

**ASSESSING THE EFFECT OF CATTAIL (*TYPHA GRASS*) ON  
HADEJIA-NGURU WETLAND UTILIZATION**

**BY**

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MANAGEMENT**

## **CERTIFICATION**

I hereby certify that this thesis was written by me and that it is a record of my own work. It has not been presented in any previous application for higher degree. All quotations and sources are acknowledged by means of references.

Signature ..... Date.....

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## APPROVAL PAGE

A thesis submitted to school of Post Graduate studies, Federal University of Technology, Yola, in partial fulfillment of the requirement for the award of Degree of master (Msc) in environmental Resources Management.

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## **DEDICATION**

This work is dedicated to all those whose livelihood depend on the existence of Wetlands.

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## **ABSTRACT**

This work seeks to examine the effect of typha grass infestation on the socio-economic and the physical environment in Hadejia-Nguru Wetland (HNW). Data are collected through the field experiment and the administration of questionnaire. A total of 200 questionnaires were administered to fishermen and farmers in the wetland. The finding from this shows that typha grass accounted for 90% reduction in crop yield, 80% reduction in quantity of fish caught, and over 80% in area coverage as compared to non infested area. A comparative analysis of field experiment of evapotranspirative and evaporation water loss between typha swamp and open water reveals that there is no significant difference at  $p=0.05$  however, the result of the experiment on mosquito larva load shows that typha swamp harbour more mosquito larva than the open water at  $p= 0.05$ . Given the available data obtained and analyzed it can be said that typha grass has become a serious to the livelihood of the wetland and therefore required an urgent intervention.

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# **CHAPTER ONE:**

## **INTRODUCTION**

### **1.1 Background of the Study**

Water is the major and valuable natural resource of the environment. Most dry environments are inhabited by poor people who have negligible resources at their disposal (Singh, 1998). The major problem of the dry environments is that they suffer from moisture stress and thereby affecting the different types of productions.

Given this scenario, the presence of any reasonable water point in the dry environment signifies the presence of life. Wetlands, according to Botkin, et al (1998) are among the most productive ecological communities in the world and many times more than a heavily fertilized corn field. Wetlands contributed many products to the rural economy; fishing and domestic fishponds are important sources of protein, so was wild fowling (Botkin, et al 1998). Reeds and sedges were harvested for the thatch that was the main roofing materials in many parts of the world.

The value of wetlands has also been based on economic criteria. The monetary values of cranberries, forest products, peat and other items generated in wetlands have been considerable (Green, 1992).

Despite the great value of wetland resource, its existence has been under serious threats over the years in several parts of the world. Kennish (2000) reported that over 50% of the wetland in the United State (US) have disappeared in the last 200 years and as much as 90% of the fresh water wetland in US as a result of

activities and negligence, a situation which prompted the passage of the clean water act in the United States in 1977 (amended in 1987) with the aim of protecting the Wetland from further degradation and destruction.

The Hadejia-Nguru Wetlands (HNW) run through the semi arid environment of north western and north eastern parts of Nigeria, cutting across Kano, Jigawa, Bauchi, and Yobe States of Nigeria and supporting over 7 million population including migrants from Niger Republic (Bdliya, et al 2003). This valuable resource is presently under threats from the invasion and proliferation of cattail (*Typha grass*) which could negatively impact on the socio-economic life of the people and the ecology of the area.

Typha grass has been identified nearly 40 years ago by the locals in the Marma channel Nguru lake complex. Two small patches of the Typha grass were found to have been growing near Badin pond in Nguru Lake. The spots were popularly known as Kachala ponds. However, the size of the spots have not been significantly increasing at the time, nearly 40 years ago. The rapid spread of Typha grass in the wetland has partly been attributed to the present condition of permanent inundation which has aid the growth of typha to maturity (Danjaji, 2006).

## **1.2 Statement of the Research Problem**

In recent times cattail otherwise known as “Kachalla” among the locals in the study area has become a common sight in the Wetland. This is particularly noticeable at the Nguru section of the Wetland as one travels along Nguru-Gashua

road. Road users and villagers within the vicinity are confronted with an offensive odour coming from the water bodies either due to partly decomposed typha grass and or dead fish and or de It is equally reported that aquatic lives notably fish population and numbers of migratory birds are declining. Also farmers and fishermen are complaining of their farmland and fishing ground being overtaken by the grass thereby affecting their means of livelihood.

Bdliya et al (2003) reported that the most outstanding impact of the threats on the Wetland is the creation of a conducive condition for typha invasion, which now occupies over 200 km<sup>2</sup> of farmlands and fishing grounds. It has also contributed to the blockage of several channels.

Given the fact that the presence of wetlands in an otherwise arid environment is seen as a resource to be jealously guarded not only because it could act as safety nets' due to their higher productivity especially during dry periods (Uyanga and Ekop 2004) but also the biodiversity or eco-balance they provide (Botkin et al 1998). It is therefore necessary that whatsoever may affect this valuable resource demand serious and urgent attention.

### **1.3 Research Questions**

This work seeks to provide answers to the following research questions:

- 1 What proportion of farmland and fishing ground is being overgrown by Typha grass in the wetland?

- 2 Has the Typha grass invasion contributed significantly to water loss in the Wetland?
- 3 What effect does Typha invasion has on quantity of fish caught in the Wetland?
- 4 What are the implications of Typha invasion on the spread of Malaria?

#### **1.4 Aim and Objectives**

The aim of this study is to assess the various effects of Typha invasion in Marma channel of Hadejia-Nguru Wetland (HNW) on the people's Socio-economic lives and the ecosystem.

The specific objectives are:-

- i)** To determine the proportion of farmland and fishing ground under Typha invasion.
- ii)** To assess the difference in quantity of fish caught between Typha swamp and the open water in the Wetlands.
- iii)** To determine evapotranspirative water loss in the Wetlands due to Typha invasion.
- iv)** To assess the health risk of Typha invasion by comparing mosquito larva load in Typha infested swamp with that of open water.

## **1.5 Research Hypothesis**

The research hypotheses generated from objective iii and iv in this study is to be subjected to statistical analysis

- i)** Ho (i): - There is no significant difference in water loss between *Typha* infested swamp and open water Wetlands.
- ii)** Ho (ii): - *Typha* swamp does not harbour mosquito larva more than the open water area of the Wetlands.

## **1.6 Significance of the Study**

This work is significant in the sense that it is expected to alert the stakeholders, government and general public on the looming danger of *Typha grass* invasion and proliferation not only on economic and social lives of the people but also on the environment it is equally expected that this work shall contribute reasonably to the on going investigative study of the weed infestation in the Nguru section of the Hadejia-Nguru Wetlands.

## **1.7 THE STUDY AREA**

### **1.7.1 Introduction**

The Hadejia-Nguru Wetlands (HNW) is located in the middle part of the Komadugu Yobe Basin in north-eastern Nigeria. It is part of the vast Lake Chad drainage basin.

The two western tributaries are the Jamaare which rises on the Jos Plateau, and the Hadejia which drains the highlands to the north west. Where these two rivers meet, extensive wetlands have developed ( Fig.1). From here on wards the river that emerges is known as Komadugu Yobe which drain into Lake Chad.

The Wetlands is made up of a network of channels and pool producing a complex pattern of permanently and seasonally flooded land (Adams et al 1998). The complex system comprises of the following identified subsystems:

- (i) Marma channel (Nguru Lake)
- (ii) Burum Gana Hadejia
- (iii) Upper Hadejia subsystem
- (iv) Kafin Hausa River subsystem
- (v) Jama'are River subsystem

### **1.7.2 Location and Extent**

The Hadejia-Nguru Wetlands (HNW) is located between latitude  $12^{\circ} 15'$  and  $13^{\circ}N$  and longitude  $10^{\circ} 00'$  and  $11^{\circ} 00'E$  and occupies an area of  $3,500km^2$ , bounded by routes linking Hadejia, Katagum, Nguru and Gashua town

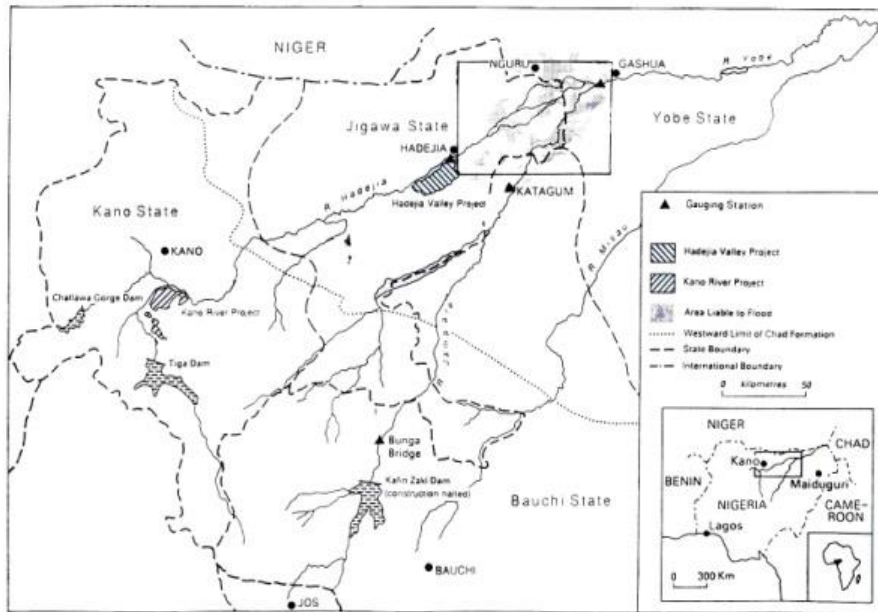


Fig.1 Map of Hadejia-Nguru Wetland showing Marma-Nguru Lake in Box

### 1.7.3 Geology, Topography and Soil

The HNW lies on permeable rocks of the chad formation overlying hard, dense and impermeable high-grade metamorphic basement complex (Schultz, 1996). The relief around the area is dominated by dunes often separated by inter-dunes depression, which contain alluvial deposits; these dunes have had the major impact on the development of the drainage pattern of the Wetlands. The topography is characterized mostly by low lying flat surface ranging between 340m and 345m and limited localized high relief in the southern and western parts which provides sites for

settlement. Carroll and Klinenberg (1992) described the soils as being dominated by the dunes and the alluvial deposit, which can be broadly divided into weakly developed, and halomophic soils of alluvia origin and non-leached ferruginous tropical soil derived from dunes deposit. The alluvial soil of the HNW is described by Kolawole (1991) as deep up to 1.5m and hydromorphic with high water retention capacity and poor drainage.

#### **1.7.4 Climate and Vegetation**

The climate is characterized by distinct wet and dry seasons. Rainfall pattern in HNW has not been stable over the years but in most cases rainfall starts from May and extend till September or October with a long break of up to a month in between the first rain and subsequent ones. Also there is variation in the rainfall even within the Wetlands area from the Southern part of the Wetlands where the rain starts earlier to the northern part where they occur later. The annual rainfall total ranges from 500mm to700mm.

The dry season usually starts from October to April, punctuated by the cold harmattan condition between December and February. The temperatures in the Wetlands vary with the time of the year reaching the peak (max.) about 41<sup>0</sup>C in April and May and about 29<sup>0</sup>C (min.) during the harmattan. In January

Table 1.1 Monthly Mean Temperature and Total Rainfall at Nguru

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp (°c)	29	34.3	39.2	41	39.7	37.5	34.5	32.8	34.5	38.3	36.2	31.9
Rain (mm)	00	00	00	00	39.1	39.7	116	259	31	1.2	00	00

Source : Nigeria Meteorological Station Nguru, 2008

Due to high temperature, low relative humidity and high insolation, the rate of open water evaporation is observed to be high, Table 1.1 for Rainfall and temperature data for the Nguru section of the Wetland in 2008

The vegetation types in the Wetlands can be broadly divided into (i) Sudan Sahel shrubs, (ii) riparian forest and (iii) flood retreat marsh land. Areas of permanent ponds and lakes give rise to a forest shrub grassland water mosaic.

Sudan-Sahel shrub savanna includes the upland farm area and the Acacia woodlands. This vegetation type is very common in the protected areas within the HNW and is rarely inundated except for those areas where small ponds exist. Most of these areas are, however, undergoing rapid transformation as a result of farmland expansion and firewood extraction. Common trees found in the upland areas are *Acacia, albida, Diospyros*.

Riparian forest is present on the fringes of flood plains of the Wetlands. The most common tree species are mahogany (*Khaya senegalensis*) and ebony (*diospros mespili* forms) which are now being heavily exported for fuel wood. *Tamarindus Indica* and *ficus sp* occur where the moisture regime is favourable.

Flood retreat marshland commonly referred to as fadama are seasonally subject to inundation during the peak flooding period. Wild aquatic grasses like *Echinochloa*, *oryza spp* and of recent *Typha spp* (the focus plant of this study) are common. Andropogen grass land which occurs at edge of the flooded zone is dominated by *Andropogen gayanus* while vertiveria grass land is dominated by *Vertiveria nigritana*.

### **1.7.5 Hydrological regime.**

The hydrological regime of the Wetlands is closely related to the rainfall pattern in the upper catchments area. Rainfall in the middle basin itself contributes little to the seasonal inundation of the flood plains although depressions with fine clay soils may be flooded by local rainfall. The inflow to the middle basin reaches its peak in August. As the streams flow on through these flood plains, large areas are inundated and this widespread flooding retards the progress of the peak flows down streams. The maximum river flood stage reaches Hadejia and Nguru towns in mid and late September respectively, Gashua by mid or late October and Lake Chad only at the end of January. River flow decreases rapidly after the peaks have passed.

### **1.7.6 Wild Life:**

The Fauna in the wetlands has been affected by the influences of climatic factors (drought), hunting and habitat modification. Large indigenous animals have become very rare, except few species found in the protected areas of Gogogram forest reserve and Dagona wild life sanctuary under the Chad Basin National Park.

The uniqueness of wetland is their avian population. Birds are abundant and varied throughout the wetlands which support important population of resident and migrant water fowl species, notably herons, ducks and waders. This high diversity and abundance of birds in the wetland has attracted both national and international attention. The wetlands are also vital spawning and nursery grounds for many indigenous fish species. Fishing activities vary seasonally between locations in the wetland and the rise and fall of the floods. The fish resource in the wetland has been reported to be on the decline due to several factors, one of which (the role of Typha grass invasion on fish quantity) is the concern of this work

### **1.7.7 Ethnic Composition and Agricultural Practice**

The principal ethnic groups on the wetland are the Fulani, Hausa, Kanuri (Mangawa) and Bedde. The Fulani are traditionally nomadic and semi-nomadic pastoralists, while the Hausa are typically settled farmers. The Bedde and Kanuri/Mangawa combine fishing with farming.

The agricultural cycle is attuned to seasonal rainfall and flooding. Preparation of upland farms for rainfed agriculture starts in April. First millet and

later sorghum are planted at the onset of the rains by the end of May or early June. Then follows a critical period since survival of the seedling depends on the interval between the first showers and the more regular rains that follow later. Harvesting of rainfed crops takes place from later September through November.

Floating rice is planted on the floodplains (fadama) when the plains are inundated in August while the harvest commences when the floods recede by mid November. From December onwards, dried-off plots on the fadama and the shores of permanent lakes are planted with wheat, onions, tomatoes, peppers and other vegetables. Irrigation by controlled flooding is practiced in the flood plain near Nguru and Gashua. The fields are separated by earthen dykes with low points where the water is let in through inflow in a controlled manner in such a way that the water level rises slowly at a rate compatible with the growth of rice. The Fulani pastoralists annually migrate with their herds of cattle, sheep and goat between the wet season upland pastures, and the dry season grazing grounds in the floodplains. The pattern of their migration routes is a complicated one and has become even more so in recent times when drought conditions and a decrease in traditional upland pasture have forced many to settle down or exploit other pasture lands.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 introduction

Denny (1985) observed that most of the research into aquatic weed problems has been directed towards the means of controlling them rather than towards understanding the ecological basis or to understanding the effects of the plants on water body and its use. In order to present a balanced view to the problem, attempt is made in this section first to fully describe what wetland is, to appraise works done not only in how to control the weeds but also to understand the interrelationship between the plants and their habitat and perhaps the consequences of any control measures.

This section is therefore organized as follows

- Conceptual definition of wetlands (Types and characteristics features).
- Functions and values of wetlands
- Threats to wetlands: Aquatic plants (*Typha grass*)
- Techniques of aquatic weed management with emphasis on *Typha grass*
- Principles of aquatic weed management.

## **2.2 Wetlands: Meaning, Types and Characteristics**

Section 404 of the Clean Water Act of the United States National Environmental Policy Act (NEPA) defines wetlands as those areas that are inundated or saturated by surface or ground water at a frequently and duration sufficient to support, and that under normal circumstances do support a prevalence of vegetation typically adopted for life in saturated soil condition (NEPA 1977).

The US Fish and Wild life service (USFWS), defines wetlands as lands transistional between terrestrial (land) and aquatic (water) systems where the water table is usually at or near the surface or the land is covered by shallow water (USFWS 1980).

The Ramsar convention in 1977, 1992 sponsored by United Nation Educational Scientific and Cultural Organization, (UNESCO) defined wetlands as areas of marsh, fen, peat land or water whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tides does not exceed six metres. This is rather very broad definition which according to Worthington (1976) has political undertone.

For the International Biological Programme which regarded wetland areas as distinct from open water, a more limited definition was used. “For inclusion in the wetland category, water was usually characterized by having emergent vegetation” (Worthington, 1976).

The Environmental council (1984) sees “wetlands as a collective term for permanently or temporarily wet areas, shallow water and land water interfaces.

The water may be fresh, brackish or saline and wetlands are characterized, in their natural state, by plants and animals which are adapted to living in wet conditions.

However, from the various definitions given above, the followings are the salient points common to all in defining what a wetland is

- (i) It is a land cover by water either permanently or temporarily.
- (ii) The water could be fresh or saline.
- (iii) There must be vegetation (plants) specifically adapted to this condition.

Kent (1994) therefore identified the following as characteristics features of wetland, they are supported by hydrophytes (water loving plants) in part or all the year, and substrates consist of undrained hydric (water saturated) soils.

Kennish (2000) identified five types of wetland system: (1) Marine (2) estuarine (3) riverine (4) lacustrine and (5) palustrine. These wetlands are equally varied in shape, size, hydrology, water chemistry, soil, vegetation and position in the landscape. He however emphasized that wetlands are typically situated in low-lying areas or shallow depressions adjacent to bays, rivers and streams.

## **2.3 Function and values of wetland**

A good understanding of the functions and values of wetland will help in appreciating the threats to its existence and utilization. Wetlands have several function and values of which the major ones are discussed here. Basically these functions can be categorized into hydrological and socio-economic functions.

### ***2.3.1 Wetland as Natural Water Storage and Flood Control***

The role of swamps (wetlands) in African hydrology has been partly reviewed by Balek (1977). He emphasized the fact that the presence of wetlands reduced surface run off thus for a catchments with an annual rainfall of 750mm, the annual run off could be reduced from 56mm to 3mm if the swamp area increased from 1 to 10% of the catchments area.

Thompson (1974) and Thompson and Hamilton (1983) pointed out the storage value of the swamps (wetlands) of the White Nile which provides 83% of the low flow (dry season) discharge to the lower Nile. Thibodeau and Ostro (1981) have quantified in monetary terms, the value of a Massachusetts wetland as a flood control and water storage area. In addition these wetlands can serve as ground water recharge areas and are expected to be used as such to an increasing extent in Massachusetts.

The recharge role of the annual floods for the shallow alluvial aquifers around HNW and the Chad formation upstream of the wetlands according to Bdliya (1997), support the vast majority of the populace within the region who are dependent on groundwater for domestic use and agricultural activities.x

### ***2.3.2 Wetland as Soil and Sediment Trap***

The efficiency of wetlands as sediment traps has been documented by various scholars. Jacot Guillarmod (1972) discussed the role of the bogs and sponges of the high altitude areas in Lesotho in the prevention of soil erosion, and points to the disastrous effects of burning and grazing these areas. Soil nutrient deficiency problems are widespread in Africa, but flood plains and other wetlands enjoy the benefits of water borne nutrients. Floodplain and wetland dwellers in Africa do not have to practice shifting agriculture as land is 'refertilised' by trapped sediment during the annual or biannual floods. The Gezira area on the Nile floodplain (Barnett, 1977), the Rufiji plains in Tanzania (Bernascek, 1981; Mwanyika, 1982) and the Pongolo floodplain in South Africa and Mozambique (Heeg and Breen, 1982) provide good illustration of this sediment 'refertilisation'.

### ***2.3.3 Wetlands as Valuable Wild Life Areas***

Wetlands are extensively utilized by wild game of all types. Wetlands usually provide good grazing and shelter during the dry months and are used by both game and domestic animals alike. The value of African wetlands as bird refuges and habitats, especially for migratory species is well known. Batchelor (1978) points out that African waterfowl require two types of wetland, those which offer refuge and a feeding area during the dry season and those which serve as a breeding habitat.

In 1995, there were over 38 water related bird species with a total population of over 259,000 in Hadejia-Nguru wetlands (Bdliya, 1997), and by 1996, a year after over 47 species were counted with a corresponding high number of birds (Bdliya, 1997)

The presence of these birds provides a unique opportunity for tourism, education and scientific research and this prompted the designation of parts of the wetlands as a component of the lake Chad Basin National park in 1992.

Several wild resources are harvested from the wetlands for food, medicine, fibre and other uses for both domestic and commercial purposes. According to Hadejia-Nguru wetland conservation project (HNWCP), it has been estimated that about ₦35 million worth of palm fronds is freighted annually out of the area (HNWCP, 1996).

#### ***2.3.4 Wetlands as Centre for Food Supply***

It is in this context that wetland is believed to have both their greatest value and also face their greatest threat (Denny 1985). Reimold (1994) describes wetland as area for food chain support. Floodplains/wetlands ecosystems are comprised of two complementary phases; aquatic (during which they are submerged) and terrestrial, following drawdown. During the aquatic phases, wetlands plants can be harvested directly as fodder crops for livestock. During the dry season African wetlands are used extensively for livestock grazing.

The annual net benefits of fourteen agricultural crops grown in the flood plain of the Hadejia-Nguru wetlands, as found out by Barbier, Adams and Kimmage

(1993) shows that, at 1989 - 1990 prices, each of the 230,000 hectares that were cultivated in the wetlands yielded agricultural crops with a net worth totaling ₦54,970,000 for the wetlands as a whole. When converted to the 1996 rate the total amount was ₦604, 670,000 if yield remained the same. Wetlands soils are generally suitable for rice cultivation, especially in Nigeria use of wetland is indeed limited in areas where rice is not a major or even a minor crop (Akamigbo, 2001)

Based on the foregoing discussion, it can be concluded that wetlands in Africa and especially the Hadejia Nguru wetland are valuable assets which should not be wasted considering over 1.5 million inhabitants of the area and the worth of goods and services they provide.

### ***2.3.5 Wetlands as Fish Habitat***

The fisheries potential of African wetlands is enormous and yet is under exploited (Denny 1985). An important aspect of fish productivity in the wetland systems is that of interface areas. This interface (moderately emergent vegetation with open water) is essential for providing feeding, breeding and sheltering areas for fish in all of the large shallow African fisheries.

The most productive wetlands from wildlife and fishery point of view are those with a complex structure and zonation, with areas of open water interspersed with vegetation (Weller, 1978), Toews and Griffith (1979) found gillnet catches in the Bangweuly Swamps to be three times than the open lake. Also, Barbier et al (1993) reported that each of the 100,000 hectares that are fished in the HNW gave a

catch with a net worth of ₦17,900,000 in 1989-1990, and if converted to the rate at the time of report, it means an annual catch worth of ₦ 196,900,000 (Bdliya, 1997).

#### **2.4 Approaches to aquatic weed problems**

Denny (1985) identified three major approaches of classifying aquatic (water) weed problems. The first is to arrange the problems in terms of the growth form and occurrence in the water bodies (i.e. submerged, floating, and emergent, etc) of the principal plants involved. Many control measures are related to the plants' position in water and this approach has the benefit of facilitating comparisons between like problems.

The second approach is to recognize that water weeds are weeds primarily in relation to their interference with water use and to classify weed problems in terms of their interference with recreation, water flow, use of water for agriculture, human consumption, the spread of disease. This approach could become a catalogue of events except ecological factors are taken into consideration.

The third approach is to classify weed problems in terms of the nature of the water body (e.g. farm dam, man-made lake, river, channel, etc). As in the first approach there is a number of ecological factors that are common to these water bodies, and this raises the possibility of predicting the occurrence, course and outcome of weed infestation in water body.

In this study, an hybrid approach (combination of the three) is adopted, that is in as much as the focus of this study is on the impact of Typha on water use in the

wetlands, an understanding of the plant ecology and perhaps adaptation shall equally be given due consideration so as to facilitate the choice of appropriate weed management programme in the wetlands.

#### **2.4.1 Typha Grass: The Ecology and Morphology**

Akobundu (1987) identified Typha grass as one of the prominent emergent macrophytes in wetlands or flooded areas and perhaps among the notorious plants causing economic hardship in the tropics.

Typha is an emergent monocotyledon which produces erect, approximately linear leaves from extensive anchoring systems of rhizomes and roots. Epidermal cells are elongated parallel to the long axis of the leaf, which allows flexibility for bending. The cell walls are heavily thickened with cellulose, which provides the necessary rigidity. The root and rhizome systems of Typha exist in permanently anaerobic sediments and must obtain oxygen from the aerial organs for sustained development. Similarly, the young foliage under water must be capable of respiring anaerobically for a brief period until the aerial habitat is reached, since the oxygen content of the water is extremely low in comparison to that of the air. Once the foliage has emerged into the aerial habitat, the intercellular gas channels and lacunae increase in size, thus facilitating gaseous exchange between the rooting tissues and the atmosphere.

There are two main species in Africa according to (Denny, 1985). They are *Typha capensis* and *Typha dominigensis*, of which the later is widespread. Typha may

persist for several years even in the absence of a flooding regime. It is both more droughts tolerant and salt resistant, and can reproduce sexually through seeds for a large area of colonization and asexually through the rhizome for denser average within the immediate area.



**Plate1: A colony of Typha Grass intersperse with open water at Bambori**

Typha grass under favourable condition (shallow inundated area), proliferate and become difficult to control, making the plant an invasive species. Under such condition it out competes almost all other plants of Hadejia-Nguru wetland in particular and other parts of Hadejia- Nguru Jama'are Komadugu Yobe

Basin In general the proliferation of Typha grass has for the past seven years constituted a strong threat to wetlands economy (DFID, 2003).

## **2.5 Nature of aquatic weed problems.**

Aquatic Weeds cause a variety of problems in Africa that are broadly similar to those caused by aquatic weeds elsewhere in the world (Mitchell, 1976, 1978).

Akobundu (1987) identified several problems caused by aquatic weeds like the Typha grass. Prominent among these problems (i) Loss of water through evapotranspiration, (ii) flow of water (iii) competition with wetland rice (iv) shelter for mosquito and (v) water quality by adding taints and odours to the water (Akobundu, 1987).

### ***2.5.1 Effect of Aquatic Plant (Typha grass) on evapotranspiration water loss.***

The effect of Typha or any other water plant on evapotranspirative water loss has been mixed (Denny, 1985). On the one hand there is evidence of considerable quantities of water lost from wetland system, while other studies are in contrast.

Burian (1971) measured an average consumption, during the 190 day period of main growth of 1 metre of water by 1m<sup>2</sup> of the reed, phragmites Australia, in the reed, swamps fringing the Neusiedler see, Australia. Over the same period the open water of the lake lost 70mm of water and the free water in the swamp itself lost 400mm which indicate that the aquatic plants lose considerable quantities of water by evapotranspiration.

Wetzel (1999) reported a comparative study of water loss from a stand of the emergent aquatic plant such as *phragmites communis*, Typha, and that of open

water, in Berlin, Germany which showed that water loss from the former is greater as compared to evaporation from open water with transpiration-evapotranspiration as high as 4:1.

Wetzel (2001) however, concluded that among aquatic macrophytes such as *Typha*, population density is important in the regulation of transpiration rates, that evapotranspiration water losses by this plant in the wetlands can be effective that the plants can significantly reduce the water level not only the wetlands but also the surrounding terrestrial area.

In contrast to the above findings, Rijks (1969) found that a papyrus infested swamp (an emergent aquatic plant like *Typha*) in Uganda lost 60% of the water being lost from adjacent open water. Linacre et al (1970) obtained similar results in Australia and found that water lost from the wetland swamp was half to a third of that from the adjacent lake of open water. However Linacre et al (1970) observed that the water loss after the rain was about the same.

Timmer and Weldon (1967) and Breizny et al (1973) made direct measurements of evapotranspiration from communities of aquatic plants and evaporation of open water. While Brenzy et al obtained the following evaporation: evapotranspiration ratios in Rajasthan India –1.00:1:26 for *Eichornia crassipes* and 1:00: 2.41 for *Typha capensis*\_\_ . Timmer and Weldon (1967) in their earlier study have shown that evapotranspiration losses from these plant communities especially

*Eichornia crassipes* (water hyacinth) can be higher than evaporation losses by by 3.7 times.

From the various findings reviewed above, it is clear that certain parameter influence the result and findings on evapotranspirative water loss of aquatic plants. These are (i) Type of plant under investigation (ii) The density or coverage (Wetzel 2001), the period of investigation (Linacre et al (1970) and the choice of method use (direct measurement or indirect measurement).

### ***2.5.2 Aquatic Plants and Transport***

Okafor (1980, 1982) estimated that over 2000 sq km of the Nigerian sectors of Lake Chad were infested with aquatic vegetation following the 1972-73 Sudano-Sahelian droughts. This condition he noted drastically interferes with transport and fishing. Fishing is directly impeded and the delay in transporting fish from where they are caught to the points of export results in a high proportion of spoilage (Okafor 1982). Among the emergent plant listed to have infested the lake are *Papyrus*, *Phragmites* Australia and *Typha domingensis*.

Swanson (1992) reported that while driving around Bowdon NWR in US, a number of wetlands were noticed to have been overrun by cattails (*Typha*). He observed that the grass has created a dense mat of dead and standing vegetation with no open water, making it unusable for a variety of wild life and even transportation. At Goronyo Dam in the Sokoto – Rima projects, Magaji (2007) revealed that *Typha* infestation has reduced the river channel capacity which not only obstructing flow of

water but equally causing flooding of farmlands which result in extensive damage to life and property.

### ***2.5.3 Aquatic Plants and Wild life/Fish Population***

A study on the effect of aquatic plant on wild life and fish population is equally controversial. While some studies show a positive relationship between aquatic plants and wild life populations, others have demonstrated how aquatic plant could be a hindrance to fish population and numbers of wild life, especially the wetlands birds.

Swanson (1992) wrote that cattail (*Typha* grass) is a recognizable aquatic wetland plant that provides excellent cover and nesting habitat for certain wild life.

The opinions of Swanson and Kennish ran contrary to the earlier writing of Howard-Williams (1979) which said areas where emergent vegetation is dense, deoxygenation occurrence is higher thereby reducing fish population except the wetland has interface areas (a moderately emergent vegetation with open water).

Thorsness et al (1992) corroborated Howard-Williams Claim. They reported that extensive cattail (*Typha* grass) infestation not only reduce movement in drainages bur equally reduce oxygenation and microbial activity in lakes and wetlands.

The growth of dense monotypic stands of cattail according to Henry and Higgin (1992) contributed to the loss of habitat and declining trends of some water fowl populations, and poor habitat for wild life (Gardner and Grue, 1996).

In line with the writing of Swanson (1992), Kennish (2000) reported that a canopy of dense leaves, typically found in the coastal wetlands causes lower insulation

than in surrounding unvegetated areas. He proceeded by saying that protection from excessive illumination and insulation make the shaded habitats appear to be particularly beneficial and presents a diversity of habitats for the protection and proliferation of fishes, birds and other organisms. From the foregoing review, it can be inferred that as much as fish and wild life requires some level of protection from aquatic plant the extent of Biomass coverage could determine the extent of wetland capacity for wild life and fish population.

#### ***2.5.4 Aquatic Plants and Area Coverage***

*Typha* produces vast quantities of long-lived and persistent seeds which can outcrop even after some dry spells, the re-emergence of *Typha* is therefore very rapid after each removal. This phenomenon makes the spread of this weed fast and difficult to controls. In Mali, it was reported that out of 60,000 ha in Niono irrigation scheme, over 15,000 ha was forfeited to *Typha* due to its resistance to control measures (Niono, 2001).

Bdliya, et al (2003) reported that Typha has occupied over 200sqkm of farmland and fishing ground out of 3500 sq km of HNW. Likewise Swanson (1992) wrote that many of the marshes at Argone National Laboratory –East (ANL-E) in U.S are dominated by narrow-leaved cattail and common cattail and reed canary grass. Swanson reported that these plants are especially prevalent in disturbed wetlands and currently approach 100% areas coverage in several areas of the wetlands.

Lyon, (1998) described Typha grass as an invasive specie whose coverage often decrease the habitat for other specie diversity by reducing the opportunity for other plant specie to become established and survive. He stated further that areas invaded by these plants may be of little use to wild life and perhaps agricultural activities.



**Plate 2: A dense canopy of Typha grass with a stream in between**

### ***2.5.5 Aquatic Plant (Typha) as Harbour to Parasite***

Denny (1985) said probably the most serious adverse effects of aquatic weeds on human welfare in the long term is the extent to which they harbour agents which are vectors for disease in man and animals, principal of which are malaria and schistosomiasis.

Parasites which cause some of the most devastating human diseases are usually animals of wetlands (Moss, 1993). Malaria is perhaps the most familiar of these disease, water among aquatic plants is ideal for mosquito breeding as long as it is not completely deoxygenated (Moss, 1993). Magaji (2007) reported that the

vegetative mass of *Typha* at Goronyo dam provides a suitable habitat for quela birds which destroy crops grown on the farmland.

Despite a number of studies that have shown that certain vectors have preferences for certain vegetation, the connection between the presence of certain disease in the human community and the aquatic vegetation in nearby water bodies is not always clear (Denny 1985). This is because in all cases the intermediate vector does not appear to be dependent on the presence of the aquatic vegetation.

## **2.6 Principles of aquatic weed management**

There are several techniques being adopted in aquatic weed management which ranges from mechanical methods, chemical method and Biological method (Denny, 1985; Swanson, 1992; Ado, 2007) to Environmental manipulation techniques and integrated system (Denny, 1985; Swanson, 1992). Each of these methods is briefly reviewed to enunciate the general principle behind it.

### ***2.6.1 Manual/Mechanical Method.***

There are two main forms of this method of weed control: cutting and dredging, the former carried out by hand and simple machine and the latter by the use of heavy machine only (Denny, 1985). The cutting tools available for manual use are mostly modified forms of agricultural tools to cut terrestrial vegetation. They have the considerable benefit of precise selection of which vegetation to remove and at which level to cut. However, the method is slow, tedious and inefficient (Denny, 1985; Ado, 2007).

The uses of mechanical devices for controlling aquatic plants are expensive and require the use of a trained operator. They are, therefore, usually only feasible for relatively large-state owned project, as was adopted at Goronyo dam project which Magaji (2007) reported to have yielded very good results.

Denny (1985) identified a number of factors to take into account when cutting methods are employed to control aquatic weeds. These include the frequency of cutting, depth of cutting and the disposal of materials. These factors could have evolved from earlier studies carried out on aquatic weed control. Singh et al (1976) found it was most effective to cut Typha grass at the flowering stage, and if they were then submerged for four after cutting weeks there was almost no regenerating.



**Plate 3: manual cutting of Typha grass in Bambori**

Sale and Wetzel (1983) have equally shown that Typha growing with their rhizomes in anaerobic condition are effectively drowned if they are repeatedly cut below the water surface.

It should however be noted that plant material left in the water after cutting will decay and generate a considerable demand for oxygen which can adversely affect other forms of life in the wetland. For example, fish died when a large of amount of vegetation has been cut and left in a small water body due to oxygen deficits. For this reason, Denny (1985) suggested cutting machines should be combined with a system

for harvesting the cut plants. This not only reduces the risk of oxygen deficits but also make it possible to make use of the harvested material.

### ***2.6.2 Chemical Methods***

This involves the use of chemicals (herbicides) to kill undesirable plants. Herbicide could be selective or non selective; contact or systematic; pre-emergence, post emergence or pre plant incorporated (Ado, 2007). This method is widely used in developed countries because of their increased effectiveness and rising labour costs. In US, the use of aquatic glyphosate-based herbicide under particular conditions has been adopted for the control of cattails (Swanson, 1992).

However, growing awareness of the risk of damage to the environment has brought chemical control under close scrutiny, and it is now used more sparingly and with more caution. This is in line with the philosophy of US integrated pest management (IPM), which emphasizes the use of tools in a way that minimizes economic, health and environmental risks (Swanson, 1992)

### ***2.6.3 Biological Control***

Of all methods of controlling aquatic weeds, biological control has experienced the most far reaching development in the last twenty years (Denny, 1985). This is the control or suppression of weeds by the action of one or more organisms, through natural means or by the manipulation of the weed organism or environment. Major developments in this area include use of vertebrate and invertebrate, use of micro organisms such as plant pathogens. The use of herbivores

to control *Typha* in African wetland has been of limited success because *Typha* plants are 70% fibrous of indigestible materials and contain about 4% protein (Gaudet, 1977). However Swanson (1992) suggested grazing by cattle could create open water in the wetland especially at early period of growth. Also, attempt has been made to explore the potential use of herbivorous fish such as Chinese grass carp to control cattails (*Typha*) in African wetland. The success rate is still debatable.

#### ***2.6.4 Environmental Manipulation***

Manipulation of water level is a good preventive aquatic weed control method because many of these plants are sensitive to change in water level at certain period of the year. This requires a good knowledge of the ecology of the weed and of the hydrology of the infested system (manning and Johnson (1975).

Imevbore (1976) attributed the absence of stable vegetation around the margin of Lake Kainji in Nigeria to the large seasonal fluctuation of water level. Even though *Typha* could withstand long dry period, Swanson (1992) says one can actually flood out or drown cattails (*Typha*); to do so the water level should be held at 1-2metres for an extended period of time, which he did not specify but which Singh suggested should not be less than four weeks (Singh, 1976). This method is currently being used in controlling cattails infestation in many wetlands areas of the U.S (Swanson, (1992).

### ***2.6.5 Integration of Control Measures***

This is a philosophy whose goal is to use all available knowledge in weed science to manage weeds in order to prevent economic losses. An appropriate integrated weed management combines two or more techniques to obtain a level of weed suppression superior to that ordinarily obtained when one technique is used (Denny, 1985; Ado, 2007). Bowdoin National Water Resources in United States uses integrated Pest Management (IPM) to control invasive species. This process uses knowledge of pest ecology and combines biological, cultural, mechanical and chemical tools in a way that minimizes economic, health and environmental risks (Swanson, 1992).

### **Conclusion**

Since the causes of most water weed problems relate to the management of aquatic systems, and the control of the weed must take account of environmental factors, water weeds cannot be managed apart from the management of the ecosystem they are infesting.

Therefore the proposals for waterweed management must be thoroughly integrated with the programme of management for the overall system.

This work opens a new research chapter on the ecological and socio- economic consequences of a peculiar weed infestation of the wetland.

## CHAPTER THREE

### METHODOLOGY

#### 3.1 Types and Sources of Data

The data for this study were obtained from reconnaissance a survey, observations, field experiment and questionnaires. Also climatic data of the study area were obtained from the meteorological centre at Nguru. Maps and diagrams of Hadejia-Nguru wetland area were obtained from Hadejia-Nguru wetland conservation project (HNWCP). The national population census 1991 and provisional result, 2006 were equally used.

Data collected through field experiment are evapotranspiration water loss, mosquito larva load (number per 100 ml) and size of fish ground and farm land under *Typha* infestation (ha). The questionnaire was designed to extract the following information: types of crop grown, estimated farm size, estimated annual yield and income, species and quantity of fish caught, fishing and farm sites, proportion of farm/fishing ground under *Typha* infestation, causes of invasion as perceived by the locals, local coping strategies/weed control.

#### 3.2 Sampling Technique

The sample frame comprises of all the villages in the Marma-Nguru Lake Complex of the Wetlands. The target population are the wetland farmers and fishermen of 16 years and above.

A total of 5 villages/settlements out of the estimated 50 villages (representing 10% of the total villages) were selected using simple random sampling techniques.

A minimum of 200 questionnaires (farmers and fishermen) were administered. To determine the distribution of the questionnaires among the sampled villages, proportional allocation techniques (Cochran, 1977) was adopted using this formula:

$$nh = Nh/N \times n$$

Where  $nh$  = number of sample household in each village

$Nh$  = the population of the individual village

$N$  = the total number of individual in the sample villages

$n$  = the total number of questionnaires to be administered

The sample frame for the field experiment consist of all the 5 villages selected out of which one village was picked using simple random Sampling. The selected village Bambori being in the same ecological zone as others served as our temporary weather station and experimental site for the period of the investigation.

### **3.3 Data Collection Procedure.**

#### ***a. Field experimental design***

A field investigation was carried out to determine the evapotraspiration Water loss, larva load accounted for by Typha invasion in the wetland and proportion of fish

ground and farm land invaded by Typha. In order to determine and compare the rate of water loss in the Wetland due to Typha infestation as against the open water.

Bambori was selected as our temporary weather station for the period of investigation (Manning, 1987). In the selected village, (1) Typha infested site of 1m<sup>2</sup> was laid at random called Site A, also, 1 site of open water at 1m<sup>2</sup> was equally laid called site B (Burian, 1971).

The maximum and minimum thermometer was installed at the Typha

Foliage in Site A to take the average daily temperature for 3 months January,

March and June to cover the period of harmattan, dryness and wet seasons.

Likewise a Piche evaporimeter was installed at the bank of the open water in Site B to measure daily evaporation for the same period. A field assistant who was also a staff at HNWCP was detailed to take these records under the supervision of the researcher.

From the record obtained in Site A, an average monthly temperature was extracted and the Blaney-Criddle (1962) method was applied to determine the potential evapotranspirative water loss due to Typha invasion. Also the record obtained in Site B was used to determine average monthly evaporation for the period under investigation. To determine the larva load due to Typha infestation, at each site A and B, water sample were collected using 100ml beaker at random and the number of mosquito larva in the sample collected for each site were counted. Averages of ten samples were collected from each site. ( appendix 1 and 11.) To determine the proportion of farmland and fishing ground infested by Typha, the researcher took the

simple linear measurement of the farm size and fishing ground area of each respondent using Linen measuring tape.

### **b. Questionnaire Administration**

Farmers and fishermen were visited on their farmland and fishing ground where questionnaires were administered. The focus is the wetland farmers and fishermen in each of the five sampled villages. Where the respondents were not literate the researcher and his assistant interpreted the quantities and recorded their responses. The administration was done between 0800hrs-1200hrs local time, being the hours the respondents were most likely to be on their respective farmland and fishing site between June – July 2008.

### **Allocation of Questionnaires in Sampled Villages**

Settlements	Population	Total allocated	Farmers	Fishermen
Wachakal N	3765	44	22	22
Zuggo	2507	29	14	15
Marma	6703	78	39	39
Adiyani	3208	37	18	19
Bambori	1041	12	06	06
Total	17224	200	99	101

Source: Survey, 2008; National Population Census figure, 1991

### 3.4 Method of Data analysis

Descriptive statistics such as totals, percentage, mean were used to summarise.

. Student t-test was employed to test the two postulated hypotheses: (i) Ho-there is no significant difference in water loss between typha infested swamp and open water wetland. (ii) Ho- typha swamp does not harbour mosquito larva more than the open water area of wetlands. Blamey- Criddle (1962) method of determining potential evapotranspiration/consumptive use (CU) was adopted.

(I) Blaney-Criddle (1962)

$$CU = Kf: \frac{f = (1.8T_m + 32) P}{39.37}$$

Where f = Monthly consumptive factor

$T_m$  = Mean monthly temperature

K = Average consumptive use or coefficient factor of the plant/crop 0.75 for typha

P = Monthly % of annual day time hours

Computing % annual day times hours

$$hdi = (hsi) (hdoi)/90$$

Where hdi =day time hours for dayi

hsi =sunrise or sunset hour angle (degree)

hdoi =day time hours at zero declination for dayi

$$P = (hdi/ha); ha = \sum hdi$$

Ha = total day time hours per year

(II) Student t-test

Where  $x_i$  = Evapotranspiration water loss (mm)

$Y_i$  = Evaporation water loss (mm)

$N_i$  = Number of months

$X_{ii}$  = Typha swamp Mosquito larva load (no/100ml)

$Y_{ii}$  = Open water Mosquito larva load (no/100ml)

$N_{ii}$  = Number of samples

## **CHAPTER FOUR**

### **RESULTS AND DISCUSSION**

#### **4.1 Introduction**

For the purpose of clarity and better understanding of the issue under study, the data and analysis are focused on the following issues in the study objectives:

- (i) Characteristics of the respondents,
- (ii) Major crops grown and fish species caught in the study area,
- (iii) Proportion of farmland and fishing ground under Typha infestation,
- (iv) Effect of Typha grass on crop yield and fish catches,
- (v) Comparative analysis of water loss in open water and Typha swamp,
- (vi) Comparative analysis of mosquito larva load in open water and Typha swamp,
- (vii) Other ecological effect of Typha grass on the wetlands.

## 4.2 Characteristics of the respondents

### 4.2 .1 Age of respondents by occupation

Majority of the respondents (both farmers and fishermen) in the study area falls within age brackets of 20-44 representing between 75-80 % of the Sampled population.

**Table 4.1 Age Distribution of Respondents**

Ages	No of farmers	%	No of fishermen	%
15-19	04	04.00	04	04.00
20-24	10	10.10	20	19.80
25-29	10	10.10	30	29.70
30-34	30	30.50	20	19.80
35-39	25	25.20	15	14.80
40-44	10	10.10	10	9.90
45-49	06	06.00	02	02.00
50and above	04	04.00	00	00
Total	99	100%	101	100%

Source: Field Survey 2008

However, the fishermen are observed to be younger than the farmers. Over 70% of the fishermen are less than 35 years as shown in table 4.2.1 as compare to farmers among whom 40% are above 35years.

The possible explanation for the age differences could be that fishing being a daily income yielding venture seems more attractive to the youths rather than farming which requires longer period to bring profit.

#### **4.2.2 Educational attainment**

Most respondents in the study area acquired Koranic /Islamic education (about 60%),

While Only few (10-15%) had primary education while none had tertiary education

**Table 4.2.2 Educational Status of Respondents**

Educational qualification	No of farmers	%	No of fishermen	%
Primary	08	08.10	15	14.80
Secondary	01	1.00	10	9.90
Tertiary	00	00	00	00
Koranic	60	60.60	60	59.50
None	30	30.30	06	5.80
Total	99	100%	101	100%

Source: Field Survey 2008

However, the fishermen appear to be more educated than farmers, about 10% of them had secondary education and only 6% had no formal education at all compares to farmers 1% and 30% respectively.

### 4.3 Major crops grown in HNW

Rice, wheat, and cowpea are the major crops being cultivated in the wetlands by the farmers of which 80% of the farmers grow rice as a principal crop.

**Table 4.3** *Types of Crop Grown As Major In the Wetlands*

Crops	No of farmers	%
Rice	90	90.90
Wheat	05	5.10
Cowpea	02	2.00
Millet	02	2.00
Total	99	100

Source: Field Survey 2008

Rice is popular in the area not only because of favourable ecological conditions but also of its high returns to investment. This confirmed Barbier et al (1993) findings on net benefits of selected agricultural crops in the flood plain of the HNW

#### 4.4 Major fish species caught in the study area

There over 10 different species of fish being caught in the study area of which four are the most commonly caught.

*Table 4.4 Major Types of Fish Specie Caught In the Wetland*

Fish specie	No of fishermen	%
Tarwada (mud fish) (Clarias spp.)	42	41.60
Karfasa (tilapia spp.)	40	39.60
Karaya (cat fish)	15	14.80
Musko (baqrus spp.)	04	4.00
Total	101	100

Source: Field Survey 2008

Tarwada (mud fish) and Karfasa (tilapia) accounted for over 80% of total catch in the study area especially in Bambori and Wachakal Ngurodi. Two factors could provide possible explanation for this. First these species are relatively larger than others species which made it easier to be caught by their nets, secondly the species are found to have suitably adapted to the environment.

#### 4.5 Proportion of farmland / fishing ground under Typha infestation

All the 99 farmers in the five selected settlements affirmed that Typha grass is a serious problem on their farmland. The proportion of infestation ranges from over 80% in Wachakal to 90% in Marma

*Table 4.5.1 Proportion of Farmland under Typha Infestation*

Settlements	No of farmers	Total farm size sampled (ha)	Total farm size infested by typha (ha)	Percentage under Typha
Wachakal	22	748.69	647.32	86.46
Zuggo	14	242.80	202.35	83.33
Marma	39	809.40	728.46	90
Adiyani	18	202.35	161.88	80
Bambori	06	161.85	121.41	75

Source: Field Survey 2008

There is no clearly defined size of area like the clearly demarcated farmland. The fish ponds/streams are commonly owned by fishermen but being administered by Sarki Ruwa in each of the territory. However, the fishermen were able to identify fishing routes, streams and ponds where fishing activities are carried out. Most of the fishermen equally affirmed that between 60 -70% of fishing routes have been infested by Typha.

**Table 4.5.2 Estimated Proportion of Fish Ground under Typha Infestation**

Proportion under Typha	No of respondents
0%-20%	15
21-40%	34
41-60%	50
Above 60%	12

Source: Field Survey 2008

It is quite difficult to empirically confirm the fishermen estimate through field measurement as in the case of farmland due to the terrain which is waterlogged thus making accessibility tasking. However, the few ponds that are accessible shows that 60% Of the fish ponds are being taken over by the Typha grass

#### **4.6 Effect of Typha Grass on Crop Yield/Output**

The presence of Typha grass on farmland and fishing ponds in the study area has become a worrisome phenomenon as over 80% of farmland is under the grass infestation table 4.5.1 and, 60% of the fishermen confirmed it as a serious threat table 4.5.2. Few respondents who cultivate small size of farm land are less threatens because they are able to overcome re emergence through continuous weeding and burning over a long period of time.

**Table 4.6 Effect of Typha on Crop Yield**

Crop types	Average yield before typha infestation/ after weeding (kg)	Average yield in typha swamp (kg)
Rice	45kg/ha	2.1kg/ha
Wheat	20kg/ha	1kg/ha
Cowpea	15kg/ha	1.4kg/ha
Millet	12kg/ha	1.2kg/ha

Source: Field Survey 2008

Information was solicited from the respondents to identify any effect the grass has on the crop yield or output. The response is quite revealing and interesting. For instance an average of 1 bag of paddy rice which weigh between 45-50kg is observed to be harvested per hectare in a non-Typha infested farmland, the output however reduce significantly by 90% in a Typha infested area and this greatly affect the income level of the farmers negatively. Many farmers said leaving Typha on the farmland could result in total crop loss. Farmers with large farm (20-40ha) particularly noticed a significant reduction in rice yield in any sector of their farmland being overgrown by Typha grass.

#### 4.7 Effect of Typha Grass on Fish Catch

The effect of Typha grass on fish catch varied and is felt much more by fishermen than farmers. While the farmers have the advantage of weeding and burning the grass, this option is much more difficult on fish ponds and streams, not only that manual cutting could be tasking but burning is nearly impossible in waterlogged Typha swamp. A comparison between average catch in non Typha pond especially in Bambori and Garbi and Typha swamp in Wachakal Ngurodi show a remarkable difference.(Table 4.7)

**Table 4.7 Effect of Typha on Fishing**

Fish specie	Average catch in non typha swamp / open water (kg)	Average catch in Typha swamp (kg)	Percent ( $\pm$ )
Tarwada (mud fish) (Clarias spp.)	70kg/week	7kg/week	-90%
Karfasa (tilapia spp.)	50kg/week	10kg/week	-80%
Karaya (cat fish)	50kg/week	4kg/week	-92%
Musko (baqrus spp.)	30kg/week	3kg/week	-90%

Source: Field Survey 2008

An average of seven Daro (basin) which roughly weigh 70kg (a Daro weighs about 10kg) is caught per week in non Typha pond as compare to one Daro in Typha swamps. It is interesting to note that though the grass reduce the quantity of fish caught yet this does not necessarily reduces the fish yield or numbers in the ponds as Typha grass provides a good habitat for fish to spawn and hide. This finding supports

Swanson (1992) reports that Typha foliage provides excellent cover for certain wild life such fish and birds.

The reduction in quantity of fish caught is due mainly to inaccessibility of fishermen to the fish ponds due to dense canopy of the Typha . It therefore means Typha grass could be used as conservative measures to protect over fish specie

#### **4.8 Typha swamp and mosquito larva load**

Bambori, a settlement three kilometres west of Nguru was selected as our experimental site where 10 sample of water were randomly taken from both Typha swamp and open water (Typha free water ponds). The table below shows the result of the experiment.

***Table 4.8 Mosquito Larva Load in Typha Swamp and Open Water***

Sample point	Mosquito load in Typha swamp (number/100ml)	Mosquito load in open water (number/100ml)
1	07	03
2	06	02
3	16	04
4	14	04
5	10	02
6	21	01
7	01	00
8	02	01
9	04	03
10	11	02
N=10	92	22

Source: field survey 2008

These results were subject to student t- test to determine if there is any significant difference between mosquito load in Typha swamp and open water. The results of statistical test shows that the calculated t value of 5.124 is greater than the critical t value of 2.10 at 95% significant level ( Appendix 1V for statistical details). This is to say there is a significant difference between the two sampled means, the Ho (ii) is therefore rejected. It therefore means that Typha swamp harbour more mosquito larva than the open water.

The possible explanation for this could also be that Typha grass provides a good habitat for the laying and hatching of mosquito eggs as it shelters it against high insolation and wind speed. This finding agrees with Moss (1993) reports on the role of aquatic plants in harbouring parasite.

#### **4.9 Evapotranspiration Water Losses: Open Water and Typha Swamp**

The evapotranspirative water loss was obtained from monthly mean temperature of Typha foliage for the months of January, March and June using Blaney-Criddle (1962) formula. This was compared with evaporation water loss from open water using piche evaporimeter for the same months. See table 4.9 below.

**Table 4.9 Total Monthly Evapotranspiration and Evaporation Water Loss  
From Typha swamp and open water**

Months	Xi(mm)	Y1(mm)
January	338	328
March	480	499
June	361	246
Total	1179	1073

Source: Field experiment, 2008

In Table 4.9 X1 stands for monthly Evapotranspiration water loss obtain from Blaney-Criddle (1962) using monthly mean temperature From Typha foliage, while Y1 stands for total monthly Evaporation water loss of open water using piche evaporimeter.

The data in table 4.9 was subject to student t-test for possible differences, the result shows that the calculated t value of 0.09 is less than the critical t value of 2.78 at 95%.

The Ho (i) is therefore accepted, implying that there is no significant difference in water loss between the two samples. The comparative analysis on evapotranspirative water loss does not show any significant difference between Typha swamp and open water and therefore it may not have been the reason for the reduction in water level in the wetlands. However, a preliminary observation shows that the grass being a good

‘trapper’ of sediment could have facilitated accumulation of sediment which perhaps lower the water depth and consequently reduce the water level.

#### **4.10 Methods of typha Controls among the Locals**

Manual weeding is the commonest method being adopted by most respondents to control Typha in the study area Table 4.10

***Table 4.10 Typha Control Measures in the Study Area***

Methods	Respondents	%
Manual weeding	180	90
Machine(cutting)	15	7.5
Chemical	05	2.5
Biological	00	00

Source: Survey, 2008.

Though the majority of fishermen and farmers use manual weeding as control measure yet the success rate is much higher among farmers than fishermen. The use of biological control is nil, while chemical is rarely used only by the few educated ones. Manual weeding involve cutting by using cutlass and sickle as shown on plate

## CHAPTER FIVE

### SUMMARY, CONCLUSION AND RECOMMENDATION

#### 5.1 Summary

A total of 200 questionnaires were administered to respondents distributed on almost equal basis between farmers (99) and fishermen (101), most of the respondents falls within the age bracket of 22-44 years, though the fishermen are observed to be younger than farmers. Also majority of the respondents had koranic education while only few, about 10% had primary and secondary education. The fishermen equally appear to be more educated than farmers.

The major crop grown in the study area are rice, wheat, millet, cowpea of which rice alone accounted for over 80% of total crop grown in the wetlands, while Mud fish (Tarwada) and Tilapia (Karfasa) accounted for more than 70% of total fish catch.

The findings reveals that Typha grass has become a serious threat to farming and fishing activities in the study area as more than 80% of the farmland are under typha infestation, while over 60% fishermen affirmed that Typha has taken over the fish ponds and streams.

The findings reveal the followings as directs effect of Typha infestation in the study area:

- \* Reduction in crop yield by over 90% on infested as compared to non infested area,
- \* Reduction in quantity of fish caught by 80%, and indirectly,
- \* By reducing personal household income,

\* Increase in labour input in terms of time allocated for weeding.

\* This study equally reveals that Typha grass harbour mosquito larva more than the open water and therefore provides a good source for mosquito breeding.

On local coping strategy, manual weeding is the common and popular method being used by the people in the study area of which the success rate is much higher among the farmers than the fishermen.

## **5.2 Conclusion**

Based on the available data obtained and analysed, the following conclusion are drawn:

- Typha grass has become a serious threat to the livelihood of the people as most of their farmland and fish ponds have been taken over by the grass.
- The control measure or coping strategy has only been limited to manual weeding which is energy sapping and time consuming.
- That Typha has become a health risks as findings shows that it harbours mosquito larva than when it is absence.
- That no tangible assistance is being provided from government or donor agencies to help in fighting the menace pose by Typha.

### 5.3 Recommendations

The following recommendations are therefore suggested:

- Given the success rate manual weeding has achieved it is suggested that the practice should be continued and strengthened by making the simple hand tools much more available and affordable
- Also given the various effect identified in this study, the entire Hadejia - Nguru Wetlands (HNW) should be declared an ecological disaster zone.
- Massive mechanical weeding should be introduced to supplement the manual weeding, and this requires the assistance of government and international organizations through provision of heavy machines and funds for the maintenance of the equipment
- It is interesting and revealing to note that Typha provides a good cover for fish, in as much as Typha swamp should be cleared for open water, a considerable portion should be preserved by leaving then undisturbed and designated as non fishing area so as to avoid over fishing as a result of opening the wetlands.
- It is recommended that all Typha infested ponds, streams and land within 1-2km radius to a settlement should be removed as a matter of urgency so as to reduce the spread of malaria disease.

- Effective mass literacy programme should be provided for the youths in the area in order to enhance their vocational skills especially as it is related to fishing and farming.

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## APPENDIX 1

### QUESTIONNAIRE ON THE THREAT OF TYPHA GRASS ON HADEJIA- NGURU WETLAND UTILIZATION

Location/name of settlement-----  
-----

Age-----  
-----

Sex-----  
-----

Marital Status-----  
-----

Educational status-----  
-----

#### To be completed by farmer

Farm Size-----  
-----

Types of crop grown

Crop type	Yield (kg)	Price/kg

Does typha (Kachalla) grow on your farmland?

Yes  No

For how long have you noticed the grass on your farm land?  
-----

Is the grass of local specie or foreign

Yes  No

What proportion/size of the farmland covered by the grass-----  
-----

Which of the option do you use to fight the grass?

- (i) Abandon the infested farmland
- (ii) Weeding of the grass
- (iii) Abandon Farming

If weeding specify the method

- (i) Manual

- (ii) Machine
- (iii) Chemical
- (iv) Biological
- (v) Environmental manipulation
- (vi) Integrated method

How successful is method adopted?

- (i) Very successful
- (ii) Successful
- (iii) Partly successful
- (iv) Total failure

Has the grass affected your farm output? Reduced  Increase  No change

In what ways has affected your farm operation?

- (i) Extra cost
- (ii) Time wasting
- (iii) Delay planting period

Has typha infestation reduced water fowl population in recent years? Yes  No

Does typha provide harbour for mosquito breeding? Yes  No

Is there any measure being taken by the government to assist Yes  No

Suggest ways of combating this problem

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**APPENDIX 11**

**QUESTIONNAIRE ON THE THREAT OF TYPHA GRASS ON  
HADEJIA- NGURU WETLAND UTILIZATION**

Location/name of settlement-----  
-----

Age-----  
-----

Sex-----  
-----

Marital Status-----  
-----

Educational status-----  
-----

**To be completed by fishermen**

Fishing ground Size-----  
-----

Fish species and quantity

Fish specie	Quantity (kg)	Price/kg

Does typha (Kachalla) grow on your fish ground?

Yes  No

For how long have you noticed the grass on your fish ground?  
-----

Is the grass of local specie or foreign

Yes  No

What proportion/size of the fish ground covered by the grass-----  
-----

Which of the option do you use to fight the grass?

(I) Abandon the infested fish ground

(ii) Weeding of the grass (iii) Abandon fishing

If weeding specify the method

(i) Manual

(ii) Machine

(iii) Chemical

- (iv) Biological
- (v) Environmental manipulation
- (vi) Integrated method

How successful is method adopted

- (i) Very successful
- (ii) Successful
- (iii) Partly successful
- (iv) Total failure

Has the grass affected fish output? Reduced  Increase  No change

In what ways has it affected your fishing operation?

- (i) Extra cost
- (ii) Time wasting
- (iii) Delay fishing period

Has typha infestation reduced water fowl population in recent years? Yes  No

Does typha provide harbour for mosquito breeding? Yes  No

Is there any measure being taken by the government to assist Yes  No

Suggest ways of combating this problem

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## APPENDIX 111

**Table 4.9 Total Monthly Evapotranspiration and Evaporation Water Loss**

**From Typha swamp and open water**

Months	Xi(mm)	Yi(mm)	X <sup>2</sup> i	Y <sup>2</sup> i
January	338	328	114244	107584
March	480	499	230400	249001
June	361	246	130321	60516
Total	1179	1073	474965	417101

$$\bar{X}_i = 393 \quad \bar{Y}_i = 358 \quad \sum X^2_i = 474965 \quad \sum Y^2_i = 417101$$

$$t = \frac{35}{\sqrt{\frac{(474965/3)-393^2}{3-1=2} + \frac{(417101/3)-358^2}{3-1=2}}}$$

$$\frac{35}{\sqrt{48302}}$$

$$\frac{35}{385}$$

$$t = 0.09$$

$$d.f = (3-1) + (3-1) = 4$$

**Decision:** The calculated value of  $t = 0.09$  is less than the critical value of 2.78 at 95% the  $H_0$  is accepted, that is there is no significant difference in water loss between Typha swamp and open water

## APPENDIX 1V

### Mosquito larva load in Typha swamp and open water

Sample no	X <sub>ii</sub>	Y <sub>ii</sub>	X <sub>ii</sub> <sup>2</sup>	Y <sub>ii</sub> <sup>2</sup>
1	07	03	49	09
2	06	02	36	04
3	16	04	256	16
4	14	04	196	16
5	10	02	100	04
6	21	01	441	01
7	01	00	01	00
8	02	01	04	01
9	04	03	16	09
10	11	02	121	04
N=10	92	22	1220	64

$$\Sigma X_{ii} = 92 \quad \Sigma \bar{X}_{ii} = 9.2 \quad \Sigma X_{ii}^2 = 1220 \quad \Sigma Y_{ii} = 22 \quad \Sigma \bar{Y}_{ii} = 2.2 \quad \Sigma Y_{ii}^2 = 64$$

$$t = \frac{9.2 - 2.2 = 7.0}{\sqrt{\frac{220/10 - 9.2^2}{10-1} + \frac{64/10 - 2.2^2}{10-1}}}$$

$$t = \frac{7.0}{\sqrt{1.42 + 0.47} = \sqrt{1.866}}$$

$$t = 5.124$$

$$d.f = (10-1) + (10-1) = 18$$

**Decision:** Since calculated value of 5.124 is greater than critical value of 2.10 at 95%,  $H_0$  is rejected and alternative hypothesis is accepted that is there is a significant difference in mosquito larva load between Typha swamp and open water