the sector is lack of knowledge of existing possibilities by farmer or can it also be due to lack of people oriented policies and research framework. Level of environmental awareness within the players in the agricultural and environmental sectors was also assessed. All the assumptions in the hypothesis were found to be true.

In preparing answers to the questions listed in the hypothesis a policy proposal has been framed in 5.2 to provide solution to the problem of incorporating sustainable development concept in agricultural policies and practices. The framework is also capable of bridging the communication gap between research institute and farmers by providing links through information technology with farmers, market, and research institutes e.t.c.

Recommendation listed in to 5 in 5.2 if adhered to and improved upon will provide for the improvement of structures for the full deployment of emerging technologies necessary for the sustainability of agriculture not only in Adamawa state but also in the country at large.

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APPENDIX A

QUESTIONNAIRE

This questionnaire is designed and drafted for the purpose of data collection on research topic Titled "The Deployment of Emerging Technologies for the sustainability of Agriculture (a case study of Adamawa state).

The research is meant to fulfill requirements for the award of post – graduate Diploma in Environmental Management by the federal University of Technology Minna. Your cooperation in supplying the information needed will be greatly appreciated. The exercise is purely academic and will be treated with utmost confidentiality. (N0. name is needed).

1. What is your (a). Age.....(b). Sex.....

   (c). Qualification.....

   (d). Designation.....

   (e). Establishment .....

2. Do you think it is necessary to include environmental concerns in Agricultural Policies:

   (a) Yes ☐

   (b) No ☐

3. What do you think is the pace for the adoption of new Techniques in Agricultural in Adamawa State?

   (a) Slow ☐

   (b) Moderate ☐

   (c) Fast ☐

4. If an answer to 3 above is (a), do you think that the reason might be due to farmer's lack of knowledge of existing possibilities.

   (a) Yes

   (b) No

   (c) Others.

5. Do you think that lack of people oriented policies and research framework responsible for the nonchalant attitude towards the conservation of Agriculture resources.

   (a) Yes

   (b) No

   (c) Others

6. What do you think is the level of awareness on Environmental issues among farmer extension workers, Legislators and policy makers in Adamawa state.

   (a) Low

   (b) Medium

   (c) High

7. Please tick as appropriate the level of the adoption of emerging technologies (listed in the table below) for the sustainability of Agricultural in Adamawa State to the best of your knowledge.