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Theme:

Climate-Smart Agriculture in the Post
COVID Era:

A Gate Way to Food Security in Africa



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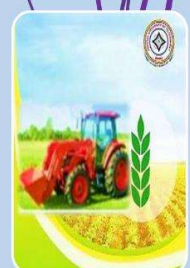
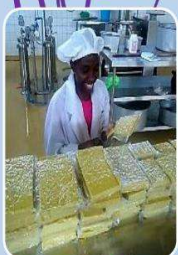
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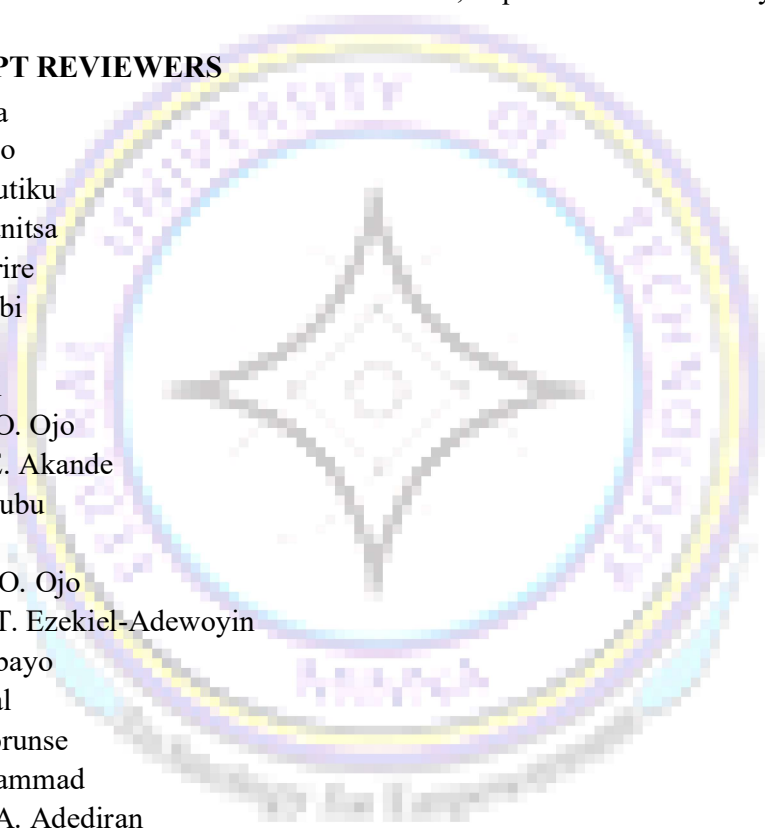
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TABLE OF CONTENTS

PROGRAMME OF EVENTS	VII
SUSTAINABLE CROP PRODUCTION PRACTICES FOR CLIMATE RESILIENCE FOOD AND NUTRITION SECURITY	3
AGRICULTURALECONOMICS EXTENSION AND RURAL SOCIOLOGY	9
1 ADOPTION INDEX OF MAIZE PRODUCTION TECHNOLOGIES AND CORRELATION MATRIX IN SMALLHOLDER SYSTEMS	10
2 RURAL WOMEN AND AGRO – PROCESSING: A CASE STUDY OF RURAL WOMEN PARTICIPATION IN GROUNDNUT PROCESSING IN KATSINA STATE	16
3 PROFITABILITY OF DRIP IRRIGATED MAIZE PRODUCTION FOR IMPROVED FOOD SECURITY IN MAIDUGURI SEMI-ARID REGION OF BORNO STATE, NIGERIA	22
4 PROFITABILITY ANALYSIS OF POULTRY EGG PRODUCTION IN IBADAN METROPOLIS, OYO STATE NIGERIA	30
5 ADOPTION OF MODERN BEEKEEPING TECHNOLOGIES IN SELECTED LOCAL GOVERNMENT AREAS OF BENUE STATE NIGERIA	37
6 ADOPTION OF RECOMMENDED COCOYAM PRODUCTION TECHNOLOGIES AMONG FARMERS IN ENUGU STATE NIGERIA	45
7 GENDER ANALYSIS OF FARMING HOUSEHOLDS' ACCESS TO LIVELIHOOD RESOURCES IN SELECTED LOCAL GOVERNMENT AREAS OF NIGER STATE, NIGERIA	55
8 INNOVATIVE APPLICATION IN MANAGEMENT OF PROBLEMATIC SOIL (ACIDIC SOIL) UNDER MAIZE PRODUCTION IN NIGER STATE, NIGERIA	66
9 EFFECTS OF RISK MANAGEMENT STRATEGIES ON POVERTY STATUS OF RICE FARMERS IN NIGER STATE, NIGERIA	73
10 EFFECTS OF FARMER-HERDER'S CONFLICT ON THE FARMERS PRODUCTIVITY IN ADAMAWA STATE, NIGERIA	79
11 EFFECTS OF ADOPTION OF IMPROVED BEEHIVE TECHNOLOGIES ON INCOME AND WELFARE STATUS OF BEEKEEPERS IN EKITI STATE, NIGERIA	86
12 ASSESSMENT OF OUT-MIGRATION AMONG ARABLE CROP FARMERS IN KOGI STATE, NIGERIA: GENDER DYNAMIC APPROACH	93

13	THE EFFECT OF AGRITECH STARTUPS ON PARTICIPATION AND POVERTY STATUS OF ADOPTERS IN OGUN STATE, NIGERIA	102
14	MICROBIOLOGICAL QUALITY OF OVEN ROASTED PLANTAIN (<i>MUSA PARASIDIACA</i>)	114
15	A REVIEW OF FOOD SECURITY AND POVERTY STATUS OF WOMEN FARMERS UNDER IFAD-VCDP IN NIGER STATE, NIGERIA	119
16	COMPARATIVE ANALYSIS OF THE EFFECT OF ANCHOR BORROWERS PROGRAMME (ABP) ON FOOD SECURITY STATUS OF RICE FARMERS IN EBONYI AND KEBBI STATES, NIGERIA	126
17	EFFECTS OF LAND DEGRADATION ON CEREAL CROP PRODUCTION IN RURAL AREAS OF NIGER STATE, NIGERIA	133
18	FUNCTIONAL PROPERTIES OF CASSAVA SEED PROTEIN CON	140
19	EFFECTS OF INSURGENCY ON CROP FARMING ACTIVITIES OF RURAL WOMEN IN ADAMAWA STATE, NIGERIA	145
20	ADOPTION OF BIO-FORTIFIED FOOD CROP IN NIGERIA: A REVIEW	151
21	DETERMINANTS OF THE ADOPTION OF IMPROVED BEEHIVE TECHNOLOGIES IN BENUE STATE, NIGERIA	155
22	FUNGI ASSOCIATED WITH MILLET GROWN IN ZONE A AGRO-GEOGRAPHICAL ZONE OF NIGER STATE NORTH CENTRAL NIGERIA	169
23	GENDER ANALYSIS OF FARMING HOUSEHOLDS' ACCESS TO LIVELIHOOD RESOURCES IN SELECTED LOCAL GOVERNMENT AREAS OF NIGER STATE, NIGERIA	176
24	FARMERS' PERCEPTION OF EFFECTIVENESS OF EXTENSION AGENTS IN OSUN STATE, NIGERIA	183
25	SOCIOECONOMIC FACTORS INFLUENCING THE KNOWLEDGE AND ATTITUDE OF MAIZE FARMERS ON THE SAFE USE OF AGROCHEMICAL IN AGAIE AND BIDA, NIGER STATE, NIGERIA	190
26	A REVIEW ONEFFECTS OF BIOFORTIFIED PRO-VITAMIN A MAIZEADOPTION ON FARMER'SLIVELIHOODSTATUS IN NIGER STATE NIGERIA	197
27	YOUTH LED ENTERPRISES UNDER INPUT SUBSIDIES ON RICE PRODUCTION IN NIGER AND BENUE STATES, NIGERIA- A REVIEW	205

28	DETERMINANTS OF ACCESS TO THE AGRICULTURAL TRANSFORMATION AGENDA (ATA) PROGRAMME AND ITS EFFECTS ON RICE FARMER'S PRODUCTIVITY IN NIGER STATE, NIGERIA	211
29	A REVIEW ON THE EFFECTS OF ADOPTION OF CLIMATE-SMARTS AGRICULTURAL (C S A) PRACTICES ON THE PRODUCTIVITY OF RICE FARMERS IN KWARA AND NIGER STATE, NIGERIA	222
30	ANALYSIS OF DETERMINANTS OF MARKET PARTICIPATION AMONG LOCAL RICE FARMERS IN SELECTED LOCAL GOVERNMENT AREAS OF NIGER STATE, NIGERIA	227
31	LIVELIHOOD DIVERSIFICATION STRATEGIES AND ITS EFFECTS ON FOOD SECURITY STATUS OF RURAL HOUSEHOLDS IN KADUNA AND KANO STATES, NIGERIA: A REVIEW	237
32	DETERMINANTS OF FINANCIAL INCLUSION AMONG WOMEN UNDER RURAL FINANCE INSTITUTION BUILDING PROGRAMME IN NORTHERN NIGERIA	242
33	IDENTIFYING STAKEHOLDERS' INTEREST IN SALINE QUINOA FARMING ALONG VALUE CHAIN IN MOROCCO	249
34	EFFECT OF CLIMATE-SMART AGRICULTURAL PRACTICES ON FOOD SECURITY OF RURAL FARMING HOUSEHOLD IN SOUTHWEST, NIGERIA	258
35	EFFECTS OF LAND TENURIAL SYSTEM ON THE PRODUCTIVITY OF SMALLHOLDER RICE FARMERS IN NASARAWA STATE, NIGERIA	265
	ANIMAL SCIENCE/PRODUCTION	272
36	EFFECT OF DIFFERENT PROCESSING METHODS ON NUTRIENTS AND ANTI-NUTRIENT COMPOSITION OF LEUCAENA (<i>LEUCAENA LEUCOCEPHALA</i>) SEEDS	273
37	PERFORMANCE OF ARBOR ACRE BROILER CHICKENS FED DIET ENRICHED WITH VARYING LEVELS OF NANO ZINC SUPPLEMENTATION AT FINISHER PHASE	279
38	DIVERSITY AND COMPOSITION OF UNDERSTORY SPECIES IN <i>CEDRELA ODORATA</i> AND <i>PINUS CARIBAEA</i> PLANTATIONS IN OMO BIOSPHERE RESERVE, AREA J4, OGUN STATE	284
39	ASSESSMENT OF MATING PROFILE OF RED SOKOTO BUCKS ADMINISTERED VARYING DOSAGE OF ETHANOLIC EXTRACT OF TIGER NUT (<i>CYPERUS ESCULENTUS</i>)	296
40	APPARENT NUTRIENT DIGESTIBILITY AND PERFORMANCE OF GROWER PIGS FED ENERGY AGRO BY-PRODUCTS	301
41	FREE RADICAL SCAVENGING ACTIVITY OF SELIM POD (<i>XYLOPIA AETHIOPICA</i>)	306

42	ASSESSMENT OF DIFFERENT DOSES OF AQUEOUS RED HOT PEPPER EXTRACT ON THE GROWTH PERFORMANCE OF THREE BREEDS OF BROILER CHICKENS	311
43	ANTIOXIDANT ACTIVITY OF SUN-DRIED TROPICAL LEMON (CITRUS LIMON) PEEL	316
44	EVALUATION OF <i>SYZYGIUM AROMATICUM</i> (CLOVE BUD) AS A POTENTIAL SOURCE OF NATURAL ANTIOXIDANT	322
45	GROWTH PERFORMANCE AND NUTRIENT DIGESTIBILITY OF RABBITS FED DIETS CONTAINING SHEA BUTTER CAKE FERMENTED WITH <i>ASPERGILLUS NIGER</i>	326
46	MEAT QUALITY CHARACTERISTICS OF WEANER RABBITS FED DIETS CONTAINING SHEA BUTTER CAKE FERMENTED WITH <i>ASPERGILLUS NIGER</i>	331
47	GROWTH PERFORMANCE AND CORRELATION MATRIX OF SAVANNA BROWN GOATS FED ENZYME TREATED SAWDUST DIETS AS REPLACEMENT FOR MAIZE OFFAL	336
48	EFFECT OF BODY WEIGHT AND METHOD OF CASTRATION ON THE COLD AND HOT CARCASS CHARACTERISTICS OF SAVANNA BROWN GOATS	341
49	INFLUENCE OF CLIMATE EXTREMES ON LIVESTOCKS' DISEASES OCCURRENCE IN BURKINA FASO	347
50	MEAT YIELD AND CARCASS CHARACTERISTICS OF BROILER CHICKENS FED <i>MORINGA OLEIFERA</i> LEAVE POWDER AS ALTERNATIVE TO SYNTHETIC LYSINE	348
51	SEMEN CHARACTERISTICS OF RABBIT BUCKS FED GRADED LEVELS OF <i>NEWBOULDIA LAEVIS</i> LEAF MEAL	356
52	PROXIMATE COMPOSITION OF RAW AND PROCESSED FULL-FAT LEBBECK (<i>ALBIZIA LEBBECK</i>) SEEDS	364
53	GINGER (<i>ZINGIBER OFFICINALE</i>) AS FEED SUPPLEMENT: INFLUENCE ON GROWTH PERFORMANCE AND HEALTH OF GROWING RABBITS – A REVIEW	368
54	ASSESSMENT OF MIXTURES MEAL OF BREWERS DRIED GRAINS AND SORGHUM BREWERS DRIED GRAINS ON GROWTH AND NUTRIENT DIGESTIBILITY OF WEANER RABBITS	374
55	MODELLING OF PHENOTYPIC TRAITS AS DETERMINANTS OF BREEDING POTENTIALS OF CATTLE UNDER LOW EXTERNAL INPUT	380
56	ASSESSMENT OF MATING PROFILE OF RED SOKOTO BUCKS ADMINISTERED VARYING DOSAGE OF ETHANOLIC EXTRACT OF TIGER NUT (<i>CYPERUS ESCULENTUS</i>)	386

57	EFFECTS OF CRUDE OR SYNTHETIC ENZYMES ON THE DIGESTIBILITY OF BROILER FINISHER CHICKENS FED GROUNDNUT-COWPEA SHELL BASED DIETS	391
58	GROWTH PERFORMANCE AND EGG PRODUCTION OF JAPANESE QUAILS FED DIFFERENTLY PROCESSED (<i>LEUCAENA LEUCOCEPHALA</i>) BASED DIETS	396
59	EFFECTS OF THE METHANOL LEAF EXTRACT OF NEWBOULDIA LAEVIS ON OESTROGEN LEVELS DURING PREGNANCY IN RABBIT DOES IN KADUNA STATE, NIGERIA	402
60	GROWTH AND BODY MORPHOMETRIC PARAMETERS OF BROILER CHICKENS ORALLY ADMINISTERED VARYING LEVELS OF LEMONGRASS EXTRACT, AT FINISHER PHASE	409
61	THERMOREGULATORY RESPONSES IN PERIPARTURIENT SAHELIAN AND WEST AFRICAN DWARF GOATS DURING THE HOT-DRY SEASON IN THE NORTHERN GUINEA SAVANNAH ZONE OF NIGERIA	417
62	GROWTH PARAMETERS OF RATS FED VARYING RATIIONS OF EDIBLE CHITOSAN-STARCH FILMS PACKAGING	423
63	EFFECT OF BREED AND SEX ON PELT GROWTH OF NEW ZEALAND WHITE AND CHINCHILLA GIGANTAS RABBITS	433
64	WATER QUALITY ASSESSMENT OF THE PROPOSED KWADNA RESERVOIR WITHIN GIDAN KWANU MAIN CAMPUS, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, NIGERIA	440
65	PHYLOGENY BETWEEN <i>CLARIAS GARIEPINUS</i> AND <i>HETEROBRANCHUS BIDOSALIS</i> INFERRED FROM SINGLE NUCLEOTIDE POLYMORPHISMS (SNPS) DNA MARKERS	447
66	EFFECTS OF PHOTOPERIOD AND FEEDING RATE ON THE GROWTH PERFORMANCE AND FEED UTILIZATION OF <i>CLARIAS GARIEPINUS</i>	452
67	IMPACT OF COVID-19 INDUCED LOCKDOWN ON AQUACULTURE PRODUCTION IN MINNA, NIGER STATE, NIGERIA	457
68	EVALUATION OF ADAPTIVE PLASTICITY IN WILD <i>SAROTHERODON GALILAEUS</i> AND <i>COPTODON ZILLII</i> IN CONCRETE POND	464
69	EFFECT OF PROCESSED SELECTED MEDICINAL PLANTS DIETS ON HAEMATOLOGICAL PARAMETERS OF <i>CLARIAS GARIEPINUS</i> (BURCHELL, 1822)	472
70	ASSESSMENT OF INORGANIC FERTILIZER ON FRESHWATER FISH CULTURE IN NIGERIA	480
71	UTILIZATION OF MAIZE BRAN CHEMICAL HYDROLYSATE USING MINERAL ACID IN THE	

PRATICAL DIETS OF CLARIAS GARIEPINUS	486
72 SENSORY AND PROXIMATE COMPOSITION OF 'BISCUIT' PRODUCED FROM SOME LESS VALUED DRIED FISH POWDER	492
73 PROXIMATE AND SENSORY ASSESSMENT OF AADUN PRODUCED FROM MAIZE AND GROUNDNUT PASTE	499
74 NUTRI-CEREALS AS POTENTIAL FUNCTIONAL INGREDIENTS: CHARACTERIZATION AND VALORIZATION	506
75 MICROBIOLOGICAL QUALITY OF DEVELOPED WHEAT BISCUIT FORTIFIED WITH EGG SHELL CALCIUM	507
CROP SCIENCE/PRODUCTION	512
76 EVALUATION OF SINGLE AND MIXED VIRUS-INOCULATED BAMBARA GROUNDNUT LANDRACES FOR NODULATION AND NITROGEN FIXATION	513
77 EFFECTS OF JATROPHA CURCAS LEAF EXTRACT ON THE GROWTH CHARACTERISTICS AND NEMATODE ASSOCIATED WITH TOMATO (<i>SOLANUM LYCOPERSICUM</i>)	520
78 EFFECT OF FOLIAR FERTILIZER APPLICATION ON PHYSIOLOGICAL CHARACTERISTICS AND HERBAGE YIELD OF AMARANTHUS AND CORCHORUS	529
79 YIELD AND POD SHATTERING BEHAVIOUR OF SOME SOYBEAN GENOTYPES ACROSS LOCATIONS IN NIGERIA	534
80 EFFECTS OF ROOT KNOT NEMATODE (<i>MELOIDOGYNE INCOGNITA</i>) ON THE GROWTH PERFORMANCE OF OKRA (<i>ABELMOSCHUS ESCULENTUS</i>) CULTIVARS IN MINNA, NIGERIA	541
81 EFFICACY OF SOME BOTANICAL EXTRACTS ON THE MANAGEMENT OF FALL ARMYWORM (<i>SPODOPTERA FRUGIPERDA</i> J.E. SMITH) ON MAIZE (<i>ZEA MAYS</i> L.)	555
82 RESPONSE OF <i>CORCHORUS OLITORIUS</i> (JUTE MALLOW) CULTIVARS INFECTED WITH ROOT-KNOT NEMATODE (<i>MELOIDOGYNE INCOGNITA</i>) TO PRE-SOWING TREATMENT	564
83 EFFECT OF FRUIT AGES ON MOTHER- PLANT SEED QUALITY OF "EGUSI" MELON (<i>CUCUMEROPSIS MANNI NAUDIN</i>) CULTIVARS	570
84 GRAIN YIELD OF EARLY MATURING PRO-VITAMIN A (PVA) MAIZE INBRED LINES UNDER STRIGA INFESTATION AND OPTIMAL CONDITIONS	576

85	EFFECTS OF LOCATION OF SEED IN FRUIT ON SEED QUALITY OF OKRA (<i>ABELMOSCHUS ESCULENTUS</i> (L.) MOENCH)	584
86	MORPHOLOGICAL AND SEEDS DIVERSITY IN DRUMSTICK PLANT (<i>MORINGA OLEIFERA</i> LAM.) GERMPLASM FROM NORTHERN NIGERIA	589
87	EFFECT OF VARIETY AND INTRA-ROW SPACING ON GROWTH AND YIELD CHARACTERS OF HYBRID MAIZE (<i>ZEA MAYS</i>) IN FCT	596
88	RESPONSE OF HYBRID LINES OF SWEET POTATO TO THE APPLIED PLANT EXTRACTS, WOOD ASH AND NPK FERTILIZER IN ABUJA, NIGERIA	603
89	RESPONSE OF GROWTH AND YIELD OF MAIZE (<i>ZEA MAYS</i> L.) TO LIME, INORGANIC AND ORGANIC FERTILIZER IN MOKWA, NIGER STATE OF NIGERIA	611
90	DETERMINATION OF IRON AND ZINC CONTENTS OF RICE VARIETIES AND LAND RACES IN NIGERIA USING ATOMIC ABSORPTION SPECTROMETRY ANALYSIS (AAS)	620
89	EFFECT OF FRUIT AND MOTHER-PLANT AGES ON THE VIABILITY AND LONGEVITY OF OKRA (<i>ABELMOSCHUS ESCULENTUS</i> L. MOENCH) SEEDS	628
92	INFLUENCE OF TEMPERATURE AND AIR VELOCITY ON THE MOISTURE DIFFUSIVITY AND ACTIVATION ENERGY IN DRYING OF AFRICAN YAM BEAN (<i>SPHENOSTYLIS STENOCARPA</i>) TUBER	634
93	PROFILING OF SOYBEAN (<i>GLYCINE MAX</i> (L.) GENOTYPES WITH HIGH FUNCTIONAL OIL CONTENT FOR INDUSTRIAL AND DOMESTIC APPLICATIONS	640
94	EFFECT OF SEED SIZE AND POSITION OF SEEDS IN POD ON THE SEED VIGOUR OF FLUTED PUMPKIN (<i>TELFARIA OCCIDENTALIS</i> HOOK)	648
95	EFFECTS OF MOISTURE STRESS AT DIFFERENT GROWTH STAGES ON THE PERFORMANCE OF ONION (<i>ALLIUM CEPA</i> L.) VARIETIES	654
96	WEEDING FREQUENCY EFFECT ON GROWTH AND YIELD OF MAIZE IN SOUTHERN-GUINEA SAVANNAH	663
97	EFFECT OF FOLIAR FERTILIZER APPLICATION ON PHYSIOLOGICAL CHARACTERISTICS AND HERBAGE YIELD OF AMARANTHUS AND CORCHORUS	670
98	EFFECT OF FOLIAR FERTILIZER APPLICATION ON PHYSIOLOGICAL CHARACTERISTICS AND HERBAGE YIELD OF AMARANTHUS AND CORCHORUS	675
99	RESPONSE OF SESAME (<i>SESAMUM INDICUM</i> L.) TO DIFFERENT NUTRIENT SOURCES IN	

	ANYIGBA, KOGI STATE NIGERIA	680
100	EFFECTS OF INTEGRATED NUTRIENT MANAGEMENT ON WEED INFESTATION AND YIELD OF SOYBEAN IN SOUTHERN GUINEA SAVANNA ZONE OF NIGERIA	692
101	EFFECT OF MILLED GROUNDNUT SHELL AS A NUTRIENT SOURCE ON THE NUTRITIONAL QUALITY OF PEPPER IN COMPARISON WITH OTHER NUTRIENT SOURCES	699
102	REACTION OF RICE VARIETIES TO RICE BLAST - AN INSIGHT INTO UNDERSTANDING OF RICE RESILIENCE TO CLIMATE INDUCED RICE DISEASES	706
103	ALLELOPATHIC EFFECT OF MINTWEED (<i>HYPTIS SUAVEOLENS</i> (L.) POIT) GREEN AND BROWN LEAVES AQUEOUS EXTRACT ON SEED GERMINATION AND SEEDLING GROWTH OF COWPEA	717
104	PROXIMATE COMPOSITION OF SOME NEW SWEET POTATO VARIETES GROWN AT GIDAN KWANO, MINNA, NIGER STATE, NIGERIA	723
105	EVALUATION OF <i>SACCHARUM OFFICINARUM</i> GENOTYPES FOR JUICE QUALITY, CANE AND SUGAR YIELD	731
106	IMPACTS OF SUGARCANE GENOTYPES AND WEED MANAGEMENT PRACTICES ON WEED DRY MATTER AND SUGARCANE PRODUCTIVITY	737
107	ISIGHTS INTO PREVALENCE AND DISTRIBUTION OF VIRUSES INFECTING MELON IN GEORGIA, UNITED STATE	744
108	GROWTH AND YIELD RESPONSES OF MAIZE TO PARTIAL SUBSTITUTION OF INORGANIC NITROGEN WITH FARM YARD MANURE AT GIDAN-KWANO	745
109	RESPONSE OF GROWTH AND YIELD OF MAIZE (<i>ZEA MAYS</i> L.) TO LIME, INORGANIC AND ORGANIC FERTILIZER IN MOKWA, NIGER STATE OF NIGERIA	753
110	UNDERSTANDING THE INTENTION TO USE GOOD AGRICULTURAL PRACTICES ON VEGETABLE FARMS – A COMPARATIVE STUDY OF FARMERS IN PUNJAB, INDIA AND NAKURU, KENYA	761
111	DETERMINATION OF DRY SEASON IRRIGATION WATER QUALITIES FOR VEGETABLE PRODUCTION IN MINNA, NIGERIA	768
112	EFFECT OF DAYS AFTER ANTHESIS AND STORAGE PERIOD ON SEED QUALITY OF TWO OKRA (<i>ABELMOSCHUS ESCULENTUS</i> L. MOENCH) VARIETIES	778

113	ASSESSMENT OF SELECTED SOIL FERTILITY PARAMETERS ALONG A TOPOSEQUENCE UNDER INTENSIVE CROP PRODUCTION AND IMPLICATIONS FOR SUSTAINABLE MANAGEMENT	782
114	EFFECT OF DAYS AFTER ANTHESIS AND STORAGE PERIOD ON SEED QUALITY OF TWO OKRA (<i>ABELMOSCHUS ESCULENTUS</i> L. MOENCH) VARIETIES	790
SOIL SCIENCE / ENVIRONMENTAL MANAGEMENT		794
115	EFFECT OF BIOCHAR AND NANOPARTICLES ON THE MICROBIAL DEGRADATION OF CRUDE OIL CONTAMINATED SOIL	795
116	INDIGENOUS KNOWLEDGE AND COPING CAPACITY OF FARMERS FOR CLIMATE CHANGE ADAPTATION: A CASE STUDY OF AGAIE LOCAL GOVERNMENT AREA, NIGER STATE, NIGERIA	803
117	ASSESSMENT OF FERTILITY STATUS OF SOME SELECTED FADAMA SOILS IN BIDA LOCAL GOVERNMENT AREA OF NIGER STATE, NIGERIA	807
118	EFFECTS OF DIFFERENT NITROGEN SOURCES ON THE GROWTH OF MAIZE AND SOYBEAN IN AN INTERCROPPED SYSTEM	813
119	EVALUATION OF IRRIGATION SUITABILITY FOR SURFACE IRRIGATION IN BAKAJEBA, NIGER STATE, NIGERIA	820
120	EFFECTS OF BIOCHAR AND NITROGEN FERTILIZER ON SOIL ORGANIC CARBON, NUTRIENT RETENTION AND MAIZE PERFORMANCE	826
121	IMPLICATION OF LAND SURFACE TEMPERATURE AS A DRIVER OF LAND COVER CHANGES ON THE URBAN DYNAMICS OF ABUJA NIGERIA	833
122	PHOSPHATE MOBILIZATION BY ADDITION OF THREE ANIMAL MANURE SOURCES IN THE SOILS OF KARU, NASARAWA STATE	840
123	COMBINATION OF ORGANIC MANURE, INORGANIC FERTILIZER AND BIO-FERTILIZER ON SOYBEAN [(<i>GLYCINE MAX</i> L. (MERRIL)] GROWTH	845
124	SPATIOTEMPORAL ASSESSMENT OF THE DYNAMICS OF DROUGHT IN NORTHEAST NIGERIA USING REMOTE SENSING TECHNIQUES	853

64 WATER QUALITY ASSESSMENT OF THE PROPOSED KWADNA RESERVOIR WITHIN GIDAN KWANU MAIN CAMPUS, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, NIGERIA

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Abstract

The study assessed the Water Quality parameters of the Kwadna Reservoir located at Federal University of Technology, Minna guided by the following objectives: determine the variation of the physico-chemical parameter across the months, the stations and to provide baseline data of the various physical and chemical properties of water. The Physico-chemical parameters of the river were studied for twelve weeks. Water samples was taken from five (5) stations in the reservoir, biweekly for the period of study. Samples collected was taken to the department of Water Resources, Aquaculture and Fisheries Technology (WAFT) laboratory for analysis. The results of the research depict that there was no significant variation in the mean values of physico-chemical parameters observed across the Station ($p > 0.05$), pH range from 7.05 ± 0.03 - 7.36 ± 0.03 , Conductivity 281.5 ± 45.5 - 311.7 ± 44.9 $\mu\text{S/cm}$, Total alkalinity 115.7 ± 22.0 - 174.0 ± 18.9 , Total hardness 48.1 ± 9.5 - 57.4 ± 11.3 mg/L, Calcium 17.3 ± 5.4 - 24.6 ± 4.6 mg/L, Magnesium 4.0 ± 2.4 - 8.6 ± 2.9 mg/L, TDS 177.2 ± 28.3 - 199.3 ± 28.9 mg/L, BOD 2.7 ± 0.1 - 3.1 ± 0.4 mg/L, Dissolved oxygen 4.9 ± 0.6 - 5.7 ± 0.1 mg/L, Carbon dioxide 1.7 ± 0.9 - 3.4 ± 2.3 mg/L, BOD 2.7 ± 0.1 - 3.1 ± 0.4 mg/L. Except Temperature and COD that has significant difference ($p < 0.05$) range between 27.0 ± 0.0 - 28.5 ± 0.5 °C and 18.1 ± 2.8 - 104.9 ± 45.9 mg/L respectively. For monthly variations most parameters had significant difference ($p < 0.05$) except Temperature and BOD that has no significant difference ($p > 0.05$). Most of the physico-chemical parameters studied were within WHO range set standard for optimal fish production and survival. The mean temperature of the Reservoir (29.46 °C) is in line with FAO (2006), which states that temperature requirements of 25 °C - 30 °C is optimum for fish growth. This shows that temperature in the proposed Kwadna Reservoir is suitable to support the growth of fish Therefore, constant monitoring of the reservoir should be encouraged.

Keywords: Water Quality, Kwadna, Reservoir, Physico-chemical

INTRODUCTION

Water is one of the vital needs of all living beings. The quality of water usually described its physical, chemical and biological characteristics. Hence it becomes necessary to find out its the suitability for drinking, irrigation, fishing and Industrial purpose. The availability of good quality water is a necessary feature for preventing diseases and improving quality of life (Oluduro and Aderiye, 2007).

Dam reservoirs, which are an integral part of civilization development, have many features that distinguish them from natural lakes or rivers, hence they constitute a different category of surface water reservoirs. Their most important functions include water collection for municipal and agricultural purposes or flood protection. They are also used for recreational purposes, hydropower and fishing.

Water quality deterioration in reservoirs usually comes from excessive nutrient inputs, eutrophication, acidification, heavy metal contamination, organic pollution and obnoxious fishing practices. The effects of these “imports” into the reservoir do not only affect the socio-economic functions of the reservoir negatively, but also bring loss of structural biodiversity of the reservoir.

Water quality can generally be defined as chemical, physical and biological waters that are characteristic with respect to their suitability for a given use (Pawar, S.S, 2017). He further stated that the physico-chemical properties of water refer to the joint of physical characteristics and chemical composition of water body which include turbidity, colour, odour, temperature, pH, conductivity, dissolve oxygen (DO), Biological Oxygen demand (BOD), hardness, alkalinity, nitrate, chloride, CO₂, etc. Each of the designated uses has different definitions of the chemical, physical and biological standards needed to support the use.

These physiochemical compositions of water bodies need to be evaluated and compared with standards as a basis for the identification of the causes of the change in the water quality, high mortality or low population of aquatic animals in the dam reservoir.

Water quality parameters examined were pH, alkalinity, calcium, conductivity, magnesium, total hardness, Dissolved carbon dioxide, Chemical Oxygen Demand (COD) Total dissolved Solids (TDS), dissolved oxygen (DO), biochemical oxygen demand (BOD).

MATERIALS AND METHODS

Study area: The study was carried out at proposed Kwadna reservoir located within Federal University of Technology Minna, Bosso Local Government Area of Niger State, Nigeria which lies in between the latitude of 9° 30' 40" N and longitude of 6° 24' 50" E in the northern guinea savannah vegetation zone of Nigeria.

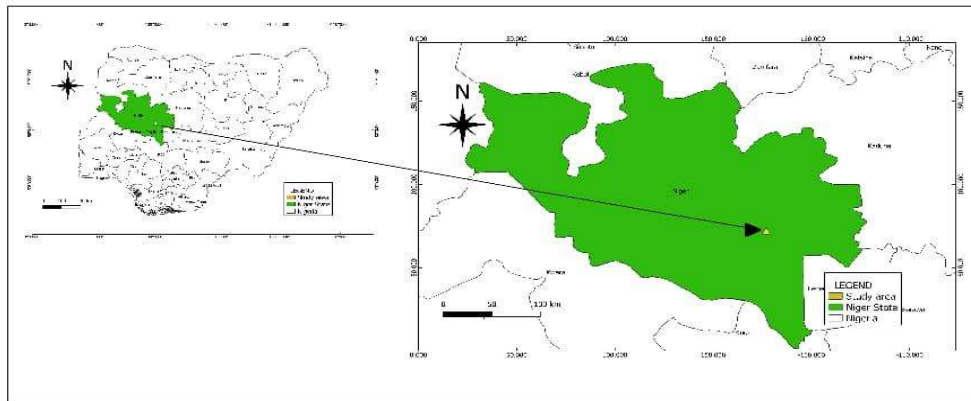


Figure 1: Nigeria indicating Niger State and the study area

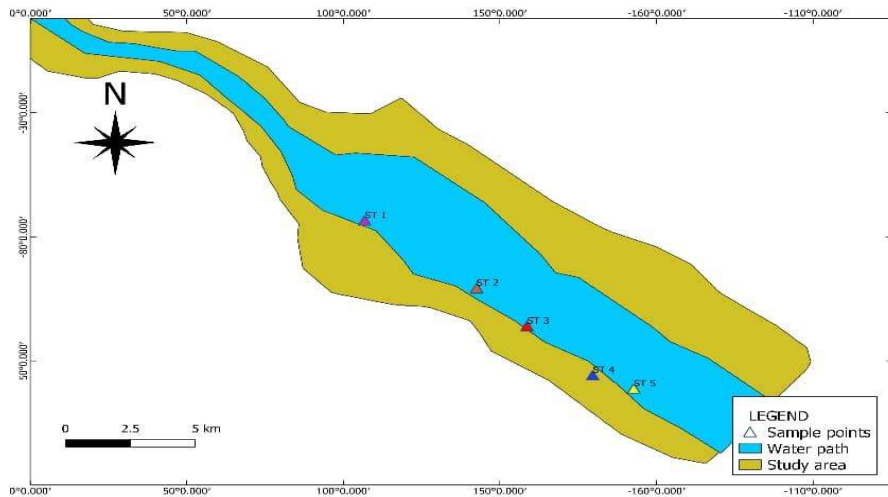


Figure 2: The study area indicating Sampling Stations

Sample collection and preparation: The samples were collected bi-weekly for three (3) months March, April, May from five different stations (Figure 2). Inlet of the Reservoir, open water of the reservoir bank of the reservoir were anthropogenic activities and opposite sides of the bank. The samples collected were analyzed for pH, Temperature, Alkalinity, Calcium, Conductivity, Magnesium, Total Hardness, Dissolved Carbon Dioxide, Chemical Oxygen Demand (COD) Total dissolved Solids (TDS), dissolved oxygen (DO), Biochemical Oxygen Demand (BOD).

Determination of pH: The pH of the water samples was determined using the pH meter. It was standardized with a buffer solution of pH range between 4, 7 and 9.

Measurement of temperature: This was carried out in-situ at the site of sample collection using a mobile thermometer. This was done by dipping the thermometer into the sample and recording

the stable reading

Determination of conductivity: This was done using conductivity meter. The probe was dipped into the samples until a stable reading was obtained and recorded.

Determination of Alkalinity: 50mL of the sample was pipetted into a clean 250mL conical flask. Two drops of methyl red indicator were then added and the solution titrated against a standard 0.01M NaOH solution to a pink end-point. (American society for testing and Materials, 1982).

Total alkalinity (mg/L) = $V \times M \times 50,000 / \text{mL of sample used}$ Where V = volume of acid used M = Molarity of acid used

Determination of total dissolved solids (TDS): by Gravimetric Method: A portion of water was filtered out and 10mL of the filtrate measured into a pre-weighed evaporating dish. Following the procedure for the determination of total solids above, the total dissolved solids content of the water was calculated. Total dissolved solids (mg/L) = $(W_2 - W_1) \text{ mg} \times 1000 \text{ mL of filtrate used}$. Where W_1 = initial weight of evaporating dish W_2 = Final weight of the dish (evaporating dish + residue).

Determination of Dissolved Oxygen: This was done using Winkler's method. Do bottle were used to collect the water sample at the sample site, 0.5ml of reagent 1 (Magnose sulphate), and 0.5ml of reagent 2 (Potassium Hydroxide + Potassium Iodide) were added immediately into the collected sample, before it was transported to the laboratory. 10ml of the sample was measured from the Do bottle into a conical flask, 5 drops of concentrated H_2SO_4 was added, 5 drops of starch indicator was also added and was titrated with Sodiumthiosulphate until color changes from blue black colorations to colorless.

$\text{DO (mg/l)} = \text{TV} \times 0.025 \times 8 \times 1000 / 20\text{mls}$

Calculation $\text{DO (mg/L)} = 16000 \times M \times V_2 / V_1 (V_1 - 2)$ Where = Molarity of thiosulpahte used. V = volume of thiosulphate used for titration V_1 = Volume of bottle with stopper V_2 = Volume of aliquot taken for titration.

Determination of Biochemical Oxygen Demand (BOD): The method involves filling the samples to overflowing, in an airtight bottle of the specified size.

Determination of total Hardness: 25mL of the samples was placed in different clean 250mL conical flask. To this were added 3mL of ammonium chloride in concentrated ammonia buffer ($\text{NH}_4\text{Cl}/\text{conc. NH}_3$) and 2 drops of Eriochrome Black T indicator. This was titrated against 0.01M

EDTA solution until there was a color change from violet to blue.

Calculation: Hardness in mg/L $\text{CaCO}_3 = V \times M \times 1000$ mL of sample used Where M = Molarity of EDTA Used V = Volume of EDTA used

RESULTS AND DISCUSSIONS

Physico-chemical parameters Variation across the stations and months

The findings of the station variations deduce that some parameters had significant variation from each other while some had no significant variation. The mean temperature of the Reservoir recorded (29.46°C) is in line with FAO (2006), which states temperature requirements at the range of $25^\circ\text{C} - 30^\circ\text{C}$ is optimum for fish growth, Conductivity was higher during the month of March $385\mu\text{S/m}$ and lowest during the month of May this is as a result of increased water evaporation and emergence from wind while mean value of Dissolved oxygen of 5.19 mg/l obtained agree with Cline (2012) value of $3-10\text{mg/L}$.

The mean BOD values of 2.91mg/l is in line with the work of Boyd (2003), which states that the optimal BOD values ranges between $3-20\text{ mg/l}$. Mean value of hardness was 53.91mg/l . indicate that the Reservoir water is a soft water which is within the desirable limit (WHO, 1984) that states hardness values below 300mg/l is potable water. For total Alkalinity the range value was 147.43mg/l this fell within the permissible range reported by Cline (2012), to be between $50-250\text{mg/L}$ suitable for fish growth.

The mean value for Calcium during the course of the research was 20.11mg/l and it fell within the permissible range as posited by WHO (1984), the maximum permissible limits for calcium in drinking water is 75mg/l . Thus the calcium level in this research is within the permissible limits. Though some parameters of the stations fall within the required range that support fish in the said period of March to May, some others are out of range which calls for greater attention to correct the causes to safeguard the future of fish survival in the Reservoir.

Table 1: Monthly variations of physico-chemical parameters of Proposed Kwadna reservoir

Parameters	March	April	May
pH	7.34±0.02 ^a	7.05±0.03 ^b	7.36±0.03 ^a
Temperature (°C)	28.5±0.5 ^a	27.0±0.0 ^a	28.0±0.0 ^a
EC (µS/cm)	346.5± 10.84 ^a	336.80±10.63 ^a	206.60±6.40 ^b
TDS (mg/l)	216.00±9.67 ^a	215.30±6.83 ^a	132.00±3.98 ^b
Alkalinity(mg/l)	162.50±12.49 ^b	156.60±8.72 ^a	118.20±18.35 ^a
Hardness (mg/l)	67.69±4.43 ^a	61.24±1.11 ^a	32.77±1.62 ^b
Calcium (mg/l)	20.75±2.58 ^a	26.32±2.01 ^a	13.66±0.72 ^b
Magnesium(mg/l)	12.85±1.17 ^a	2.87±0.95 ^b	4.03±0.57 ^b
DO (mg/l)	4.70±0.29 ^b	5.12±0.17 ^b	5.19±0.09 ^a
DCO2 (mg/l)	5.28±0.83 ^a	1.59±0.14 ^b	1.08±0.20 ^b
BOD (mg/l)	2.71±0.13 ^a	2.96±0.13 ^a	3.08±0.21 ^a
COD (mg/l)	58.24±27.27 ^a	23.73±6.84 ^b	59.20±11.87 ^a

Mean in the same row followed by the same superscript are not significantly different (P>0.05)

Mean not followed by the same superscript are not significantly different (P<0.05)

Table 2: Stations variation of physico-chemical parameters of Proposed Kwadna reservoir

Parameters	Station 1	Station 2	Station 3	Station 4	Station 5
Ph	7.26±0.0 ^a	7.31±0.09 ^a	7.25±0.12 ^a	7.23±0.12 ^a	7.20±0.11 ^a
Temperature (°C)	28.5±0.5 ^b	27.0±0.0 ^a	28.0±0.0 ^a	28.2±0.0 ^b	27.5±0.5 ^a
EC (µS/cm)	297.3±51.1 ^a	311.7±44.9 ^a	291.8±49.7 ^a	299.8±41.0 ^a	281.5±45.5 ^a
TDS (mg/l)	189.8±32.8 ^a	199.3±28.9 ^a	177.2±28.3 ^a	191.8±26.3 ^a	180.7±29.1 ^a
Alkalinity(mg/l)	174.0±18.9 ^a	123.5±22.5 ^a	162.3±17.9 ^a	161.7±6.4 ^a	115.7±22.0 ^a
Hardness (mg/l)	57.4±11.3 ^a	53.8±13.5 ^a	54.9±20.6 ^a	55.4±10.8 ^a	48.1±9.5 ^a
Calcium (mg/l)	18.9±3.0 ^a	19.3±4.2 ^a	20.5±4.1 ^a	24.6±4.6 ^a	17.3±5.4 ^a
Magnesium(mg/l)	8.6±2.9 ^a	6.5±4.3 ^a	6.9±2.5 ^a	4.0±2.4 ^a	6.9±3.8 ^a
DO (mg/l)	5.1±0.4 ^a	4.9±0.6 ^a	5.1±0.2 ^a	5.1±0.3 ^a	5.7±0.1 ^a
DCO2 (mg/l)	1.7±0.9 ^a	3.4±2.3 ^a	2.3±0.8 ^a	2.7±1.2 ^a	3.0±1.5 ^a
BOD (mg/l)	3.1±0.4 ^a	2.9±0.1 ^a	2.7±0.1 ^a	3.0±0.3 ^a	2.9±0.2 ^a
COD (mg/l)	50.9±11.0 ^{ab}	18.1±2.8 ^b	35.2±17.6 ^{ab}	26.1±2.3 ^b	104.9±45.9 ^a

Mean in the same row followed by the same superscript are not significantly different (P>0.05)

Mean not followed by the same superscript are not significantly different (P<0.05)

Conclusion

The study on the assessment of physico-chemical parameters of Proposed Kwadna dam reservoir, Minna, Gidan Kwano Niger State was carried out bi-weekly for the period of three months in order to provide baseline information on the ecological status of the Reservoir. The physico-chemical parameters of the Reservoir varied with months and stations. The variations may be due to change in weather cycle during the study period.

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