

# VULNERABILITY AND ADAPTATION TO CLIMATE VARIABILITY AND CHANGE BY RURAL HOUSEHOLDS IN THE SUDAN -SAHEL REGION OF NIGERIA

by

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# Introduction (1)

## Background to the Study

- There is sufficient evidence to show that the Sudan-Sahel region of West Africa (SSWA) has experienced climate variability:
  - E.g. Adejuwon et al (2007, 2008); Nyong et al (2008); Dabi et al (2008, 2010)
- There is convincing evidence to also show that the region is undergoing a climatic change
  - E.g. IPCC (2001, 2002); Leary et al (2008)
- The environment being sensitive to both anthropogenic and natural stressors.
  - E.g. Nyong et al (2008); Dabi et al (2008, 2010); Mertz et al (2011)

# Introduction (2)

## Objectives of the Study

- The objectives of this paper as follows:
  - To examines the level of vulnerability of households to climate variability and change in the rural areas of in the Sudan-Sahel region of Nigeria;
  - To document their coping and adaptation strategies;
  - To examine the place of adaptation and mitigation in this environmental setting; and
  - To make recommendations toward improving the livelihood of these poor but “innocent” rural population.

# Introduction (3)

## Concepts: Stressors

- Ozone layer depletion
  - Due to the emission of Chlorofluorocarbons (CFCs) e.g. Freon, Neon etc.
- Greenhouse effect
  - Due to the concentration of Greenhouse gases (GHGs) e.g.  $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{N}_2\text{O}$  etc.
- These are a result of combined anthropogenic stressors (deforestation, industrialization, urbanization, transportation, technology) coupled with natural forces leading to Global Warming

# Introduction (4)

## Concepts: Global Warming

- An increase in global temperature due to accumulation of greenhouse gases (GHGs) following bush (forest) burning, deforestation, forest degradation, burning of fossil fuels etc.
- This GHGs create a greenhouse effect leading to a rise in atmospheric temperature.
- The result is Climate Change which leads to the melting of icecaps, snowmelt, sea level rise, extreme climatic events (droughts, floods, windstorms etc)
- While climate change poses an immense challenge today, the continued degradation of these ecosystems threatens to greatly increase greenhouse gas emissions and intensify the negative effects of climate change in the future

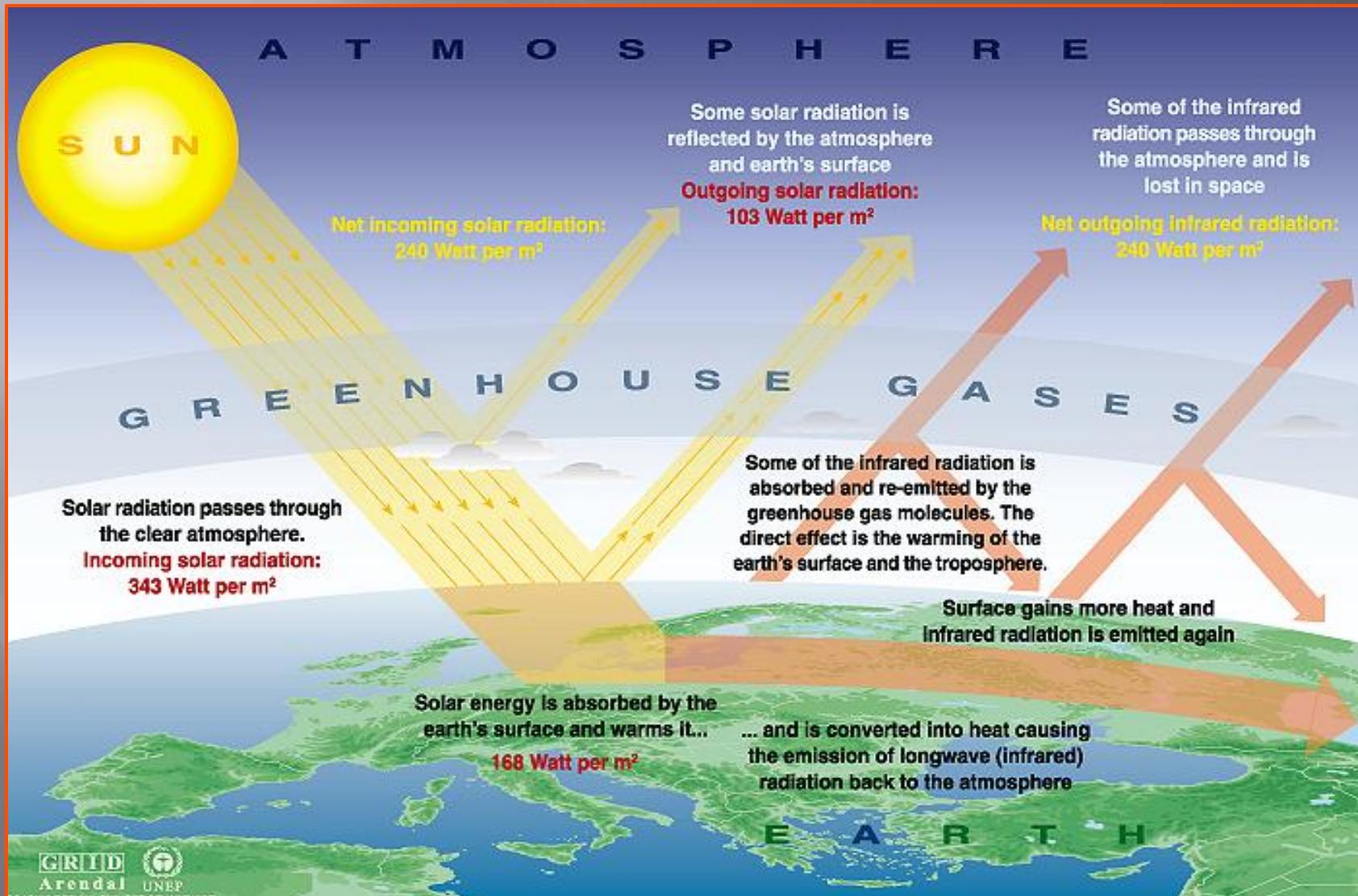
# Example of Greenhouse Gases (GHGs)

Greenhouse gases	Chemical formula	Pre-industrial concentration	Concentration in 1994	Atmospheric lifetime (years)***	Anthropogenic sources	Global warming potential (GWP)*
Carbon-dioxide	CO <sub>2</sub>	278 000 ppbv	358 000 ppbv	Variable	Fossil fuel combustion Land use conversion Cement production	1
Methane	CH <sub>4</sub>	700 ppbv	1721 ppbv	12,2 +/- 3	Fossil fuels Rice paddies Waste dumps Livestock	21 **
Nitrous oxide	N <sub>2</sub> O	275 ppbv	311 ppbv	120	Fertilizer industrial processes combustion	310
CFC-12	CCl <sub>2</sub> F <sub>2</sub>	0	0,503 ppbv	102	Liquid coolants. Foams	6200-7100 ****
HCFC-22	CHClF <sub>2</sub>	0	0,105 ppbv	12,1	Liquid coolants	1300-1400 ****
Perfluoromethane	CF <sub>4</sub>	0	0,070 ppbv	50 000	Production of aluminium	6 500
Sulphur hexa-fluoride	SF <sub>6</sub>	0	0,032 ppbv	3 200	Dielectric fluid	23 900

Note : pptv= 1 part per trillion by volume; ppbv= 1 part per billion by volume, ppm v= 1 part per million by volume

\* GWP for 100 year time horizon. \*\* Includes indirect effects of tropospheric ozone production and stratospheric water vapour production. \*\*\* On page 15 of the IPCC SAR. No single lifetime for CO<sub>2</sub> can be defined because of the different rates of uptake by different sink processes. \*\*\*\* Net global warming potential (i.e., including the indirect effect due to ozone depletion).

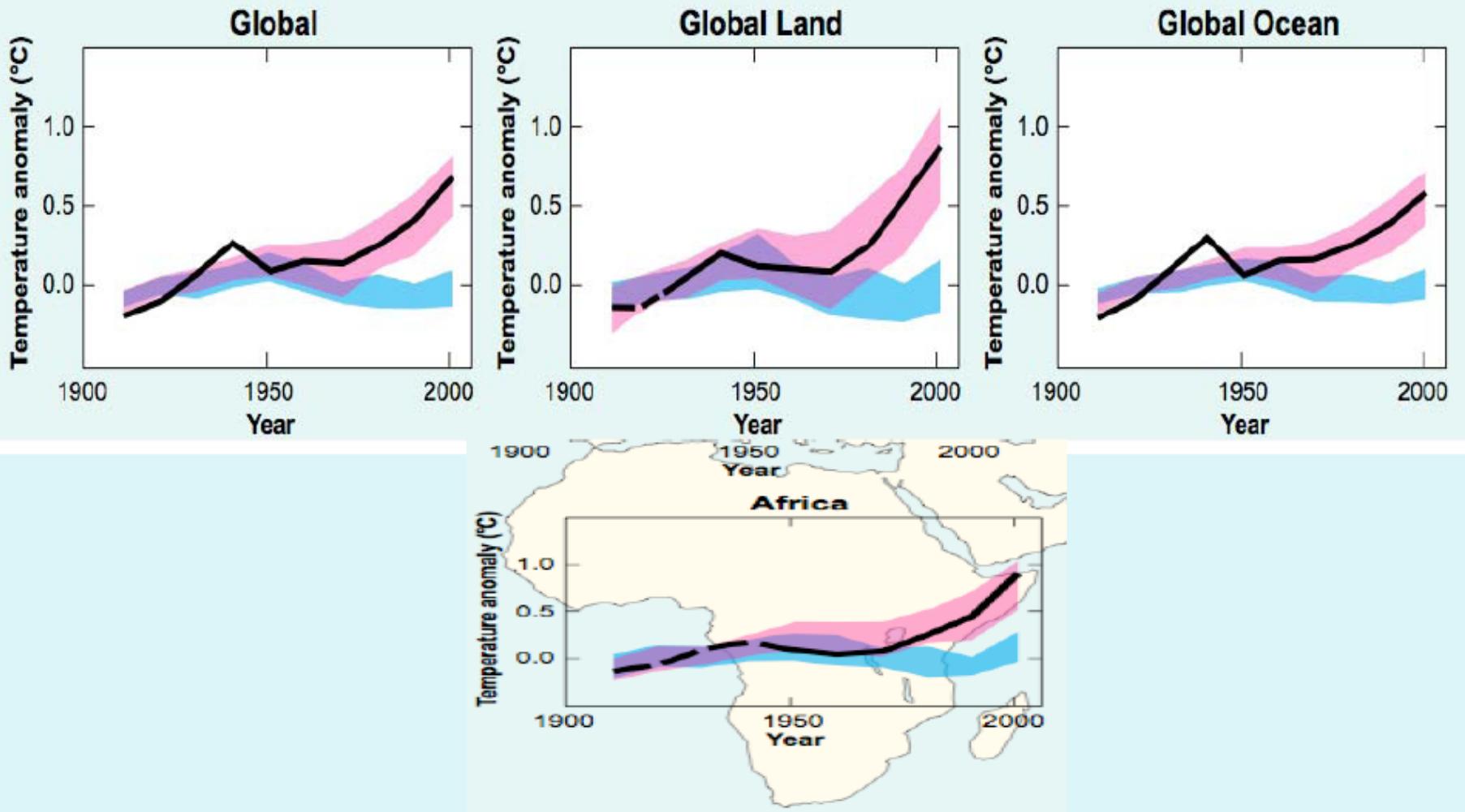
# An Illustration of Greenhouse Effect



# Examples of Sahelian Forests & Deforestation

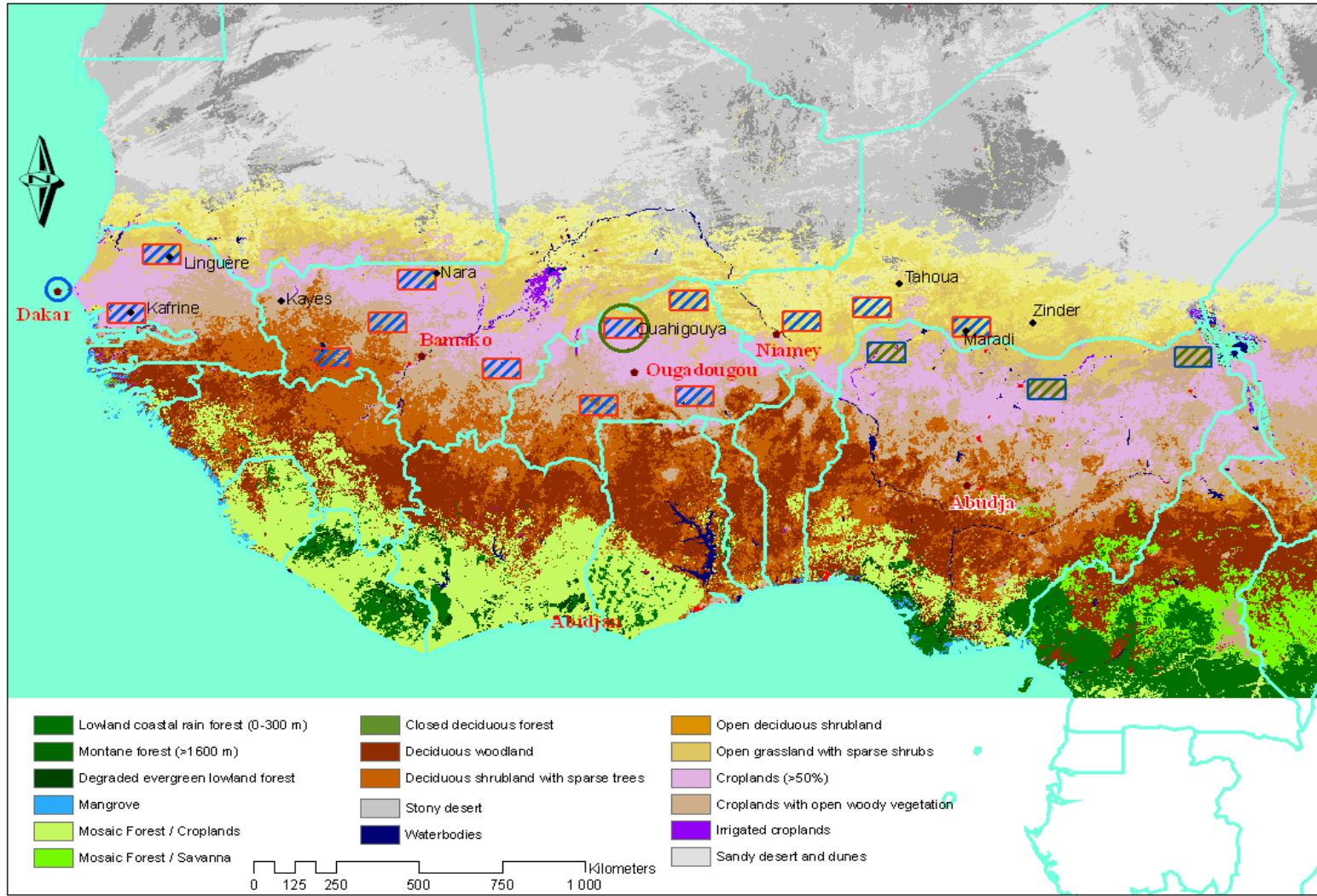


# Evidence of Eminent Global Warming



# Methodology (1)

## Sudan Sahel: West Africa



# Methodology (2)

## Case Study Area

- The Sudan-Sahel region of Nigeria is located within 3° to 15° East and 10° to 14° North
- Temperatures are generally high reaching about 40.6°C in the hot summer months MJJAS (rainy season). Temperatures are lower during the cold harmattan (winter) months ONDJFMA (dry season)
- Rainfall ranges between 450mm to 700mm during the short rainy season (MJJAS)

# Methodology (3)

## Selected Villages in the Study Area

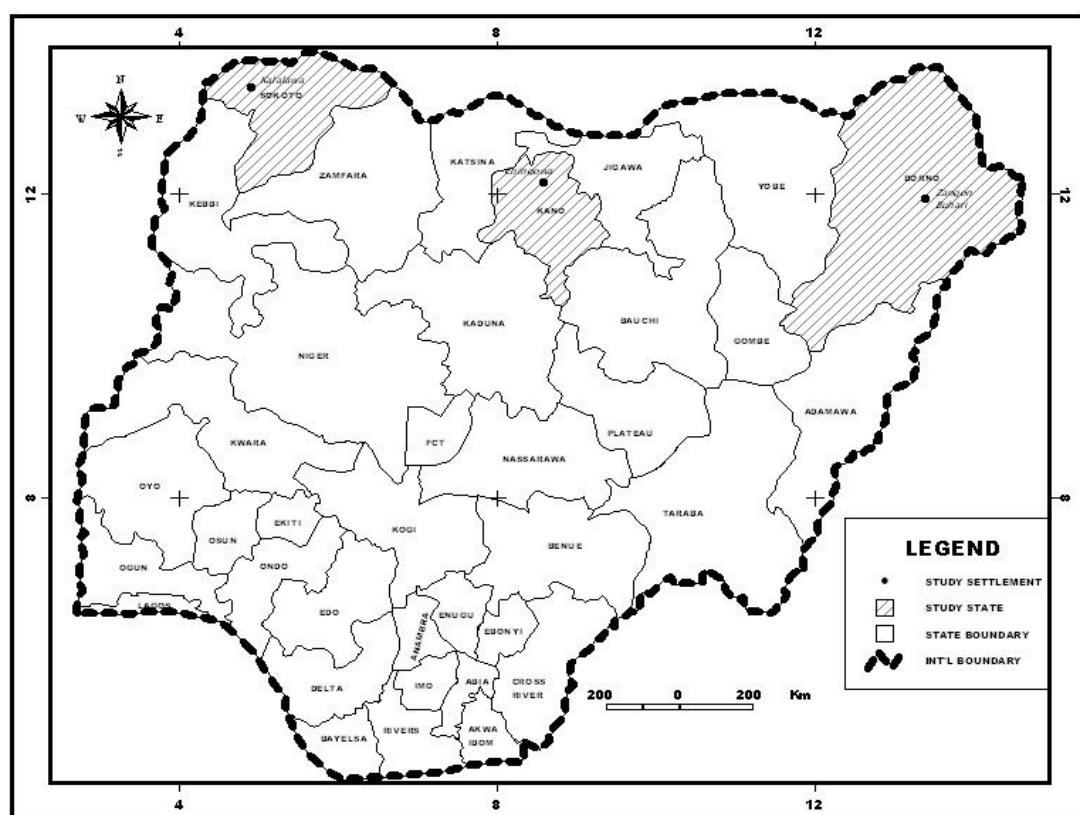


Fig.1: Nigeria Showing The Studied Locations Sampled

Source: GIS lab, UNIJOS

# Methodology (4)

## Data Collection

- Data was collected from 3 villages in the region
  - Kalalawa village (long 5.024 and lat 13.210) - West
  - Zangon Buhari (long 8.550 and lat 11.663) - Central
  - Chingowa (long 12.888 and lat 12.537) - East
- 150 copies of a well structured questionnaire was administered to a sample of households in the selected villages
- Focus Group Discussions (FGDs) were conducted with stakeholders in each of the villages

# Methodology (6)

## Data Analysis

- Descriptive statistics were used to summarize data collected in the form of frequencies and percentages and presented in tables and graphs;
- Inferential statistical techniques were also used:
  - ANOVA F- test to examine the level of variation among selected variables;
  - Simple correlation techniques to establish the relationship between crop yield and climatic variables as well as quantity of fertilizer used.

# Results (1)

## Economic Activities of Households

- ❑ More than 90% of Households are engaged in rainfed farming;
- ❑ Of this percentage, about 50% of households combined rainfed farming with animal husbandry
- ❑ Less than 20% of households combined rainfed farming with irrigated farming
- ❑ Only 10% of households are solely engaged in off-farm activities

# Results (2)

## Sources of Water

Water sources	Selected settlement			Total	Percentage (%)
	Kalalawa	Zangon Buhari	Chingowa		
Rain water	41	42	44	127	26.4
Well water	28	32	28	88	18.2
Bore-hole	43	28	4	75	15.6
Community well	11	21	15	47	10
River	3	44	7	64	13.3
Water vendor	8	28	44	80	16.6
<b>Total</b>	<b>140</b>	<b>197</b>	<b>144</b>	<b>481</b>	<b>100</b>

# Results (3)

## Changes in Sources of Water

Water sources	Selected settlement			Total	Percentage (%)
	Kalalawa	Zangon Buhari	Chingowa		
Increase	46	45	48	139	55.82
Stable	15	7	6	28	11.24
Decrease	15	35	21	71	28.51
Disappeared	-	-	-	-	-
New	11	-	-	-	4.42
<b>Total</b>	<b>76</b>	<b>87</b>	<b>75</b>	<b>249</b>	<b>100</b>

# Results (4)

## Observed Changes in Sources of Water

- Rainfall was perceived to have decreased with incidences of droughts reported in the last twenty years;
- This is unlike temperature which farmers observed has remained stable (normal?);
- These changes have contributed to the decline in crop yield and increased household vulnerability to climate variability and change.

# Results (5)

## A sign of Decline in Sources of Water (a)



# Results (5)

## A sign of Decline in Sources of Water (b)



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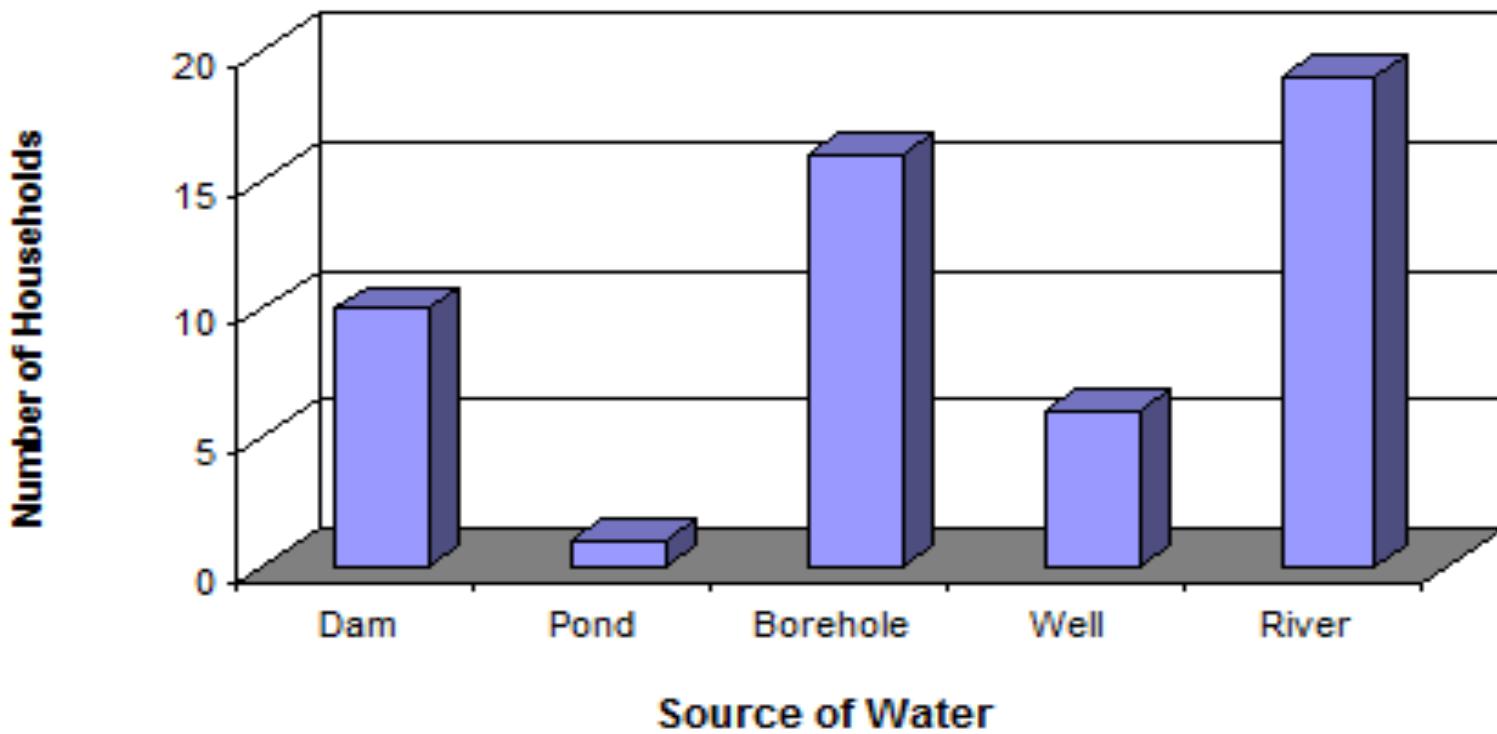
# Results (6)

## Strategies Adopted to Cope with Declining Sources of Water (declining rainfall and droughts)

- Use of alternative sources of water;
- Use of manures and fertilizers to boost crop yield;
- Reduction in the number and quantity of daily meals consumed;
- Reduction in quantity of domestic water used;
- Selling of livestock and other assets.

# Results (7)

## Examples of Strategies Adopted: Alternative Sources of Water



**Figure 4: Sources of water for irrigation by Farmers in Zangon-Buhari**

# Results (8)

## Examples of Strategies Adopted: Use of Fertilizers

Crops Harvested	Quantity (Kg)	Fertilizer (Kg)
Tomatoes	207,225	40,250
Pepper	1,368	250
Onions	101,640	1,400
Sugar cane	16,881	1,700
Water melon	50	100
Groundnuts	500	50
Maize	67,500	650
Rice	100,000	350
<b>Total</b>	<b>495,164</b>	<b>44,750</b>

# Discussion (1)

## Vulnerability

- Vulnerability aggravated by the interaction of climate and other 'multiple stresses'.
- Vulnerability – function of exposure, sensitivity and adaptive capacity
- Households in the Sudan-Sahel Region of Nigeria are Vulnerable to Climate Variability and Change and they also have very low adaptive capacity
  - Poor Institutional capacity
  - Inadequate know-how and education
  - Unavailability of technology (Crude local technology/ Indigenous knowledge)
  - Limited Wealth (poverty)
  - Poor Terms of Trade

# Discussion (2)

## About Adaptation and Mitigation

UNITED NATIONS FRAMEWORK CONVENTION  
ON CLIMATE CHANGE (UNFCCC)

### □ Adaptation

- Addressing the consequences
- Reducing the negative impacts of climate change that still occurs

### □ Mitigation

- Addressing the causes
- Reducing greenhouse gas concentrations in the atmosphere

# Discussion (3)

## Adaptation and Mitigation Action

### ADAPTATION

- Local problem: how to adjust local systems to local changes
- Cuts through all climate-sensitive sectors
- Need to start right away, impacts already happening
- Local responsibility for implementation

### MITIGATION

- Global problem: no difference between emissions anywhere on earth
- Primarily related to energy and environment
- Needs to start in the short term, even if it only helps to avoid long-term impacts
- Common but differentiated responsibilities: primary responsibility for OECD

# Discussion (4)

## Adaptation or Mitigation for the Sahel?

- Africa and especially the Sudan-Sahel region of Nigeria are faced with the worst impacts of climate change, and therefore very vulnerable, yet they contribute little to global greenhouse gas emissions
- Hence, the priority for Africa and the Sudan-Sahel is ADAPTATION
- Nevertheless, mitigation should be taken into account wherever possible
- Adaptation costs money and such monies are outside the reach of many African countries including Nigeria
- The real cost of adaptation in Africa is still speculative.

# Discussion (5)

## Managing the Ecosystem

- Climate change is being accelerated by biodiversity loss and ecosystem degradation.
- Healthy ecosystems – for example, forests and bogs – contain massive carbon reservoirs and are vital to regulating the global climate (CO<sub>2</sub> Sinks).
- The sustained supply of certain ecosystem services – such as stream flow regulation in drought prone areas – will be critical in buffering human populations from the adverse impacts of climate change, which include coastal flooding, droughts and other hazards. Healthy and diverse natural ecosystems are expected to be more resilient in the face of climate change than ones that have been degraded.
- This can be achieved through Afforestation and Reforestation

# Discussion (6)

## Afforestation and Reforestation

- ❑ **Afforestation** is the establishment of a forest or stand of trees in an area where there was no forest.
- ❑ **Reforestation** is the reestablishment of forest cover, either naturally (by natural seeding, coppice, or root suckers) or artificially (by direct seeding or planting).<sup>[1]</sup>
- ❑ Many governments and non-governmental organizations directly engage in programs of *afforestation* to restore forests, increase carbon capture and sequestration, and help to preserve **biodiversity**.

# Conclusion (1)

## Recommendations

- Action by International Governments:
  - Support Adaptation in developing countries as enshrined in the UNFCCC charter
  - Support the development and transfer of low carbon-intensive technologies to developing countries
  - Increase research funding for local studies in developing countries
  - Reform agricultural trade to increase developing countries' participation in international trade
  - CUT DOWN GREENHOUSE GAS EMISSIONS through the adoption of more sustainable developmental pathways.

# Conclusion (2)

## Recommendations cont'd

- Ensure environmental sustainability (Goal 7 of the MDGs):
  - Target 7a: Integrate the principles of sustainable development into country policies and programmes; reverse loss of environmental resources;
  - Target 7b: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss;
  - Target 7c: Reduce by half the proportion of people without sustainable access to safe drinking water and basic sanitation;
  - Target 7d: Achieve significant improvement in lives of at least 100 million slum dwellers, by 2020

# Conclusion (3)

## Concluding Remarks

- “*Although individual decisions may seem small in the face of global threats and trends, when billions of people join forces in common purpose, we can make a tremendous difference.*”  
- *UN Secretary-General Ban Ki-Moon*
- Take care of your immediate environment:
  - Be environment friendly by maintaining environmental sanitation and keeping the environments **GREEN** (**plant a tree today**).  
- *Professor D.D. Dabi*

Thank you

*Merci*

*Mafeng*