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National Agricultural Research Organisation. National Fisheries Resources Research Institute Annual Report 2011/2012

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NATIONAL AGRICULTURAL RESEARCH ORGANISATION (NARO)



NATIONAL FISHERIES RESOURCES RESEARCH INSTITUTE (NaFIRRI)

ANNUAL REPORT 2011/2012

Acronyms

ACERECA	Association for strengthening Agricultural Research in Eastern and Central Africa
ATAAS	Agricultural technology and agribusiness advisory services
BEL	Bujagali Energy Limited
LVBC	Lake Victoria Basin Commission
LVFO	Lake Victoria Fisheries Organisation
IUCEA	Inter University Council for Eastern Africa
SON	Source of the Nile
IDRC	International Development Research Centre
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
KAAD	Kajjansi Administration
NARC	National Agricultural Research Council
VicRes	Lake Victoria Research Initiative
DWRM	Directorate of Water Resources Management
NWID	National Wetlands Inspection Department
ECOVIC	East African Communities' Organization For The Management Of Lake Victoria Resources
UFPEA	Uganda Fish Processors and Exporters Association
UNCS&T	Uganda National Council of Science and Technology
ZARDIs	Zonal Agricultural Research and Development Institutes

1.1) The **Mandate** is to manage, promote and undertake applied and basic research of strategic and national importance in aquaculture, capture fisheries, water environment, socio-economics and marketing, information communication management and any emerging issues in the fisheries.

1.2 Vision is to be center of excellence for fisheries innovations in collaboration with SMART partnerships.

1.3 The **Mission** is to generate the knowledge base, develop and disseminate fisheries technologies for increased but sustainable fish production, conservation of the fisheries genetic resources, water quality and fish habitat, and to develop and manage the research and required linkages with stakeholders

1.4) The **Goal** is to enhance the contribution of fisheries research to increased but sustainable fish production and conservation of the natural resource base.

1.5) Objectives

a) Generation of knowledge and technologies of strategic importance for the management, development and conservation of fisheries resources and water quality.
b) Establishment and management of the human, physical and financial resources of the National Fisheries Resources Research Institute.
c) Provision of technical backstopping and capacity building to the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), Zonal Agricultural Research and Development Institutes (ZARDIs) and other agencies dealing in fisheries research and water quality.
d) Development and management of fisheries research information and ensuring collaboration with stakeholders.
e) Planning, monitoring and evaluation of all fisheries research programmes undertaken by the institute to ensure conformity with national research strategy.
f) Ensuring the quality of knowledge and technologies developed, multiplied and disseminated through uptake pathways.
g) Generation of periodic reports on fisheries and water quality research programmes to National Agricultural Research Council (NARC) and other stakeholders.
h) Establishment of sustainable linkages and partnerships with local, regional and international research bodies.

1.6) Research Projects implemented (Research Thrust)

Projects implemented during the year were the rationalised projects Under ATAAS, Lake Victoria Environmental Management Project (LVEMP II), Making Agri-Food Systems Work for the Rural Poor in Eastern and Southern Africa (IDRC Project), Association for strengthening Agricultural Research in Eastern and Central Africa (ASARECA), Equipping small scale fishers and riparian communities with adaptation strategies to cope with impacts of climate variability and change (Climate Change Project) and consultancies (BEL, BIDCO and SON).

1.6.1 ATAAS Projects: Capture Fisheries and Aquaculture

i. Monitoring Changes in fish stocks and development of appropriate harvesting technologies

ii. Fish diversity, Reproductive Ecology and Improvement of Genetics and Culture Practices of Commercial value fishes.

iii. Selection, mapping and bio-manipulation of appropriate sites and systems for profitable fish production.

iv. Research into alternative livelihoods and coping mechanisms for reducing pressure on natural fish stocks.

v. Natural feeding interactions and development of cost-effective fish feeds and regimes

vi. Market development and Cost-benefit analysis of selected fisheries and aquaculture enterprises

vii. Environmental Socioeconomic Monitoring and determination of fish production levels and planning.

viii. Equipping Small Scale Fishers and Riparian Communities with Adaptation Strategies to Cope with Impacts of Climate Variability and Change

ix. Status of quality of effluent discharged into the environment by BIDCO Uganda Limited in Jinja.

x. Assessment of impact of current policies and technologies on the fisher communities in Lake Kyoga

1.5.3 Institutional Consultancies

a) SON: Quarterly Environment Monitoring Surveys (February, May, September and November 2011) for Source of the Nile (SON) fish farm with respect to a cage rearing facility at Bugungu in Napoleon Gulf, northern Lake Victoria.

b) BEL: Quarterly environment and fisheries monitoring surveys at the Bujagali hydro-power construction site including the newly created reservoir.

c). BIDCO: Bi-monthly environment monitoring of the lake area around the oil processing factory**.**

1.6) Staffing (by discipline, gender and category i.e. scientist, technician and support staff)**:**

	Category/ discipline	**Research Scientists**			**Technicians**			**Support Staff**			**All staff**		
category	**Gender**	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
NARO	**Total**	17	7	24	12	3	15	29	11	40	58	21	79
Project		5	5	9	2	1	3	17	11	28	24	17	41

Research Scientists by Qualifications

	Discipline	Qualifications			Total
		PhD	MSc	Bachelors	
NARO		10	12	3	25
PROJECT		....	.....	10	10

1.7) Collaboration and Linkages

NaFIRRI collaborated with other NARO PARIs (especially NARL and MUZARDI). Non-NARO collaborators were: the Department of Fisheries Resources (DFR), the Lake Victoria Fisheries Organisation (LVFO), Makerere University (MAK), Directorate of Water (Resources Management) (DWRM), the National Water and Sewerage Corporation (NW&SC), the National Wetlands Inspection Department (NWID), National Environment Management Authority (NEMA), East African Communities' Organization For The Management Of Lake Victoria Resources (ECOVIC), Uganda Fish Processors and Exporters Association (UFPEA) and Uganda National Council of Science and Technology (UNCS&T).

Regional collaborators included Kenya Marine Fisheries Research Institute (KEMFRI), and the Tanzania Fisheries Research Institute (TAFIRI), Lake Victoria Basin Commission (LVBC), Egerton University, Njoro, Kenya, Lake Victoria Environmental Management Project (LVEMP II), Lake Victoria Research Initiative (VicRes) of the Inter University Council of East Africa (IUCEA) and Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA).

International collaborators were: the International Network for the Availability of Scientific Publications (INASP), McGill University (Canada), National Geographic, Toronto Zoo (Canada) Universities of Florida and Boston, Auburn University (USA) and World Fish Centre

1.8) NaFIRRI Funding

Research project	Total Budget Receipt (SHILLINGS) 2011/12	CUMULATIVE AMOUNT RECEIVED (SHILLINGS) 2011/2012	Funding Agency	BEGINNING OF FINANCIAL SUPPORT	End Date	Balance as at 30th June 2012
LVEMP II	-	609,867,000	World Bank	2012	30/06/2016	144,414,418
ATAAS		579,620,000	World Bank	2012	30/06/2017	388,761,546
Identification & Mapping of Ecologically Sensitive areas in Lake Victoria	3,761,430	-	LVBC		30/06/2011	-
Effluent sampling on L. Victoria	155,000	4,050,000	BIDCO	2009	30/06/2015	99,500
Making Agri food systems work for the rural poor in Eastern & Southern Africa	66,671,223	122,253,422	IDRC	2009	31/12/2012	32,612,754
Aqua Links schools program	5,158,625	-	Toronto Zoo	2009	30/06/2013	-
Environmental & Social Impact monitoring of Bujjagali dam construction	8,829,049	48,189,213	BEL	2000	30/06/2015	18,384,337
Climate change	-	406,045,338	Rockfeller Foundation	2011	30/09/2014	274,141,311
Environment monitoring of cage farming on Lake Victoria	5,636,800	11,703,725	SON Fish	2011	31/12/2011	4,011,525
National Geographic	40,950,000	-	National Geographic	2011	30/06/2014	-

Catch Assessment	-	65,857,050	LVFO		31/12/2011	-
VicRes - Livelihoods	19,173,858	-	IUCEA	2009	30/09/2017	3,211,658
VicRes - Riverine	-	19,725,420	IUCEA	2009	30/09/2015	15,216,020
VicRes - Pastoralism		50,795,094	IUCEA	2009	30/09/2016	50,795,094
VicRes - Aquaculture	38,000	-	IUCEA - Aquaculture	2009	30/09/2013	38,000
ASARECA LFP	-	221,183,160	ASARECA	2011	30/09/2013	153,596,960
MSI-NILE PERCH	16,923,628	100,070,000	World Bank	2008	30/06/2012	-
FAO-Northern Res.	6,926,197	-	FAO		30/06/2012	79,397
Mc Gill university	1,125,683	11,930,100	Mc Gill University	2009	30/09/2012	-
ZCADF (NAADS)	6,166,100	-	G.O.U		30/06/2013	76,100
KAAD	8,760,596	67,008,800				17,377,010
Sub Total	**190,276,189**	**2,318,298,322**				**1,102,815,630**
FIRRI Housing	164,623	111,103,040	G.O.U	.....	30/06/2012	153,724
FIRRI Building & Reh.	-	27,632,000	G.O.U	.....	30/06/2012	0
Fish Fry Kajjansi	251,350	23,056,000	G.O.U	continues	30/06/2012	191,500
Development	50,840,993	152,113,212	G.O.U	2005	30/06/2012	0
Recurrent	-	278,196,541	G.O.U	2005	30/06/2012	0
Sub Total (GOU funds)	**51,256,966**	**592,100,793**				**345,224**
Grand Total (GOU and Donor)	**241,533,155**	**2,910,399,115**				**1,103,160,854**

1.9) NaFIRRI Infrastructure status/ Physical Resources

The table below represents a summary of infrastructure status at Na FIRRI

a) Structures and other facilities (by type)

Structures/facilities	Jinja	Kajjansi
Hatcheries	-	2
Feed mills	-	1
Ponds	-	25
Concrete tanks	-	46
Museum	1	-
Aquaria	2	1
Laboratories	3	3
Computer rooms	1	1
Board rooms	4	4
Conference rooms	1	1
Stores	13	1
Workshops	2	-
Staff houses	44	6
Scientific Laboratory offices	11	6
Hostels	2	2
Research Vessels	3	-
Research Canoes	7	-
Cars	19	6
Moto cycles	5	1
Tractor	-	1

NaFIRRI has 4 vehicles grounded and 11 identified for boarding off

(2.0) ACHIEVEMENTS IN CAPTURE FISHERIES AND AQUACULTURE RESEARCH

ATAAS PROJECTS:

Project 1: Fish diversity, Reproductive Ecology and Improvement of Genetics and Culture Practices of Commercial Value Fishes

This project covers the following studies/experiments

i. Developing culture technologies for new high value species
ii. Genetic improvement of growth of Nile tilapia in Uganda
iii. Characterization and zoning of fish breeding/nursery grounds for protection in the major water bodies
iv. Development of appropriate control and preventive strategies for fish disease conditions in commercial farms

Overall Objective:
The main objective is to assess fish species diversity in Ugandan water bodies for conservation, investigate their life histories, and select suitable species for fish culture, food and ornamental purposes

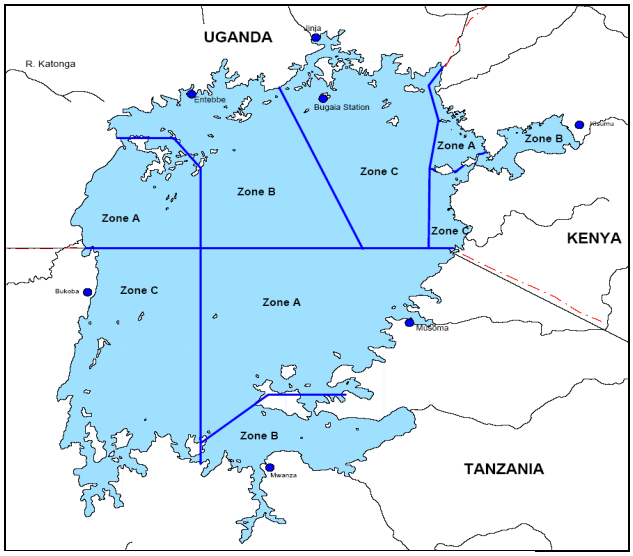
Specific objectives

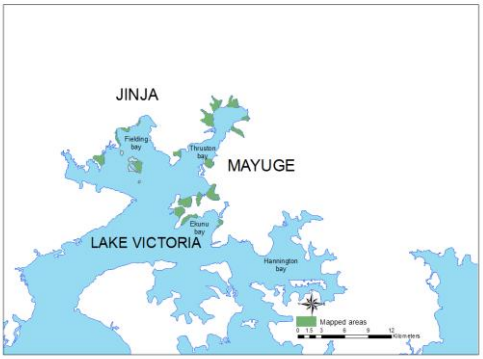
i) To determine fish species composition, abundance and distribution
ii) To domesticate ornamental fish species for increased aquarium trade.
iii) To identify and map fish breeding/ nursery grounds for gazettement of protected areas
iv) To increase the diversity of aquaculture species for the fish market.
v) To develop genetically improved strains to enhance productivity of Nile tilapia
vi) To develop appropriate control and preventive strategies for fish disease conditions

a) Activities undertaken on Lake Victoria

i. Conducted 1 survey (between Jinja and Mayuge districts) – Long rain season
ii. Captured geo-referenced data and mapped 18 breeding/nursery grounds

Key observations
Maps of Fish breeding/nursery areas



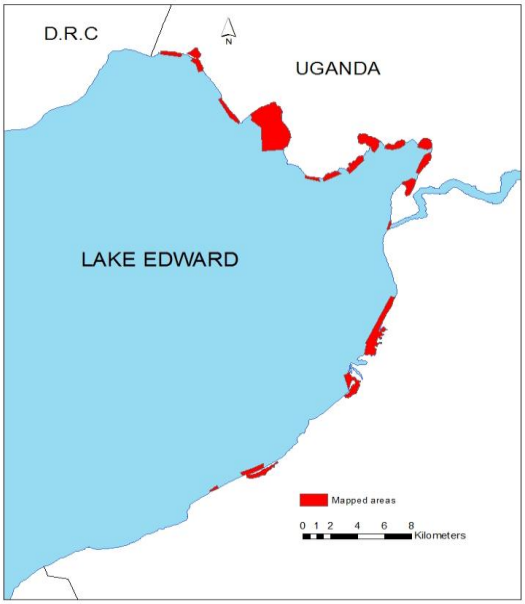


Outputs:
One technical report
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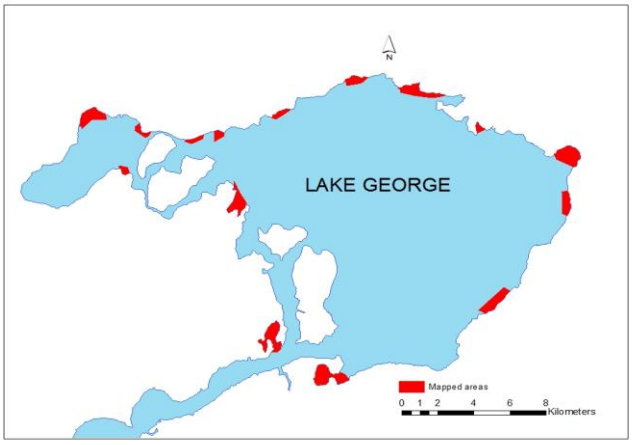
b) Activities undertaken on lakes Edward and George

i. Conducted 1 survey during the short dry season
ii. Identified, characterized and mapped 16 fish breeding/nursery grounds on Lake Edward
iii. Mapped 15 fish breeding/nursery areas on Lake George

Key observations



Map showing fish breeding/nursery areas on L. Edward



Map showing fish breeding /nursery grounds on Lake George

Outputs:

Two technical report with information on fish breeding grounds.

Project Outcomes

1. Improved knowledge and understanding on the physical location of fish breeding/nursery grounds and fish breeding seasons.
2. Basis for formulation of specific guidelines providing best practice, standards, access levels etc for the management of fish breeding/nursery grounds in the different aquatic systems.
3. Basis for definition of strategies and mechanisms for the management and protection of fish breeding/nursery areas.

Project Impacts

1. Adaptive management and the sustainable utilisation of fisheries resources.
2. Enhanced productivity of aquatic systems for food security and income

3. Accelerated learning for all stakeholders (at both local and regional level) about fish breeding/nursery grounds.
4. Established policies for the management and protection of fish breeding/nursery grounds.

Technology/ Dissemination
Generated information on location of nursery and breeding grounds was disseminated to clients through oral presentation and information brochures during a stakeholder workshop in Jinja.

Lessons learnt:
Closed areas need to be identified and demarcated for awareness of , both fishers and enforcement personnel.

Research activities in progress: Reconnaissance surveys and characterisation of geographical features and environmental factors associated with fish breeding/nursery areas in Lake Victoria; identification and mapping of the remaining fish breeding/nursery grounds in Lakes Victoria, Kyoga, Albert, Edward & George; determination of breeding periodicity for the major commercial species.

Project 2: Selection, mapping and bio-manipulation of appropriate sites and systems for profitable fish production.

This project covers the following experiments/studies

i) Development of a database and map of aquaculture production in Uganda
ii) Manipulation of brood stock productivity and fingerling survival for profitable hatchery production
iii) Assessment and bio-manipulation of the water bodies (lakes, rivers, reservoirs, ponds, tanks, cages) in Uganda for enhancing fisheries productivity

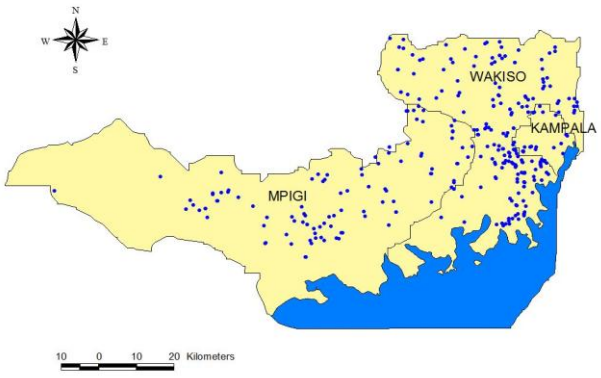
Objectives

i) To develop an aquaculture database for monitoring aquaculture development
ii) To generate technologies for increasing fish hatchery productivity and profitability.
iii) To develop technologies, practices and management models for improving and sustaining fisheries productivity in water bodies (lakes, reservoirs, rivers, streams, ponds, tanks) in Uganda.

Activities undertaken
Undertook 1 field survey and mapped fish farming sites in Wakiso, Mpigi and Kampala

Outputs
One geo-referenced map for Wakiso, Mpigi, and Kampala districts

Geo-referenced map for Wakiso, Mpigi and Kampala showing location of fish farming sites



Project Outcomes:
Contribute towards increased productivity and profitability of fisheries production systems (lakes, rivers, streams, reservoirs, ponds, tanks, cages)

Project Impacts:
Contribute to improved livelihoods through increased household food security (fish) and income levels

Technology/Result Dissemination:
Research results were disseminated to clients during a stakeholder workshop in Jinja District.

Lessons learnt

i) Record keeping at farm/household level is important to support correct and realistic decision-making by the farmers

ii) Key stakeholders such as fish farmers, fisher-folk, fisheries officers, and BMU members can contribute to the research system.

Project 3: Natural feeding interactions and development of cost-effective fish feeds and best fish feed management practices

Project objectives:

i) To determine natural foods and feeding habits of major commercial fish spp.
ii) To determine availability of natural fish food organisms; and conditions that affect them
iii) To determine the nutritional values of natural food organisms for fish growths and condition; and conditions that affect them
iv) To develop cost-effective fish feeds, improve cost-effectiveness of one industrial feed; and develop best feed management practices for aquaculture
v) To develop technologies for sustainable mass production of larval fish food organisms

Key activities
Undertook 3 field surveys on Lake George

Key observations

i. Natural fish foods were constituted by algae, zooplankton (3 categories), macro-benthos (5 categories) and small prey fishes
ii. Natural fish food organisms are in general widely distributed in the lake and occur in adequate abundances for fish production
iii. Some key food items among algae, zooplankton and macro-benthos indicate deteriorating water environment due to excess nutrients and pollution

Outputs:

i) Technical reports (4) on fish food organisms, selected commercial fishes and their diets, environmental conditions and energy return values in selected commercial fishes from Lake George.
ii) Policy brief (1) on influence of environmental conditions on natural fish food organisms in Lake George

Project Outcomes

i) Enhanced stakeholder knowledge/perception on the environment status vis-a vis aquatic communities (algae, invertebrates and fishes)
ii) Enhanced stakeholder knowledge/perception on levels and effects of aquatic pollution in Lake George

Impacts:

Community empowerment with knowledge to actively participate in protection of aquatic environment for sustainable biological production.

Lessons learnt

i. Catchment-based activities such as mining, industries (effluents), agricultural practices impinge on the adjacent aquatic systems thereby affecting productivity potential.
ii. Lake George is still a very productive system but there is evidence of water quality deterioration (eutrophication & pollution) from both industrial sources and large populations of park animals (e.g. Hippos), which may gradually change food chain characteristics to make it less productive water body
iii. ii) Regular monitoring is essential for detecting and correcting any negative changes in the environment and aquatic communities as a result of the dam construction activities.

Technology/Result dissemination:

Generated research information was disseminated to clients and discussed during a stakeholder workshop in Jinja.

Research Activities in progress:

i. Field surveys of fish and fish food organisms for Lake Edward and George
ii. Determination of food energy returns for commercial fish species on Lakes George and Edward

Project 4. Research into alternative livelihoods and coping mechanisms for reducing pressure on natural fish stocks

Projects 4 did not get ATAAS funding for 2011/2012.

Project 5
Monitoring Changes in fish stocks and development of appropriate harvesting technologies

This project covers the following areas:

a) Evaluation and improvement of technologies for harvesting and processing of emerging fisheries in the major lakes of Uganda

b). Monitoring changes in stocks of the major commercial fish species in the five major water bodies of Uganda (Victoria, Albert, Kyoga, Edward and George)

Project objectives: To determine variations in magnitude and trends of fishing capacity and effort; determine quantities, value and trends of fish catches; determine composition, abundance, distribution and trends of major commercial fish stocks; and assess impacts of fisheries exploitation on the biology, ecology and diversity of fishes.

a) Activities undertaken on Lake Victoria:
Hydroacoustic and Catch Assessment survey's were carried out in Lake Victoria to provide information on fish production and fishing effort in the Ugandan waters of the lake. Similar surveys are simultaneously conducted in the Kenyan and Tanzanian parts of the lake.

Key observations:

i) The total fish biomass was estimated at 2.1 mt representing a 30% increase from 1.6 mt in a similar period in 2009.
ii) The total fish production from the lake increased from 162,000 mt in 2010 to 169,000 mt in 2011

Detailed Summary of Catch Assessment Survey (CAS) results, Lake Victoria:

The annual fish catch estimates based on the Monthly sample estimates from 2005 to 2011. The overall annual catches of Nile perch in the Ugandan part of the lake has decreased over the years from 94,903 in 2005 to 70.061 in 2011; representing a 24% reduction in 7 years. Despite the reduction in catches, the gross revenue from the catches has almost doubled to approximately Shs 435 billion. The annual catch estimates for tilapia (decreased) by 34% from 29,415.0 in 2005 to 19,350 in 2011but like for the Nile perch, the gross revenue from the catches has almost doubled to approximately Shs 54 billion. The annual catch estimate for Mukene (88,808 mt) was higher than that recorded in 2008 and 2010 (70,001 and 58,717 respectively) since

2005 but was still low compared with the estimate for the past years between 95,000 and 113,791.

Estimated Annual catches (tones) and value (Million Shs) in 2005 to 2011

	2005		2006		2007		2008		2010		2011	
	Catch (t)	value	Catch t)	value	Catch (t)	value	Catch (t)	value	Catch (t)	value	Catch (t)	value
Nile perch	94,903	182,810	91,039	175,368	86,655	147,454	80,977	180,855	84,969	297,048	70,061	326,456
Tilapia	29,415	28,351	27,061	26,141	24,356	25,515	19,557	27,736	16,971	36,926	19,350	54,233
Mukene	106,400	20,748	95,734	18,668	113,791	19,176	70,001	19,049	58,717	16,147	88,808	46,119
Other species	7,815	8,176	2,109	1,628	2,685	2,221	2,489	2,922	2,270	4,478	3,605	7,998
Overall	238,533	240,085	215,943	221,805	227,487	194,366	173,024	230,562	162,929	354,599	183,824	434,805

NOTE:
Both Frame and Catch Assessment surveys on Lake Victoria showed moderate changes in fishing effort and landed fish biomass attributed to improved management of the fisheries.

Outputs
The surveys generated reports which include:

i. One report on Hydro-acoustic survey
ii. Two technical reports on catch assessment surveys

b) Activities undertaken on Lake Albert/Albert Nile (collaborated with DFR)
Conducted 1 Catch Assessment Survey and 1 Frame Survey

Key observations

i) Total fishing effort showed an increase from 5,700 to 6,000 boats between 2007 and 2012.
ii) The number of fishers increased from 15,300 to 16,000 over the same period of time.
iii) On Albert Nile, total fishing effort was 2,700 boats and 4,500 fishers (Note: 1st time to obtain complete effort on Albert Nile).

Outputs

i. One publishable manuscript under review
ii. One Technical report

Fishing capacity on the Uganda side of Lake Albert and Albert Nile. Data from frame surveys carried out in January 2007 and 2012 (NaFIRRI-FS, 2007; 2012). The numbers of fishers are rounded off to the nearest 100s.

Water Body/Period	Lake Albert		% Change	Albert Nile
	2007	2012		2012
Number of landing sites	72	78	8.3	126
Number of fishers	15,400	15,400	0.0	4500
Fishing Boats				
Using engine	416	311	-25.2	3
Using paddles	5,350	5887	10	2,678
Using Multifilament gillnets	2,033	2532	24.5	1,439
Monofilament gillnets	161	519	222.4	59
Long lines	1,533	527	-65.6	661
Beach/Boat seine	47	22	-53.2	46
Cast net	81	116	43.2	303
Hand line	13	14	7.7	14
Traps	53	56	5.7	141
Small seines	1,619	2303	42.3	13
Other gears	32	33	3.1	2
Total number of fishing boats	5,766	6179	7.2	2681
Fishing gears				
Multifilament gillnets	96,655	126,826	31.2	30,881
Monofilament gillnets	1,049	3,934	275.0	386
Long line hooks	1,978,224	747,206	-62.3	146,788
Beach/boat seines	47	22	-53.2	46
Castnets	81	125	54.3	303
Hand lines	246	447	81.7	275
Traps	655	745	13.7	935
Scoop nets	30	0	-100.0	2
Small seines for light fishery	1,619	2,303	42.3	13

Note: Some boats had no gear and others used more than one fishing gear

c) Activities undertaken on Lakes Edward and George

Conducted 2 Catch Assessment Surveys on both lakes

Key observations

i) Total fishing effort was estimated at 600 boats and 1,200 fishers on Lake George and 300 boats and 600 fishers on Lake Edward.
ii) Annual fish production estimate was 2,100 mt and 2,690 mt for lakes Edward and George respectively.
iii) Lake Edward annual catch 2011 was 2047.81± 260.64 tonnes. and for Lake George was 2691.4± 574.4 tonnes

Outputs:

Two technical reports generated

Project Outcomes: Information and policy advice to guide fishing capacity management and improvement of fisheries productivity and biodiversity Policy makers. Fisheries management and development plans for specific water bodies (generated and disseminated for implementation at local and national levels).

Project Impacts:
Increased and sustainable fisheries harvests for improved livelihood of the fisher communities; improved management of fish diversity and functioning of the lake ecosystem

Technology/Result Dissemination:
Research results were disseminated to clients during a stakeholder workshop at Jinja District; 500 copies of information brochures on investigated aspects were distributed during the workshop.

Lessons learnt:

1. There is inadequate control of importation and/or local manufacturing of illegal fishing gears.
2. There are far too many fish landing sites for monitoring of illegal fishing gears and practices and sustainable exploitation of the fisheries
3. Open access to fisheries resources makes it difficult to limit the number of fishers, boats and gears (effort) exploiting the fisheries.

Recommendations:

1. There is need to strictly control importation and/or local manufacturing of illegal fishing gears
2. There is need for a consultative process to reduce the number of fish landing sites to ease monitoring of fishing activities
3. There is need to review open access to fisheries so as to control the number of fishers, boats and fishing gears

Research activities in progress:

1. Determining quantities, value and trends of fish catches in the investigated lakes.
2. Developing and evaluating appropriate technologies for harvesting and processing emerging fisheries Ragoge and Muziri in Lake Albert.

Project 6. Market development and Cost-benefit analysis of selected fisheries and aquaculture enterprises

Projects 6 did not get ATAAS funding for 2011/2012.

Project 7: Environmental and socio-economic monitoring for determination of fish production levels and planning

Project objectives:

i) To determine the sources, levels and effects of water quality parameters on suitability of fish production systems.
ii) To identify and quantify the magnitude of aquatic weeds, their prevalence and factors contributing to their persistence and required remedial measures.
iii) To establish and quantify social, cultural and economic indicators of health, co-management and livelihood benefits based on bio-economic models and management guidelines at different levels of fish production.

Activities undertaken
One field survey of Lake Kyoga

Key observations

i) Information on policies on managing suitable water quality for fish production in aquaculture and natural systems.
ii) Strategies for controlling proliferation of aquatic weeds.
iii) Guidelines on social, cultural and economic indicators of health, co-management and livelihood benefits based on bio-economic models and management guidelines at different levels of fish production.

Outputs:

iv) Geo-referenced hot for major aquatic weeds infestation identified, and policy recommendations and guidelines for management of weeds
v) 1 Technical report

Project Outcomes

i. Enhanced participation of stakeholders in management of water quality for improved fish production.
ii. Improved awareness on the policy recommendations and management guidelines for management of aquatic weeds.
iii. Number of new policy recommendations and management guidelines being used to manage aquatic resources of the major production systems.
iv. Improved socio-economic status, health and management for enhanced fisheries production and planning.

Research under LVEMP II

Project 1: Determination of levels of pollution and their impacts on water environment and aquatic biota in Lake Victoria

Key observations

i. Concentrations of heavy metals in lake sediments from river mouth areas and bays of (Katonga, Kagera, Sio and Nakivubo channel) were higher than those expected in unpolluted sediments
ii. Areas furthest away (1 Km) from Katonga River mouth had the least number of species of zooplankton (7-8 species) and numerical abundance (65,000-163,000 ind. m^{-2}).
iii. Key water quality parameters (DO, temperature, pH, conductivity) in lake areas with suspected pollution effluents were within ranges that favor aquatic productivity
iv. Key zooplankton taxonomic groups i.e. Copepoda, Cladocera (water fleas) and Rotifera (wheel animacules) do not appear to be negatively affected by current pollution levels.

v. In highly polluted Murchison bay, lower macro-benthic taxa (7) and high abundance of pollution-tolerant Oligochaetes (183081 and 66106 ind. m^{-2}) indicated pollution impacts.
vi. *Astatotilapia* fish species were relatively more abundant in pollution-prone Murchison Bay compared to other survey areas.

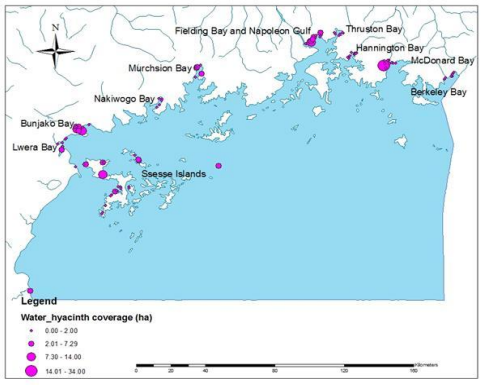
Outputs
4 technical reports on pollution levels in Lake Victoria
One progress report (contribution to LVEMP annual progess report)

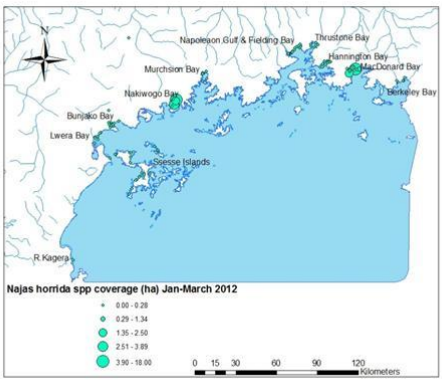
Project 2: Field monitoring and assessment of key water weeds and their impacts on environment and fisheries

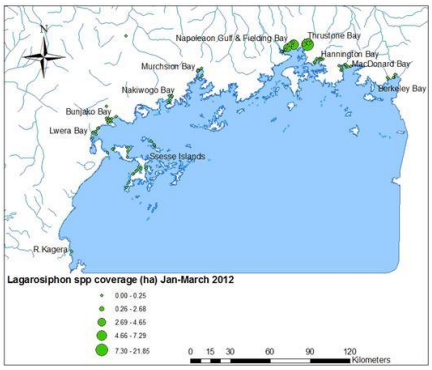
Objectives
i. To update information and data on the extent of aquatic weeds infestation
ii. To map out hot spots and develop management guidelines and control measures for the major invasive aquatic weeds

Activities undertaken
Undertook 4 field surveys on Lake Victoria

Key observations
i. Major Water Hyacinth centres were Bunjako, Fielding and MacDonald bays ; and Kalangala Islands and biological control agents were well established in these areas.
ii. Major centers for *Lagarosiphon* (African Elodia) in Lake Victoria were in Napoleon gulf, Fielding bay and to date, there is no known control measure for this weed.
iii. *Najas horrida* (Saw weed) was found significantly in MacDonald and Nakiwogo bays in Lake Victoria and this weed too has no control measure yet.







Maps of water weed hotspots in northern Lake Victoria

Outputs:

i) One technical report with information on the magnitude, impacts and management options for invasive water weeds on Lake Victoria
ii) One technical report with information on environmental factors associated with proliferation of aquatic invasive weeds on Lake Victoria
iii) One technical report with information on impacts of major invasive water weeds on the water environment, fish habitats and on the people on Lake Victoria
iv) One technical report on methods and policy advice for biological and other control options of major invasive water weeds

Project Outcomes

1. Improved community awareness on cover abundance, diversity and distribution of invasive water weeds;
2. Enhanced community understanding of the impacts of invasive water weeds infestation on the water environment, fish production and on peoples' livelihoods;
3. Enhanced participation of stakeholders in the management of invasive water weeds.
4. Policy recommendations for management/control of major invasive water weeds.

Project Impacts:

1. Reduced coverage of invasive water weeds;
2. Improved fish catches hence enhanced income and nutrition at household and community levels;
3. Participatory conservation and management of aquatic resources;
4. Enhanced researcher-stakeholder collaboration in management/control of aquatic weeds;
5. Policy recommendations for management/control of major invasive water weeds.

Technology/Dissemination: Generated information on weeds was disseminated to clients during a stakeholder workshop in Jinja.

Lessons learnt
Regular monitoring of aquatic weeds is essential to guide weed management, assess impacts of weed infestation on fish stocks/ fisheries and water environment quality.

Research Activities in progress

i. Bi-annual Ecological monitoring surveys of the Upper Victoria will continue including the reservoir
ii. Water weed surveys on Lake Victoria basin to reveal seasonality trends of the weeds and impacts on environment and fisheries
iii. Quarterly monitoring surveys to selected pollution hotspots in L. Victoria

2. Climate Change project: Equipping small scale fishers and riparian communities with adaptation strategies to cope with impacts of climate variability and change

Objectives
i. To improve capacity to address climate variability and change in fisheries
ii. To enhance the knowledge and practices of fishers and riparian communities to focus, adopt and cope with impacts of climate variability and change
iii. To equip them with adaption strategies to cope with impacts of climate variability and change

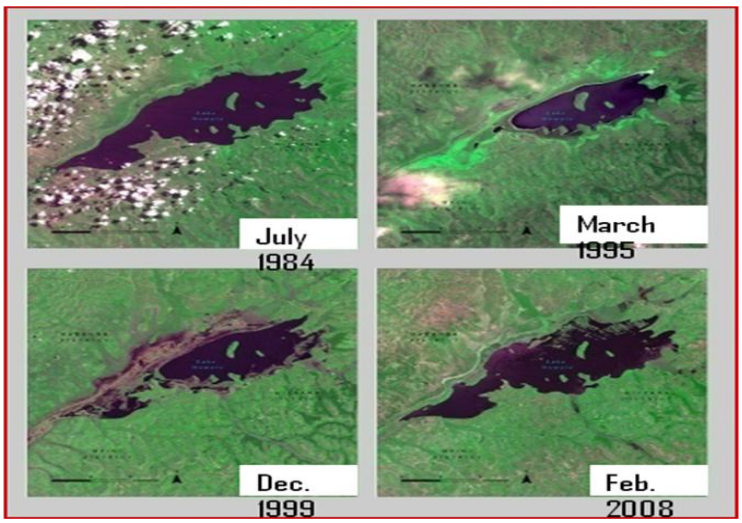
Activities undertaken
i. Undertook 3 field surveys to Lakes Wamala and Kawi
ii. Created a team at NaFIRRI to obtain and package information on how water environment, fisheries, socio-economics, livelihoods are affected by climate variability and change and develop adaptation strategies;
iii. Collaborated with Makerere University to incorporate climate change in fisheries training curriculum and in preparing a training manual in climate change issues in fisheries;
iv. Collaborated with the Directorate of Water Resources Management (DWRM) to provide information on impacts of climate change on hydrological balance including water levels and rainfall data;
v. Collaborated with Pamoja Media, East Africa Limited, to develop an Information Communication Outreach Strategy and Action Plan;
vi. Collaborated with African Technology Policy Studies (ATPS) to translate fisheries climate research outputs into policy, legislative and governance frameworks.
vii. Collaborated with National Agricultural Research Laboratories (NARL) to consolidate fisheries into NARO-wide climate change program and promote cross learning between climate change projects in NARO.
viii. collaborated with District Fisheries Officers (DFOs) and National Agricultural Advisory Services (NAADS) coordinators of the project areas to promote integration of project outputs into district programs and with leaders of Beach Management Units (BMUs) to coordinate with the fishers and riparian communities.

i) identified progressive community members to be used as change agents for promoting agreed adaptation strategies.
ii) Examined impacts and adaptation to climate variability and change in inland fisheries and riparian ecosystems.
iii) Determined impacts, identified adaptation strategies, develop policies, build capacity and increase awareness

Key observations and progress up to date:

i. Relationship between changes in water level, life-history parameters and size of nets used to catch Nile Tilapia on Lake Wamala
ii. Annual estimates for lake Wamala done in March 2012 was 1169.45± 191.23 tonnes, 26 landings and 614 boats.

Parameter	Pre 1985	~ 1995	1997-98
Water depth (m)	**4**	**1.5**	**4**
Max. Size (cm)	**40**	**20**	**40**
Size at maturity (cm)	**25**	**15**	**25**
Mesh size of net used to fish (mm)	**102**	**51**	**102**



Changes in lake areas of Lake Wamala in different years due to climate factors

a) Effects climate change on livelihoods

i. Fish scarcity, shrinking lakes, sudds
ii. Dry soils, wilting of crops
iii. Rotting of root crops and tubers
iv. Drying pastures and water sources
v. Livestock pests and diseases

b) Community responses to climate change

i. Fringeland farming, use of pesticides
ii. Influx of population
iii. Soil erosion
iv. Encroachment of forests

Coping with climate change

i. Change fish species targeted
ii. Change fishing ground
iii. Increase & change fishing gear
iv. Concentrate on trading
v. Concentrate on farming
vi. Work for others

Challenges in adapting to weather changes

i. Non-affordable legal gear and life jackets.
ii. Lack of low-interest credit/ grants to initiate other income generating activities.
iii. Prohibited use of the 100m shore line for farming.
iv. High cost of motorcycles for fish traders
v. Inadequate training on improved seeds and farming methods
vi. Lack of market access

Outputs

i. 250 copies of brochures on the project were prepared, printed and distributed to inform stakeholders on the project;
ii. Project Web pages were set up on the NaFIRRI website and materials provided for profiling the project on The Rockefeller Foundation website;
iii. 11 databases were defined, data entered, analysis and report preparation started;
iv. Several adaptation strategies were identified;
v. Produced 3 technical reports
vi. 1 manuscript was prepared and presented at Uganda Scientists Journalists Association (USJA) Forum;
vii. 2 abstracts were submitted and accepted for presentation at Arizona University conference (USA) on adaptation on 29th May 2012 and Great Lakes of the World (GLOW) VII meeting in Bujumbura in June 2012; and
viii. Developed a communication strategy

Project Outcomes

Management of the fisheries resources of the lake based on research findings and recommendations.

Project Impacts
Sustainable fisheries resources of the lake supporting livelihoods of the associated fisher communities.

Technology/Result dissemination:
Information from the survey was disseminated to clients during a stakeholder workshop in Jinja District .

Lessons learnt:
A lot of enthusiasm has been raised among end users and yet provision for testing adaptation and coping strategies was not provided for in the project. The project is trying to overcome this by looking for funding for adaptation trials and promoting change among riparian communities. This should be accommodated in future project designs. The project has also learnt that working with beneficially communities can have a positive impact.

3. Making Agri-Food Systems Work for the Rural Poor in Eastern and Southern Africa.

Objectives

i. To identify and promote local innovations and adaptation strategies that work
ii. for the poor rural men and women to cope with food security vulnerabilities.
iii. To adapt and scale up technology and market innovations for promoting orphan crops that enhance food security, increase incomes and ecosystem integrity in selected areas of Malawi, Kenya and Uganda.
iv. To analyze and promote specific policies and governance mechanisms for
v. sustainable agri-food systems.
vi. To determine mechanisms for scaling up agri-food systems and sustainable
vii. agriculture.

Activities undertaken:
i. Conducted survey of farming and food security of small farmers
ii. Established 390 trial gardens with 45 farmer groups for improved varieties of neglected crops.
iii. Conducted value chain research for neglected crops
iv. Identified market opportunities for neglected crops
v. Trained 225 farmers on improved management of neglected crops, food security and group management

Key observations:

Nature of food insecurity
i. Inadequate food produced
ii. Lack of money to buy food
iii. Lack of food supply on the market

What created food shortages
i. Large households to feed
ii. Low commitment to work
iii. Lack of alternative cash sources

iv. Insufficient land holdings

How farmers could cope with food shortages

Adaptation Strategies

i. Quality seed
ii. Soil degradation
iii. Climate change
iv. Farming skills
v. Market access

Outputs

Three scientific papers presented at an international conference

Outcomes

i. Farmers gained knowledge & access to improved varieties of neglected crops
ii. Farmers gained knowledge of market opportunities for neglected crops

Impacts

i. Capacity Building of LG & NAADs field staff to manage variety introductions
ii. Training modules, video & fact sheets in Runyankole, Luganda, Ateso & Adhola

4. Value addition of fish and fisher folk capacity building on sustainable livelihoods – VICRES

Objectives

i. improved livelihoods of fishing communities in the Lake Victoria basin:
ii. Improve methods for processing mukene, N. perch and tilapia through propagating deep frying and improved sun-drying
iii. Build the capacity of fishing communities on sustainable livelihoods.
iv. Enhance and diversify sources and strategies of fishers' livelihoods

Key observations/achievements

Value addition:

i. Trained 445 fishers
ii. Promoted drying mukene on racks
iii. Deep frying mukene, N. perch and tilapia
iv. Salting-sundrying fillets of N. perch, tilapia

Alternative livelihoods

i. Making liquid soap
ii. Beads and ornamentals
iii. Skills for savings & credit groups and linkages with financial institutions

Impacts

i. Improvement of available data to the participating districts, for use in planning at the district and sub-county levels.
ii. Skills development in survey management, participatory diagnostics and crop trial research for the technical staff of the participating district and sub-county local governments
iii. Knowledge improvement of participating farmers (mostly women) on food security vulnerabilities and adaptation strategies as well as for minor crop selection and management

Outcome

Increase in ability to expand best-fit adaptation strategies to improve food security by the rural poor, women and the vulnerable

Technology Dissemination

Three stakeholder workshops were conducted to disseminate results from the research activities including baseline surveys, FGDs, AIs and farmer trials.

5. National Geographic Project

During the year, the Conservation Trust of the National Geographic, National Geographic Society, and United States of America directly contributed funds supporting a joint collaborative Aquatic Biodiversity Outreach Program between Secondary Schools. The activity was carried out among 9 Kyoga Basin School around 5 districts surrounding the Kyoga Basin

Objectives of the program

i. **Protecting Uganda's Lakes' biodiversity**, for the benefit of the public, the environment and its animal and plant life.
ii. Educating students through an international education programme to encourage them to participate in international stewardship of aquatic resources, and enhance public awareness in natural history and aquatic conservation issues.

iii. Using aquaria to investigate aquatic ecosystems, and gain hands-on experience observing and caring for endangered species and their dependence on a healthy ecosystem.

iv. Linking educators and students in Canada and East Africa (Uganda) using the Internet and mail so as to allow participants to gain a cross-cultural understanding and foster attitudes as global citizens.

Project Outputs:

i. Enhanced awareness on conservation of aquatic biodiversity and integrated natural resources management among school children in Uganda.

ii. Communication links between Ugandan children and educators and those of Canada initiated and strengthened.

iii. Enhanced collaboration that may result into a wider school curriculum development.

iv. 1 question and answer booklet

Project Outcome:

i. Enhanced awareness on conservation of aquatic biodiversity and integrated natural resources management among school children in Uganda.

ii. Enhanced collaboration that may result into a wider school curriculum development.

Project Impact:

i. Observable improvement of education among the students

ii. Improved awareness of natural resources conservation and management in Uganda and Canada at an early stage.

Technology Dissemination

Aquatic biodiversity Information was disseminated to school children inform of lesions. 6 lesions were disseminated to the students

6. ASARECA) Project

Building public, private sector partnership to enhance productivity and competitiveness of Aquaculture in Eastern and Central African Region

a) Market studies and Value addition



Achievements/Outputs

Initiated a study on product diversification with initial results showing:

i) 600g tilapia costing 4,800/= made 18 fish fingers sold for a total of 18,000/=

ii) 1kg tilapia costing 8000/= (farm gate price) gave 15 fish balls sold at a total of 15,000/= when spiced, fried and garnished.
iii) 1kg tilapia costs 8000/= (farm gate price) when marinated, fried and garnished was sold at 12,000/=

Value addition
Promoted Chorkor Kiln smoking of the Male (African catfish) and passed on the technology to the private sector.




MSI Project

Project 7. Development of Culture technologies for increased and sustainable production of the Nile perch (*Lates niloticus*) (Linnaeus, 1758)

Objectives

1. To develop the genetic tools for identification of Nile perch species and/or sub species in Uganda.
2. To determine genetic variability in the current wild populations so as to assess their suitability as a source of brood stock for culture. (STOCK)

3. To study relevant aspects of natural reproduction of the Nile perch so as to develop technologies for induced spawning and rearing of the species under culture conditions and systems. (SEED)

4.To study the structure and function of the digestive system of the Nile perch so as to develop technologies for feeding the fish under culture conditions. (FEED)

Outputs:
1. Students' reports and theses on
   a. Nile perch Genetics Towards Aquaculture of Nile perch
   b. Reproductive biology and influencing factors in Nile perch, *Lates niloticus* from Lake Victoria.
   c. Seasonal variation of the reproductive hormones in nile perch, (*lates niloticus*, linnaeus, 1758)

d. Digestive enzymes in the juvenile Nile perch, insights in dietary requirements

2. Quarterly Summary technical reports for UNCS&T was prepared

Summary of results so far:

Induced spawning trials for Nile perch (High value fish with well established markets)
Feeding trials for feed acceptability
SUMMARY OF OUTPUTS FROM THE PROJECT
1. Studies
Genetics

- ✓ Two Morphs of the Nile perch
- ✓ Genetically health Nile perch populations
- ✓ Nile perch close to Epinephelus spp (groupers) *and not Lates calcarifer* (Baramundi). This was proved genetically and physiologically

2. Digestive and nutritional

- ✓ Presence of 05 ceaca
- ✓ Some ability to digest carbohydrates but diet will require high protein and PUFA's
- ✓ Larval feeding will require zooplankton and artemia
- ✓ Zooplankton can be commercially produced using locally available media like cow dung, soya bean.

2. Reproduction

- ✓ Nile perch spawning season was determined ; **Nov – Jan**
- ✓ Size at sexual maturity; females 59.4 cm Total length; males 57.8 cm Total length
- ✓ No sex Change although male hormones detected
- ✓ Small sized (0.55mm), floating eggs likely to produce very small larvae
- ✓ Very long incubation periods similar to the yellow perch and the groupers
- ✓ Handling of brood fish possible with Clove oil which is cheap and available (over the counter drug)
- ✓ 2morphs of Nile perch identified in EA,
- ✓ Sources of brood stock for the proposed Nile perch culture identified

Achievements

- Egg size 475.5 ± 70.7 µm
- Fertilization of eggs achieved but incubation failed after 6 days
- When to capture brood fish (October –November)
- Nile perch Cloning of FSH α sub units found that Nile perch is not related to Baramundi but the flounders and Yellow perch – This was confirmed by egg hatching

Challenges:

- Feeding trials done on wild fish rejected artificial feeds
- High mortality of eggs following several days of incubation

Fertilization of eggs achieved



Consultancies

1. Status of quality of effluent discharged into the water environment by BIDCO (U) Ltd in Jinja area

Objective
To examine the quality of effluent discharged by BIDCO in order to guide in improvement and attainment of standard concentration limits that are not harmful to the environment and aquatic biota.

Activities undertaken
Bi-monthly field sampling of lake area adjacent to BIDCO factory

Key observations
The level of Sodium salt in the storm water was exceptionally high (74,034.4mg/L) compared to the standard recommended by NEMA (100mg/L) resulting into very high conductivity, total dissolved solids and pH. most likely resulting from heaps of Sodium salt observed stacked in the open

Outputs
1. Database of water quality parameters in the lake area affected by the BIDCO effluent
2. Bimonthly technical reports (including recommendations) on selected water quality parameters in the lake area affected by the BIDCO effluent

Outcomes
Knowledgeable proprietors (BIDCO) on the content and impacts of untreated BIDCO effluent to water quality and aquatic biota.

Impacts
Improved water quality in the lake area affected by the BIDCO effluent

Technology/Result dissemination

Generated information on water quality was disseminated to clients during a stakeholder workshop in Jinja.

Lessons learnt: Factory owners need technical backstopping to understand the nature and impacts of their effluent on the water quality and biological productivity of the lake.

Research activities in progress: Regular monitoring of effluents and technical advice to polluting factory owners continue.

2. Bujagali Energy Limited (BEL)

In pursuit of providing technical support for a 250MW hydropower plant on the Upper Victoria Nile in Uganda, NaFIRRI undertook environment two environment monitoring surveys for BEL in August, 2011 and April 2012.

Objectives

The major objective of the surveys was to determine the status of water environment, fish ecology, fisheries and sanitation upstream and downstream of the BHPP site at Dumbbell Island during and post construction phases by:

1. Monitoring water environment parameters (physical-chemical parameters, algae and aquatic invertebrates.
2. Studying the biology and ecology of fishes and food webs
3. Carrying out fish stock assessment and catch surveys including economic aspects of catch.
4. Carrying out sanitation/vector studies (bilharzia and river blindness).



An aerial view of the Bujagali Hydropower Plant of Bujagali Energy Limited (BEL)

Activities undertaken
Four field surveys

Key observations

i. The zooplankton (microscopic organisms without backbones living suspended in the water column) community was comparable with past records before creation of the reservoir with high species diversity and abundance values indicating potential for a future fishery
ii. BEL activities were found not to impact Water Quality.
iii. Creation of the reservoir led to extermination of shoreline vegetation.
iv. The Reservoir had not yet had developed shoreline vegetation by the time of April 2012 survey
v. Oxygen-sensitive macro-invertebrates (larger organisms without backbones commonly occurring in bottom sediments) such as Ephemeroptera (mayfly) juveniles) and Trichoptera (caddis fly juveniles) did not occur at the reservoir and this together with the occurrence of snail species such as *Bellamya unicolor, Melanoides tuberculata, Gabbia humerosa* and *E. eliptica* was indicative of good water quality in the reservoir and hence potential for fish production.

Outputs
Four technical reports providing information on water environment, fish catch, sanitation and bilharzias disease vectors.

Outcomes
Guidance of the BEL Limited management on possible environmental perturbations from the dam construction activities

Impact of the study
BEL management knowledgeable on potential impacts of dam construction to water environment, fisheries and sanitation

Lessons learnt
Stakeholder-researcher cooperation is important to allay possible environmental impacts from major construction works

Technology dissemination
Information from the survey was disseminated clients during a stakeholder workshop in Jinja District.

Research areas in progress

Quarterly Aquatic Ecology Monitoring at the dam construction site for Bujagali Energy Limited

3. Environmental Monitoring of Fish Cage waters (Source of the Nile (SON) Fish Farm).

Objective:
To determine/assess key environmental parameters, fish stocks, socio-economic status and determine general suitability for the proposed cage culture site.

Activities undertaken
Baseline and socio-economic surveys on Source of the Nile (SON) site 2 in northern L. Victoria were undertaken.

Key observations

i. Sufficient DO (6.0 to 8 mg/l.), a suitable temperature (26.5 - 27.5 0C) and favourable other water quality conditions were observed in the proposed cage site area
ii. High algal/phytoplankton biomass (199449.61ug/L) observed at the site was considered to be an advantage for DO production and supplement natural food for the culture tilapia fishes
iii. Invertebrates and fish communities in the area indicated normal and favourable conditions for cage fish culture
iv. Few fishers were opposed to cage fish farming but the majority were in favour mainly because of anticipated advantages such as acquisition of new fish production skills, employment opportunities and socio-economic development of the area
v. The fish communities in the proposed cage site area were the normal species expected in offshore water in Lake Victoria and were not likely to be affected by the cage operations

Outputs
1. One technical report was prepared

Technology/Result dissemination
Information/Technical report from the survey was submitted to SON management and Commissioner for Fisheries (MAAIF)

Follow-on activities

i. Bi-annual monitoring surveys at SON's Site 1 at Bugungu will continue
ii. Periodic environment monitoring will be instituted at SON 2 site once cage fish production activities commence.

Non-ATAAS research activities at Kajjansi ARDC

Aquaculture Research and Development Centre (ARDC), Kajjansi

Semutundu domestication research

i. Initiated Genetic Characterisation of Semutundu populations from Lakes Edward and George (138 samples have been submitted to the Genetics Lab. MAK for further analysis).
ii. One scientist embarked on PhD studies in Australia aimed at culture of Semutundu with support from LVEMP II.

Identification of sites suitable for cage fish farming in Lake Victoria

i. Initiated identification of suitable cage fish farming sites
ii. Preliminary results indicate that out of the 21 Bays surveyed between Mukono and Jinja, 6 were suitable while 7 were required modifications

Cage demonstration on Lake Victoria, Jinja

i. Under the Uganda China friendship, 50 Cages of 5X5X5 m were set up in Jinja and partial results indicate the Nile tilapia attains about 0.45 Kg in 3 months
ii. Draft training material on key aquaculture concepts was tested to a total of 50 fisheries students from Makerere University and Fisheries training Institute aimed at further refinement for specific target audiences



China-Uganda Training to Makerere University and Fisheries Training Institute



Developing fish health diagnostic tools and control measures

i. 56 fish samples from 3 farms 97 specimens from the wild were collected and delivered to Makerere University for further diagnostics.
ii. All the 56 have undergone isolation 23 have been processed for histopathology awaiting identification



Plate 1. Adult Kisinja (*Barbus altianalis*)

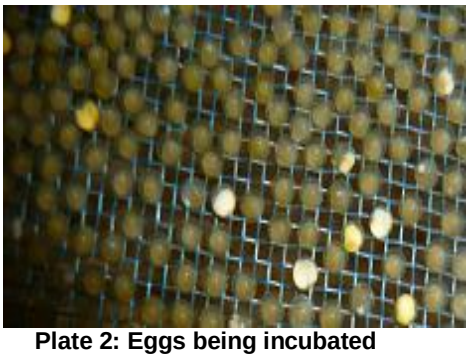


Plate 2: Eggs being incubated





Mass production Ningu eggs achieved

Development of Ningu

Culture of ornamental fish

i. At least 6 haplochromine fish species from Kyoga lakes are potential culture species for the fish ornamental industry.
ii. Live fish of the above species have been kept in concrete and glass tanks at Kajjansi pending further monitoring and investigation

Some of the proposed ornamental species (Nkejje and Kisinja clans











Fish rearing Tanks









Concrete fish rearing tanks **Tanks and Raceways**

Research Extension Interface-Outreach (Kajjansi ARDC)

i. Continued providing technical backstopping to a commercial farmer who set up 20 cages on river Nile in Adjumani
ii. Hatchery modifications in country to provide for the high demand
iii. Finalized the aquaculture parks policy in collaboration with DFR and UIA
iv. Technical guidance to Ugachick, Kahora and farmers.
v. Extended technical advice to the public and private sector in fish farming in EAC i.e. Burundi and Rwanda
vi. Hosted over 50 schools and provided back stopping to over 147 farmers and prospective fish farmers

Research Extension Interface (Jinja)

Activities undertaken

Outputs:

1. Fifteen thousand (10,000) copies of Communication support materials produced and disseminated to stakeholders
2. Nine hundred 1500 reprints digitized
3. Thirty five (25) library books/reference materials acquired;
4. Two hundred fifty (250) publications processed and added to library information materials;
5. Seven hundred fifty (1000) bibliographic records of historical information entered into institute databases;
6. A vote control system was developed by ICT section;
7. NaFIRRI website updated with 25 technical reports, 15,487 bibliographies, 29 annual reports; a fish museum /database linked to Fishbase (accessible at http://www.firi.go.ug)
8. Participatedin the world food day celebrations were research information was disseminated to stakeholders.

Outcomes: Increased awareness about fisheries sector by stakeholders; Research information preserved with electronic storing methods; Faster and effective methods (website, E-Board) of broadcasting and accessing fisheries research information.

Impacts: Improved stakeholder stakeholders knowledge on the fisheries sector.

Technology dissemination: 15,000 copies of research information (printed materials) on Lake Albert, Kyoga and Victoria printed and disseminated to stakeholders and during stakeholder workshop held in Jinja district; disseminated research information/technologies to stakeholders during the annual National Agricultural and Trade Show; research information posted on the institute website (www@firi.go.ug)

e) Lessons learnt: Continuous engagement of stakeholders is important and the stakeholders anxious to interact with researchers.

Research-related activities in progress

Follow-up on translation of actionable recommendations into regulations and policy frameworks for enhanced fish productivity in the 5 major lakes (Victoria, Albert, Kyoga, Edward and George); further partnership with media for research information dissemination; production of information documentaries and fact sheets; Information Needs Assessment; Aquatic Biodiversity Conservation initiative in schools through Aqua-link outreach program; add/create relevant website cross links; external review of the L. Albert and Kyoga Monograph drafts and publish them; develop an electronic registry management system.

APPENDIX 1

A. Publications in referred Science Journals:

Aanyu, M., C Carpaij and M Widmer **(2012)** Effect of diets with graded levels of inclusion of cotton and sunflower seed cakes on the growth performance and feed utilization of Nile tilapia, *Oreochromis niloticus in Livestock Research for Rural Development 24 (5) 2012*

Basita, K.R. , Aruho, C., Kahwa, D., Nyatia, E., Bugenyi, F.W. Rutaisire (2011). Differentiated genochorism in nile perch lates niloticus from Lake Victoria, Uganda. *African Journal of Aquatic Science. Vol 36, Issue 1.*

Kiggundu, V. Mwebaza-Ndawula, L., Makanga, B. and Nachuha, S**. (2011).** Variation in zooplankton community structure and water quality conditions in three habitat types in northern Lake Victoria: *Aquatic Ecosystem Health and Management*

Okello, W. and Kurmayer, R. **(2011),** Seasonal development of cyanobacteria and microcystin production in Ugandan freshwater lakes**.** *Lakes & Reservoirs: Research & Management. Special Issue: WLC Special Issue Volume 16, Issue 2, pages 123–135, June 2011*

Namulawa V.T, Mbabazi J & Kwetegyeka J. **(2011).** Fatty acid profiles of the eggs and juvenile muscle of Nile perch (*Lates niloticus*, L. 1758) caught from Lake Victoria, Uganda. *African Journal of Pure and Applied Chemistry,* 5(6): 127 -137.

Mwanja M.T., V. Muwanika, S. Nyakaana, C. Masembe, **D. Mbabazi**, **J. Rutasire** and W. W. Mwanja, **2011** Population morphological variation of the Nile perch (*Lates niloticus,* L. 1758), of East African Lakes and their associated waters. African *Journal of Environmental Science and Technology, **5(10)***

Naigaga I, H. Kaiser, W.J. Muller, L. Ojok, **D. Mbabazi**, **G. Magezi & E. Muhumuza 2011**. Fish as bioindicators in aquatic environmental pollution assessment: A case study 3 in Lake Victoria wetlands, Uganda. *Physics and Chemistry of the Earth.*

B. Theses:

Nkalubo, N. W. (2012) Life history traits and growth of Nile perch, *Lates niloticus* (L.) in Lake Victoria, Uganda: Implications for management of the fishery".

C. Unpublished Reports:

Mbabazi, D. Bassa S. , Muhumuza, E. Amina, B. : (2011) Final Report of the Fisheries Catch Assessment Survey in the Uganda Waters of Lake Victoria May 2011

NaFIRRI (2011): Aquatic Ecology Monitoring: Water Quality, Fish, Fish catch, Sanitation and Disease Vectors

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2. **Owori-Wadunde (2012)** Cage Aquaculture adopting higher productivity, higher profit system

3. **Owori-Wadunde**.....etal **(2012)** Opening access to the competitive East Africa regional market offering a wider market choice for farmed fish

4) Technologies for improving the marketing of farmed fish

5) Wanda, F.M., E. Ganda & M. Namukose **(2012) Status of Aquatic Macrophytes on Lake Kwania**

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