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Trans-boundary Water for Biodiversity and Human Health in the Mara River Basin

PROJECT SUMMARY REPORT

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About the Transboundary Water for Biodiversity and Human Health in the Mara River Basin (TWB-MRB) Project:

The TWB-MRB Project, 2005-2012, has been a collaborative effort under the Global Water for Sustainability (GLOWS) Program with participation from CARE Tanzania, the Mara River Waters Users Association (MRWUA), Florida International University (FIU), World Wildlife Fund Eastern and South Africa Regional Programme Office (WWF-ESARPO) and World Vision Kenya. These partners have supported governmental and local partners for the improvement of water resources management towards the betterment of both people and the world-renowned biodiversity in the Mara River Basin and Mara-Serengeti eco-region. The program's goals included providing potable water, improved sanitation and hygiene to basin communities.

About the Global Water for Sustainability (GLOWS) program:

The Global Water for Sustainability (GLOWS) program is a consortium financed by the United States Agency for International Development (USAID) working to increase social, economic, and environmental benefits to people of the developing world. GLOWS works on-the-ground to implement water supply, sanitation, and hygiene (WASH) services, improve water management practices, and build local capacity.

The GLOWS Consortium is led by Florida International University and includes CARE, WaterAid America, Winrock International, World Vision, and the World Wildlife Fund (WWF). Together the partners possess skills and worldwide experience in water supply/sanitation/hygiene, water productivity, and water resources management.

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This summary report was prepared by GLOWS staff and draws upon annual project reports, technical reports, and synthesis documents. Please contact glows@fiu.edu or www.globalwaters.net for more information or to request technical reports mentioned within this summary document.

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List of Useful Acronyms

ADP	Area Development Plan
BOQ	Bill of Quantities
BSAP	Biodiversity Strategies and Action Plan
CBO	Community-based Organisation
CHAST	Children's Hygiene and Sanitation Training
CHW	Community Health Worker
CTC	Child-to-Child
EAC	East African Community
EcoSan	Ecological Sanitation
EFA	Environmental Flows Assessment
EIA	Environmental Impact Assessment
FIU	Florida International University
GIS	Geographic Information System
GPS	Global Positioning System
FY11	Fiscal Year 2011
GLOWS	Global Water for Sustainability Program
IEC	Information, Education and Communication
IGA	Income-generating activities
IMRBP	Integrated Mara River Basin Programme
LVBC	Lake Victoria Basin Commission
LVBWO	Lake Victoria Basin Water Office
LVSCMA	Lake Victoria South Catchment Management Area
LVSCA	Lake Victoria South Catchment Authority
MOU	Memorandum of Understanding
MoWI	Ministry of Water and Irrigation
MR	Mara River
MRB(P)	Mara River Basin (Program)
MRCC	Mara River Catchment Committee
MRTWUF	Mara River Trans-boundary Water Users Forum
MRWUA	Mara River Water Users Association
NELSAP	Nile Equatorial Lakes Subsidiary Action Program
NMK	National Museums of Kenya
NSF	National Stakeholders' Forum
PES	Payment for Ecosystem Services
PHAST	Participatory Hygiene and Sanitation Training
POU	Point of Use
PS	Permanent Secretary
RWH	Rain Water Harvesting
SEA	Strategic Environmental Assessment

TAC	Technical Advisory Committee
TWB-MRB	Trans-boundary Water for Biodiversity and Human Health in the Mara River Basin
TWUF	Trans-boundary Water Users Forum
VIP	Ventilated Improved Pit
VSL	Village Savings and Loan
WADA	USAID-Coca Cola Water and Development Alliance
WATSAN	Water and Sanitation
WRMA	Water Resource Management Authority
WRUA	Water Resource Users Association
WUA	Water Users Association
WUC	Water Users Committee
WUG	Water Users Group
WVK	World Vision Kenya
WWF-ESARPO	WWF Eastern and Southern Africa Regional Programme Office

Introduction and TWB-MRB Project Background

The TWB-MRB project was a collaborative effort between Florida International University (FIU), WWF Eastern and Southern Africa Regional Programme Office (WWF-ESARPO), World Vision International, CARE Tanzania, and the Mara River Water Resource Users Association (MRWUA) to support numerous governmental and local partners in the development and implementation of a basin-scale integrated water resources management plan in the trans-boundary Mara River Basin of Kenya and Tanzania. The project began in October of 2005 and extended through September of 2012.

The overall project goal was to support sustainable water supply, sanitation, and hygiene services to improve health and increase economic resiliency of the rural poor while also conserving biodiversity within a trans-boundary integrated water resource management framework.

To achieve this overarching goal, a project was developed that worked within a coordinated approach to implement sustainable and equitable improvements in access to safe water, sanitation and hygiene services, while conserving the unique biodiversity of the Mara River Basin, through improved trans-boundary management of the basin's water resources. These activities were integrated within the larger vision for the Mara River Basin developed by USAID/EA and USAID/Kenya, in which the Mau Forest is conserved and the recommendations of the Environmental Flow Assessment and Biodiversity Strategy and Action Plan are implemented through the Lake Victoria Basin Commission.

The primary objectives of the TWB-MRB project were as follows:

- 1. Increase sustainable access to water supply by poor rural and small town dwellers.*
- 2. Increase sustainable access to sanitation and hygiene services by poor rural and small town dwellers.*
- 3. Improve the management of water resources within the trans-boundary context to conserve biodiversity and improve human health.*

The consortium as a whole fulfilled the above objectives, with specific partner organizations focusing geographically and technically within the basin. Operating in the Serengeti District (TZ) and Kirindon (KE), CARE Tanzania and World Vision Kenya, respectively, shared primary responsibility for the fulfillment of objectives pertaining to water supply, sanitation and hygiene. Also contributing to water and sanitation objectives was the Mara River Water Users Association (MRWUA), working within the Bomet region (KE). WWF-ESARPO retained primary responsibility for the development of

institutional capacity towards improving the management of water resources and conservation of the Mara's unique biodiversity. WWF's efforts were focused throughout the basin and addressed the national and transnational interests of both Tanzania and Kenya. FIU, as the lead coordinating organization and the primary scientific body, also implemented water resource management related activities throughout the basin and supported programs that facilitated opportunities for graduate-level scientific research for management in the basin.

While each partner organization retained responsibility for the discrete activities pertaining to their organizational strengths and geographic location, all partners operated within the broader goal of the TWB-MRB project. Accordingly, the consortium was an active collaboration whereby each partner strived to harmonize project activities in order to achieve multi-objective outcomes. This active collaboration was facilitated by the Program Coordinator and implemented through partner communication, regular consortium meetings, and strategic work plan development, among others.

The TWB-MRB program was nested within the larger Global Water for Sustainability (GLOWS) program, a consortium primarily financed by the United States Agency for International Development (USAID) and led by FIU. GLOWS works to increase social, economic, and environmental benefits to people of the developing world. GLOWS works on-the-ground to implement water supply, sanitation, and hygiene (WASH) services, improve water management practices, and build local capacity in WASH and water resources management. For more information, see www.globalwaters.net.

The Mara River Basin – A Brief Overview¹

The Mara River Basin, part of the larger Lake Victoria-Nile River system, encompasses areas of high biological and cultural diversity in a transnational landscape.

The Mara River begins in the Napuiyapui Swamp of Kenya, where an average of 1,400 mm of rain every year maintains seeps and springs that feed the Mara's main tributaries—the Amala and the Nyangores—as they flow through the Mau Forest. However, rapid deforestation in this region in recent decades has resulted in 32% loss of forest cover, leading to faster runoff of rainwater and greater rates of erosion (see studies by Mati et al. 2008, Defersha and Melesse 2011, Defersha and Melesse 2012), which have in turn led to changes in the hydrological regime of the upper tributaries, including higher and flashier floods and lower and more prolonged low flows (Mango et al. 2011a, 2011b). As the rivers leave the Mau Forest, they flow through areas densely populated by small-scale settlements. In this region, the Amala and Nyangores provide a primary water resource for local communities, particularly during the dry seasons, but they are also increasingly impacted by degradation of riparian forests through cultivation and livestock watering, increasing rates of extraction for irrigation, and development of urban centres that lack sufficient facilities for sewage treatment or solid waste disposal.

¹ Most of this section was drawn from the final Mara River Environmental Flow Assessment Report, prepared by Subalusky et al. 2012, supported by the TWB-MRB project.

The two tributaries join to form the Mara River in a more arid region in which annual rainfall is below 1,000 mm. Here, the Mara becomes the only permanent source of flowing water, providing a critical resource for the pastoralist Maasai community for watering of livestock and for wildlife inhabiting the surrounding grasslands. However, high densities of livestock and resulting over-grazing on this fragile land have led to declines in grassland cover, bringing rapid runoff and high sediment loads into the river (Dutton 2012). Additionally, poorly regulated development of tourism facilities in the region, particularly along the riverbanks, has increased inputs of often-untreated sewage directly into the river. Downstream of this region, the Mara enters the world-famous protected areas of the Masai Mara National Reserve in Kenya and the Serengeti National Park in Tanzania. Here, the river sustains one of the wonders of the natural world—the largest remaining overland migration of over one million wildebeest, zebras and other ungulates, who rely on the Mara as the only perennial water source in the region. Due to strong reliance of the migration on the river, some studies have suggested that significant declines in the quantity and quality of water in the river could result in a crash of the wildebeest population and the entire Serengeti ecosystem (Gereta et al. 2009). The quality of water in this region is strongly influenced by flow level, likely due to the huge effect of large wildlife upon the river such as hippopotamus, further emphasizing the importance of maintaining sufficient flows in the channel (GLOWS 2011).

Downstream of the protected areas, the river flows through a region of small-scale cultivation and livestock keeping in which hundreds of thousands of people depend upon the river as their primary water source, particularly in the dry season. However, the river also supports small- and large-scale mining operations in this region, which utilize heavy metals in processing materials near the riverbanks, as well as increasing levels of extraction for irrigation. The river flows downstream from here into the expansive Mara Wetland, which plays an important role in filtering the river water before it enters Lake Victoria and supports a number of fishing communities who live along it. Although the wetland provides a variety of ecosystem services for these communities, it also occasionally threatens them and their livelihoods by flooding and expanding into settlements and cultivated areas nearby. Expanse of the wetland has been suggested to be caused by increased rates of sediment deposition from upstream reaches, although this link is still untested (Mati et al. 2008).

Throughout the entire basin, the Mara is a living resource, providing a variety of resources, but also impacted by the use of these resources in ways that could eventually threaten the very resources the river is able to provide. Maintaining sufficient quantity and quality of water in the river is the key to maintaining all the other ecosystem services upon which people and wildlife in the basin rely. Currently, the Mara is still flowing and in good condition, which makes this the perfect time to put in place measures to ensure this state into the future.

Legal and institutional frameworks for the TWB-MRB project

Both Kenya and Tanzania recently (in the last decade) have passed legislation aimed towards ensuring access to safe water resources for all people, as well as sustaining the

valuable ecosystems upon which these people depend. And both countries consider water resources management at a basin scale, focusing on natural boundaries along or within which water moves. In both countries, the TWB-MRB project worked closely with the water resources management authorities to support implementation of these policies, and the TWB-MRB project's influence was particularly strong as related to implementation of environmental or reserve flows (see Box 1, adapted from the Mara Environmental Flow Assessment report by Subalusky et al. 2012).

Box 1. Regional laws that support protection of reserve flows for the Mara River

Both Kenya and Tanzania have passed legislation aimed towards ensuring access to safe water resources for all people, as well as sustaining the valuable ecosystems upon which these people depend. The principle of environmental flows is evident in the wording of water resources policy from both Kenya and Tanzania. Through scientific studies and a consortium approach, the TWB-MRB project supported the development of recommendations for an environmental flow regime for the Mara River as a whole. The respective water policies in each country therefore provided a legal framework for this initiative.

Kenya Water Resources Management Act (2002)

Defines the "reserve, in relation to a water source, [as] that quantity and quality of water required (a) to satisfy basic human needs for all people who are or may be supplied from the water resource; and (b) to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the water resource." The Water Act further states that "the Minister, the Authority and all public bodies shall, when exercising any statutory power or performing any statutory function in relation to the water resource concerned, take into account and give effect to the requirements of the reserve (Part III, 13 (3))."

Draft versions of the new Kenya Water Resources Management Act include very similar wording in regards to determination and protection of the reserve.

Kenya Water Resources Management Rules (2007)

Calls for the Authority to establish the reserve based on a) Water resource records and reserve water demand, or b) 1) ecological vulnerability, 2) human vulnerability, 3) local observations of historic drought flows, 4) maintenance of perennial flows, and 5) consultations with WUAs.

Tanzania National Water Policy (2002)

Recognizes the importance of environmental flows and prioritizes water use such that "Water for basic human needs in adequate quantity and acceptable quality will receive highest priority. Water for the environment to protect the eco-systems that underpin our water resources, now and in the future will attain second priority and will be reserved (Section 4.1.2)."

Tanzania Water Resources Management Act (2009)

Defines the reserve as "the quantity and quality of water required for (a) satisfying basic human needs... and (b) protecting aquatic ecosystems" and states that "the Minister shall...determine the reserve for the whole or part of each water resource which has been classified...and the Minister, the National Water Board, Basin Water Boards and all public bodies shall, when exercising any statutory power or performing any statutory duty, take into account and give effect to the requirements of the reserve (Section 37, 1-3)."

Progress Made and Results Achieved by the TWB-MRB Project

In the subsections below, an overview of the contributions of the TWB-MRB project by each partner organization is discussed. More details about specific activities and indicator targets can be found in the TWB-MRB project's annual reports, available upon request to glows@fiu.edu.

One of the primary strengths of the TWB-MRB project was that it encompassed the many issues as related to freshwater and sustainability—water supply, sanitation, and hygiene; water resources management; environmental conservation; legal and institutional frameworks for water—all under the same project umbrella. These topics are often addressed in isolation of one another, and while partners under TWB-MRB may have been working in different geographic areas, they were all contributing to advancement of access to basic water services and improved water resources management within the same basin. The fundamental idea behind this unique collaboration was the notion that by conserving water resources and managing them in an integrated manner, there would be better opportunity for protecting and improving access to basic water supply and key freshwater ecosystem services upon which human populations in the Mara River Basin depend. Similarly, by increasing access to basic water services, particularly sanitation and hygiene, there is opportunity for decreasing pressure and threat to freshwater resources. Following the first years of the TWB-MRB project, this same line of thinking has been applied to other initiatives in the East Africa region, including the Tanzania Integrated Water, Sanitation and Hygiene (Tanzania iWASH) Program in the Wami-Ruvu Basin of Tanzania (see www.globalwaters.net for more information).

Florida International University (FIU)

Florida International University (FIU) is a public institution located in Miami, Florida, USA, and among the 25 largest universities in the USA. As of 2012, it has a student body of roughly 46,000 students, and ranks first in the USA in granting of undergraduate and master's degrees to Hispanics, therefore classifying it as a minority-serving institution. As a large, public university, FIU has a strong educational and research mission. Many departments within the university lent support to the TWB-MRB project, either through coordination, involvement in scientific research in the basin, or involvement in teaching and training activities. Among those most influential were the Department of Earth and Environment, the FIU-GIS Center, and the Global Water for Sustainability center.

The role of FIU within the TWB-MRB program was to provide overall coordination of partners and activities, and to provide scientific guidance to activities as related to water resources management. Additionally, FIU led the implementation of a scholarship initiative under which many US and East African students were able to complete graduate-level research in the Mara River Basin. An overview of progress made by FIU and major results achieved follows here.

Coordination of the TWB-MRB program

Throughout the period 2005-2012, FIU played a primary coordinating role in the TWB-MRB program, and worked closely with partner organizations to take advantage of their existing infrastructure and networks. In the first phase of the project, FIU relied heavily on WWF-ESARPO for office support and for logistics. In fact, this access to vehicles, local support staff, and well-equipped offices was viewed as one of the advantages of the partnership, allowing FIU and partners under the TWB-MRB program to quickly begin implementation without a long start-up period. Additional partners, including CARE-Tanzania, World Vision Kenya, and in the final phase, the Mara River Water User's Association, also lent support to the project by offering their support structures and networks when needed. This support allowed for very minimal administrative and local office support costs on the part of FIU.

The TWB-MRB program received leadership and direction from Dr. Michael McClain over the entire performance period 2005-2012, but also benefitted from the technical and management support of several other FIU colleagues and local consultants. Four different coordinators, based in Kenya, served the program: Mark Nicholson, Christopher Dutton, Nathan Karres, and Iman Yazdani. The role of these coordinators was to maintain relations among all partners and to interact frequently with USAID/East Africa. To ensure that regular and effective interaction between partners was taking place, the coordinator scheduled a quarterly meeting of all implementing partners in the Mara Basin, with the hosting of the meeting rotating between the partners and their primary activity locations. This meeting offered an opportunity every three months for all partners to discuss achievements and challenges, but also allowed for sharing of experiences and better knowledge of partner activities by those involved in the Mara program. Documentation of presentations from quarterly meetings and quarterly reports are available upon request to glows@fiu.edu.

FIU's strength to the partnership was centered on its role as an academic, scientific institution, with broad research experience in water resources management. Based on this strength, FIU was able to support other partners with specific activities that needed more scientific input; an example here was the technical guidance provided by an FIU scientist to WWF for the development of a Biodiversity Strategic Action Plan (BSAP) for the Mara Basin. Additionally, several FIU researchers and their FIU graduate students visited the Mara Basin over the course of the program and conducted applied studies that fed into the knowledge base for water resources management in the basin. Some examples included hydrologic balance models and land use change analyses (Dr. Assefa Melesse); understanding of willingness to pay and frameworks for payment for environmental services (Dr. Mahadev Bhat); studies of gender and water (Dr. Rebecca Zarger); and mapping and use of Geographic Information Systems to understand status and trends with water and related natural resources in the basin (Daniel Gann).

Finally, over the course of the TWB-MRB program, FIU and partners formed close collaborative relationships with the Lake Victoria Basin Commission (LVBC) and with the Kenyan and Tanzanian water authorities. The LVBC has the legal mandate for

coordinating the joint management of the environmental resources of the Lake Victoria Basin for the five partner states (Burundi, Kenya, Rwanda, Tanzania and Uganda). The LVBC has adopted many of the primary reports generated by this project and will be implementing the findings to assist with the sustainable management of the Mara River Basin. The Kenyan Water Resource Management Authority and the Tanzanian Ministry of Water were integral to many of the TWB-MRB program's activities, many of which were designed by FIU and partners to specifically support these institutions through capacity building and through scientific studies. FIU managed these strategic alliances, and it is anticipated that the strong relationship formed between them and TWB-MRB partners will continue beyond 2012.

As part of its coordinating role and also as lead scientific institution, FIU has put together several summary documents and a database with abstracts of scientific studies and student research theses that were conducted under the TWB-MRB program. This database is freely available for download at: www.globalwaters.net, specifically at http://www.globalwaters.net/wp-content/uploads/2012/02/Mara-River-Research-Database_ver10031.pdf. Beyond the scientific studies contained in this database, three particular initiatives under FIU's direction merit specific mention here, as they spanned the entire length of the program or were broad in scope. These are the mapping of the Mara, the Environmental Flow Assessment for the Mara River and the Mara Scholars program, described below.

Mapping of the Mara River Basin – Geographic and Hydrologic Information

At the start of the TWB-MRB project in 2005, very limited geographic information was available for the Mara River Basin. Similarly, only few analyses had been conducted using available hydrologic records for the basin, and there was limited knowledge of water quality conditions. Therefore, in the initial phase of the TWB-MRB project, as led by FIU, much emphasis was placed by project partners in filling critical gaps in knowledge of hydrologic tendencies and water quality trends, and in creating a database of geographic data using Geographic Information Systems (GIS) for the entire basin. Geographic data on the Mara Basin that was gathered as part of this project is now housed at FIU's GIS center, but has also been shared with all partners in the region and is available for download (<http://gis.fiu.edu/>). Reports on detailed hydrologic and water quality analyses (see Mara River Research Database at www.globalwaters.net) are also freely available upon request. These baseline studies provided critical information that could later be used in more detailed analyses of water use, land use and land cover, and climate change trends in the Mara River Basin.

Environmental Flow Assessment for the Mara River

FIU also played a leading role in the development of a trans-boundary environmental flow assessment for the Mara River Basin, one of the activities that formed a pillar of the TWB-MRB project. An environmental flow refers to the quantity, quality, and timing of freshwater flows necessary to sustain aquatic and riparian ecosystems, as well as the ecosystem services upon which humans depend. Environmental flow assessment is quickly becoming standard practice in water resources management at a global scale, and as a way to understand the flow regime necessary to be allocated to the environment. The

Mara EFA activity spanned nearly the entire TWB-MRB program and included a series of capacity building events, scientific studies, workshops, and information dissemination forums. It also involved many different stakeholders, including scientists from US, Kenyan, and Tanzanian universities, internationally recognized EFA experts, staff from water management authorities in Kenya and Tanzania, Serengeti National Park ecologists, the Lake Victoria Basin Commission, and WWF, among others. The activity took a holistic approach to EFA, drawing upon well-recognized methodologies like the Building Block Method (BBM), developed in South Africa. From 2006-2008, an initial series of workshops and field visits helped the EFA team gather and synthesize information in order to recommend an environmental flow regime for three sites on the Kenyan side of the Mara River Basin. Following this first phase, suggestions for further data collection on the Kenyan side of the basin led to the development of a monitoring program for water quality and general environmental conditions at the three key sites, as well as multiple other areas of the basin deemed critical. The information collected during this second phase allowed for refinement of original recommendations, and helped guide the planning for a third phase of the EFA in 2010-2012, which involved expansion of the activity into the Tanzanian side of the basin. Here, two sites were studied intensely, and environmental flow recommendations developed for these sites through a consensus process involving the team of scientists, water resource managers, and local stakeholders. The final set of EFA recommendations for the entire basin is being disseminated widely and has been through a process of adoption by LVBC. Details on the EFA activity, all scientific studies, and final recommendations are published in several free-standing reports (see Mara River Research Database at www.globalwaters.net), available upon request to FIU at glows@fiu.edu. The Mara EFA represents one of a growing number of EFA studies in East Africa, and one of the first examples of a trans-boundary EFA globally.

Mara Scholars

As an academic institution, one of the main missions of FIU is to train the next generation of scholars and facilitate opportunities for research. FIU brought this mission to the TWB-MRB program, and used graduate student research as both grounds for training and a means for filling in gaps in scientific knowledge for natural resources management in the Mara Basin. Graduate student research was concentrated in a few main areas—climate change and land use change; water quantity and quality, sediment processes and ecosystem function; and resource use, livelihoods and ecosystem services. These in turn provided background information for the Strategic Environmental Assessment (SEA), the Environmental Flow Assessment (EFA), the Biodiversity Strategic Action Plan (BSAP) studies, as well as socio-economic data for the development of a Payment for Ecosystem Services mechanism in the basin.

Many FIU graduate students benefited from field experience and experiential education in the Mara, strengthening their graduate research and training. Additionally, many East African students had the opportunity to pursue graduate degrees at FIU or conduct graduate level research through the TWB-MRB program. Several East African students were provided with small research scholarship funds by the program, usually between \$1000-5000. Participating universities included FIU, Egerton University, Kenyatta

University, Jomo Kenyatta University of Agriculture and Technology, Moi University, and the University of Dar es Salaam. Additionally, as an offshoot to the Mara Scholars initiative that was supported financially by the TWB-MRB, other universities began similar efforts to support graduate-level research in the Mara, such as UNESCO-IHE's Mara Flows program, and students from other universities who were working in the Mara linked up with the TWB-MRB program. Overall, during the course of the TWB-MRB project, 42 students have conducted graduate level research in the Mara River Basin on some aspect related to freshwater resources (Table 1). Abstracts for graduate theses supported by the TWB-MRB project, or conducted in collaboration, are freely available (see Mara River Research Database at www.globalwaters.net), and copies of completed theses may be obtained upon request to FIU (glows@fiu.edu).

Table 1. Total number of students who conducted graduate-level research in the Mara Basin with direct or indirect support from the TWB-MRB program, 2005-2012.

Degree	TWB-MRB sponsored	UNESCO-IHE sponsored	Other	TOTAL
Master's	18	11	5	34
PhD	0	5	3	8
TOTAL	18	16	8	42

WWF-ESARPO

WWF is one of the world's largest and most experienced international conservation organizations, with a global freshwater program working to promote policy reforms, best practices, conservation of wetlands and other critical ecosystems, and poverty reduction of dependent communities. For more information visit <http://www.panda.org> and <http://www.worldwildlife.org>. In the TWB-MRB project, WWF's Eastern and Southern Africa Regional Programme Office (WWF-ESARPO) played a primary role in the partnership over the entire course of the project, both in terms of supporting FIU in project coordination as well as facilitating activities that would promote integrated water resources management of the Mara River Basin within its trans-boundary context. WWF-ESARPO's linkages to the larger WWF network and international conservation community facilitated the involvement of many of the world's leading experts on environmental flow assessment, biodiversity conservation, and payment for environmental services in the TWB-MRB project.

WWF-ESARPO was instrumental in the design and initial phase of the TWB-MRB project. Prior to the start of TWB-MRB, WWF-ESARPO already had a series of pilot activities in the basin, recognizing that the Mara Basin and the Mara-Serengeti Eco-Region is a world heritage site, a prime tourist destination, and home to approximately one million people, many of whom live on less than one dollar per day. The ecosystem of the Mara-Serengeti, and the lives and livelihoods of human inhabitants of the basin are all tightly linked to the health of the Mara River. In 2005, WWF-ESARPO began its collaboration under the TWB-MRB project in response to:

- High amounts of catchment degradation as a result of an absence of coordinated management and conservation, and opportunistic tourism development
- Low institutional capacity to implement integrated water resources management
- Legal and policy reforms that had just been instituted to improve water resources management (see Box 1)
- Very limited trans-boundary outlook for water resources management, but a lot of potential (LVBC had just been formed)
- Very little information on the quality and quantity of water available for the Mara River Basin

Within this context, WWF-ESARPO worked in two main ways: first, to strengthen the institutional capacity and collaborations that would promote more integrated management of water and other natural resources; and second, through specific initiatives that would provide backbone for a trans-boundary outlook for water resources management and conservation in the Mara River Basin. WWF-ESARPO, early on and throughout the project, played a key role in networking the TWB-MRB initiatives with strategic government, NGO and local partners in the region, especially the LVBC and the Kenyan and Tanzanian water authorities. WWF-ESARPO provided capacity building and mentoring to these partners, and helped work towards the adoption and implementation of policies based on scientific information being generated and lessons learned from specific initiatives in the basin, many that were supported by the TWB-MRB project. These specific initiatives under the TWB-MRB project included three in particular: a Biodiversity Strategies and Action Plan (BSAP), a Payment for Ecosystem Services (PES) framework for the Mara River Basin, and a Strategic Environmental Assessment (SEA). A summary of those three initiatives, based on their final reports, is given below.

The BSAP was written to elucidate the overall strategy and action plans to conserve critical biodiversity habitats throughout the Mara River Basin. The BSAP was developed for the following reasons: a) Regional watershed protection: The Mau Forest in Kenya and the Mara riverine forest in both Kenya and Tanzania comprise one large drainage basin of Lake Victoria. The protection of this watershed and associated biodiversity is important nationally, regionally and internationally; b) Reduction of environmental degradation: The MRB is vulnerable to many anthropogenic activities including fire, over-utilization of resources and increasing aridity in an area of unpredictable rainfall. Therefore, a strategy to protect biodiversity in the MRB provides an opportunity to develop mitigation measures for a much larger problem affecting environmental management in East Africa; c) Protection and management of biodiversity: The MRB is very rich in biodiversity, but this is being depleted. It is necessary to develop strategies to curtail biodiversity loss; d) Tourism potential: The basin is unique in terms of forest and savanna biodiversity which is unequalled by any other area in the world. It is the centre of wildlife and nature based tourism, and the biodiversity of the basin is valuable as an international tourism asset; and e) Socio-economic development: The diverse topography and climate of the area is amenable to various land uses including agriculture, agro-

forestry, fisheries, pastoralism, hunting and gold mining. These activities have socio-economic and ecological impacts on biodiversity, and it is imperative that a coordinated approach is used to achieve biodiversity conservation in this region. Detailed activities in accordance with the BSAP in the future are to be developed by the responsible actors and will be included in a detailed work plan, as well as a list of measurable performance indicators in terms of quantity, quality and timeframe. The responsible actors are comprised of government departments, international conservation organizations, protected area authorities, environmental conservation agencies, private individuals, and research and financial institutions. Overall coordination, monitoring and evaluation will be the responsibility of the LVBC. Implementation of the BSAP will contribute to sustainable development and economic benefits for the people of the MRB and beyond. However, commitment will be required from stakeholders including landowners, land-managers and policy makers to achieve these ends through protection of biodiversity of the MRB. It is expected that the governments of Kenya and Tanzania and the EAC partner states and other stakeholders will build on the recommendations made in the BSAP to create a vibrant and effective framework to support the conservation and management of biodiversity resources of the MRB. The BSAP is an adaptive and dynamic document, and there will be need for continuous and improved understanding, development and evaluation of the knowledge of biodiversity conservation and socio-economic policy interface, as well as establishment of feedback loops in its implementation.²

Early in the TWB-MRB project, it was suggested that a viable approach for improving the management and conservation of water resources, and mechanism for financing related activities, could be the implementation of a PES framework (also known as an Equitable Payment for Watershed Services—EPWS). The Mara River Basin has a large number of stakeholders with diverse interests regarding the use of the water. These stakeholders are located at all stages of the river: the catchment, mid-stream and downstream. The stakeholders in the catchment have access to good quality of water as they obtain it from the source and they are not too much concerned about the water quality. The mid-stream and downstream stakeholders may care more about the water quality when it comes to domestic uses but they may care less when it comes to other types of uses (e.g. water for irrigation and extracting minerals). Several studies and stakeholder workshops were conducted over the course of the TWB-MRB project to assess the value of water resources as well as the willingness to pay of interested users in the basin. Following these background assessments, in order to establish the necessary and sufficient conditions for an EPWS mechanism, WWF-ESARPO facilitated the production of four important reports in 2011, namely:

- Hydrology study to guide development of an Equitable Payment for Watershed Services Scheme in Mara River Basin.
- Assessment and analysis of livelihoods trends to guide development of an Equitable Payment for Watershed Services scheme in the Mara River Basin.

² Drawn from the Executive Summary of the BSAP, LVBC 2010. Available at www.globalwaters.net or upon request to glows@fiu.edu.

- Development of an Equitable Payment for Environmental Services Scheme in the Mara River Basin - Policy and Legal Report.
- An assessment and analysis of costs and benefits to guide development of an Equitable Payment for Watershed Services Scheme (EPWS) in the Mara River Basin.

Following the review of these documents and extensive stakeholder consultations, a final EPWS document, outlining possible types of EPWS mechanisms was developed. These recommendations were proposed for piloting in both Kenya and Tanzania. The final document was presented to LVBC, who ideally will assume responsibility for moving forward with the process of final design and eventual implementation of a PES mechanism in the Mara Basin.³

The Strategic Environmental Assessment actually integrated the findings of the EFA, BSAP, and EPWS, together with evidence and analysis from a wide range of publications and the views of key Stakeholders on the long-term future of the Mara River Basin. Information was drawn together and new ideas generated using the process of Strategic Environmental Assessment (SEA). There are over 130 examples of SEA around the world, but relatively few have been undertaken in a trans-boundary context and the Mara River Basin SEA was seen as a Pilot for other trans-boundary river basins that lie within the Lake Victoria watershed. The MRB Trans-boundary SEA was conducted in two phases; an initial study in 2008 and an additional process between February and August 2011. The first component involved extensive consultation and investigation of issues throughout the Mara Basin but its wide-ranging conclusions were not presented in a form that could be acted on with ease. Following a review in early 2011, the final SEA process carried out further analysis, including examination of scenarios for the future by the principal stakeholders and the development of firm proposals for action. The SEA followed the principles laid down in Trans-boundary Guidelines for Environmental Assessment adopted by LVBC (2005), together with the latest international thinking on SEA contained in the OECD Guidelines on SEA (2006) and Guidelines for Strategic Environmental Assessment in Policy and Sector Reform (The World Bank 2011).⁴

The complete documents for each of these initiatives are available upon request from glows@fiu.edu or on www.globalwaters.net. Each of these final products was presented, as facilitated by WWWF-ESARPO, to the LVBC for adoption and later implementation in the Mara River Basin. It is the hope of those involved with the TWB-MRB project that the linkage of these initiatives within a large network of collaborators and their adoption by the LVBC will help to ensure longer-term sustainability of the activities implemented under the TWB-MRB project. In fact, as of September 2012, LVBC is already working in several ways to carry forward the work started under these initiatives.

³ Drawn from the final EPWS / PES report for the Mara Basin, available upon request from glows@fiu.edu.

⁴ Drawn from the Executive Summary of the SEA report, available upon request from glows@fiu.edu.

CARE-Tanzania

CARE is a leading humanitarian organization fighting global poverty. Women are at the heart of CARE’s community-based efforts to improve basic education, prevent the spread of HIV, increase access to clean water and sanitation, expand economic opportunity and protect natural resources (<http://www.care.org>). Through its CARE-Tanzania office, CARE was involved in the TWB-MRB project over the period 2008-2012, and its efforts were focused on the water supply, sanitation, and hygiene components of the larger project, something that was added to the TWB-MRB portfolio of activities several years into the project.

With support from the TWB-MRB project, CARE-Tanzania’s work focused in four wards of the Serengeti District; Machochwe, Nyamatare, Busawe and Nyamoko; activities aimed to help provide safe water and adequate sanitation in those communities. Specific interventions by CARE Tanzania included protecting and improving boreholes, constructing water jars at the household level, constructing rainwater harvesting tanks and promoting access to sanitation and hygiene services. Additionally, the formation of Village Savings and Loan (VSL) groups was an important part of the activities and the sustainability plan for TWB-MRB interventions in the Serengeti District. VSLs groups were utilized to provide an avenue for the financing of sanitation services and products directly by the local communities. This VSL approach has been used by CARE in other settings in Tanzania and other countries, and has been shown to be a viable mechanism for financing household and village level water service infrastructure.

The many ways in which CARE worked to support improved service delivery, capacity building, and sustainability as related to WASH are detailed in the series of TWB-MRB project annual reports (2009, 2010, 2011, 2012). Noteworthy here is the summary of the estimated beneficiaries of CARE activities:

Table 2. Summary of estimated beneficiaries (number of people) for CARE’s water supply, sanitation and hygiene education interventions in Serengeti District, Tanzania.

Year	Water Supply		Sanitation		Training	
	<i>Female</i>	<i>Male</i>	<i>Female</i>	<i>Male</i>	<i>Female</i>	<i>Male</i>
2009-10	5744	5578	1583	981	1727	1871
2010-11	1867	1491	2993	3228	82	116
2011-12	3040	2585	3248	2674	48	78
TOTAL	10,651	9654	7824	6883	1857	2065
	20,305		14,707		3922	

Mara River Water User’s Association (MRWUA)

The Mara River Water User’s Association (MRWUA) was formed through the assistance of WWF-ESARPO and GLOWS/FIU, with support from the TWB-MRB project and

other sources. In 2010, the MRWUA came on board as one of the main implementing partners in the TWB-MRB project, with a responsibility of also supporting the project's initiatives as related to water supply, sanitation and hygiene promotion. To this end, the MRWUA's activities included providing safe drinking water to schools, the protection of springs, the construction of cattle troughs, the formation of drama clubs to promote good sanitation practices and the training of spring management committees. Alongside the construction of these water service delivery systems, the MRWUA also provided capacity building and collaboration with local communities, as a way to encourage ownership of local interventions and to enable their sustainability. MRWUA was primarily active in the Bomet region of Kenya.

Table 3. Summary of estimated beneficiaries (number of people) for MRWUA's water supply interventions in the Bomet region of Kenya

Year	Water Supply		Training	
	<i>Female</i>	<i>Male</i>	<i>Female</i>	<i>Male</i>
2010-12	4990	4636	27	43
TOTAL	9626		70	

In addition to the beneficiaries mentioned in the above table, MRWUA's initiatives also resulted in benefits as related to the construction of cattle troughs. One of the main achievements overall though, and something not reflected in numbers, was related to the fact that early in the TWB-MRB project, the MRWUA was the recipient of much support and capacity building by TWB-MRB partners. In the final two years of the TWB-MRB project, the MRWUA then actually became one of the main implementing partners for TWB-MRB activities, contributing to the overall achievement of the project's objectives to improve access to basic water supply.

World Vision Kenya

A Christian relief and development organization, World Vision works in nearly 100 countries to provide assistance in a variety of development sectors including emergency relief, safe water supplies and improved sanitation, food security, agriculture, and economic development. For more information visit <http://www.worldvision.org>. The TWB-MRB project was supported by World Vision Kenya, whose activities focused on the Kirindon region of Kenya on water supply, sanitation, and hygiene promotion. Specifically, World Vision Kenya aimed to increase access to and governance of improved and safe water and sanitation services in target communities, and promote multiple use of improved water sources to bring additional benefits to communities and promoting improved health and hygiene to target communities. The work of WVK in Kirindon under the TWB-MRB project was part of a larger WVK Integrated Development Program.

World Vision's interventions that were supported by the TWB-MRB project included several different kinds of locally applicable approaches to improve access to water supply and sanitation. In terms of water supply, World Vision constructed several water pans, constructed cattle troughs, drilled and equipped many boreholes with de-florination units,

developed a rock catchment, and installed multiple rainwater harvesting tanks. In terms of improving access to basic sanitation services, World Vision constructed dozens of VIP latrines and hand washing facilities, with a focus on schools. Additionally, World Vision formed or sustained at least 30 health clubs to promote good hygiene in schools. In all of these interventions, World Vision encouraged multiple uses of water and aimed to make community participation a key component of all activities. Specific details and locations of all of World Vision’s interventions are provided in annual reports of the TWB-MRB project that were produced in 2009, 2010, 2011, and 2012. Noteworthy here is the summary of estimated beneficiaries from World Vision’s activities:

Table 4. Summary of estimated beneficiaries (number of people) for World Vision’s water supply, sanitation and hygiene education interventions in Kirindon, Kenya.

Year	Water Supply		Sanitation		Training	
	<i>Female</i>	<i>Male</i>	<i>Female</i>	<i>Male</i>	<i>Female</i>	<i>Male</i>
2009-10	700	667	477	453	109	225
2010-12	7298	7017	1773	1825	24	60
TOTAL	7998	7684	2250	2278	133	285
	15,682		4528		418	

Chronological Summary of Key Project Activities

The TWB-MRB project spanned from October 1, 2005 to September 30, 2012. In this section, we highlight some of the key activities per year. More detail on each of these activities and summaries of total number of participants or other relevant project monitoring data is contained within the TWB-MRB annual reports, available upon request at glows@fiu.edu. The lead implementing partners for each activity are listed in parenthesis.

Year 1, October 1, 2005 – September 30, 2006:

- Project design and start up; partnership meetings (FIU; WWF-ESARPO)
- Regional stakeholders’ workshop, organized jointly with the East African Community (EAC), including 35 participants from diverse Kenyan and Tanzanian organizations (WWF-ESARPO)
- Participation by collaborators in TWB-MRB project in a regional course on Environmental Water Allocations, held in Dar es Salaam, Tanzania (FIU; WWF-ESARPO)
- Capacity building workshop for Environmental Flow Assessment (EFA) in the Mara Basin held in May 2006, led by international experts on EFA; formation of scientific team for EFA in the Mara Basin, including specialists from the fields of socio-economics, hydrology, riparian vegetation ecology, aquatic/fish science, invertebrate science, geomorphology and hydraulic engineering (FIU)

- Field data collection for water quality assessments, hydrologic analyses, and geographic / spatial data analyses for the Mara River Basin, and associated capacity building of local project collaborators (FIU)
- Baseline study of gender and water issues in the Mara River Basin (FIU)
- Support for graduate-level research by students from FIU and local universities (FIU; WWF-ESARPO)

Year 2, October 1, 2006 – September 30, 2007:

- Regional dialogue meeting on IWRM, including participation of water users from Kenya and Tanzania (52 participants total; 25 from Kenya and 27 from Tanzania) from water users associations, NGOs, local government, county councils, among others (WWF-ESARPO)
- Second capacity building workshops for EFA in the Mara River Basin, and field data collection at three sites on the Mara River on the Kenyan side of the basin (FIU)
- Additional field data collection for water quality assessments, hydrologic analyses, and geographic / spatial data analyses for the Mara River Basin, and associated capacity building of local project collaborators (FIU)
- GIS training for Kenyan and Tanzanian water authority staff and for WWF-ESARPO staff (FIU; WWF-ESARPO)
- Development of a first draft of a Biodiversity Action Plan (later to become the Biodiversity Strategic Action Plan – BSAP) and discussion of this plan in a stakeholders workshop in June 2007 in Kisumu, Kenya (WWF-ESARPO)
- Documentation of water resource management issues in the Mara River Basin through video and photography (FIU; WWF-ESARPO)
- Regular consultations with EAC/LVBC, the Nile Basin Initiative, and the Nile Equatorial Lakes Subsidiary Action Programme (NELSAP) on collaborative mechanisms for IWRM in the Mara Basin (WWF-ESARPO)
- Support for graduate-level research by students from FIU and local universities (FIU; WWF-ESARPO)

Year 3, October 1, 2007 – September 30, 2008:

- Series of consultative meetings to discuss the establishment of a Transboundary Water Users Forum (WWF-ESARPO)
- Initial development of a transboundary Strategic Environmental Assessment (SEA) for the Mara River Basin (WWF-ESARPO)
- Background work for establishment of a Payment for Ecosystem Services (PES) mechanism for the Mara River Basin (FIU; WWF-ESARPO), including a series of workshops to determine willingness to pay and potential opportunities for PES

- Expansion of TWB-MRB partnership to include CARE-Tanzania, and development of plans for CARE-Tanzania's activities as related to water supply, sanitation, and hygiene promotion (CARE)
- Field assessment in Serengeti District, Tanzania, to select wards for WASH project implementation, including multiple visits to local government offices (CARE)
- Capacity building and awareness raising of local communities, with a focus on water users and leaders, on the importance of safe water, sanitation and hygiene, and the advantages of Village Savings and Loan programs for financial sustainability for WASH services (CARE)
- Continued development of the BSAP and circulation of BSAP document to key stakeholders in the basin (WWF-ESARPO)
- Support for graduate-level research by students from FIU and local universities (FIU; WWF-ESARPO)

Year 4, October 1, 2008 – September 30, 2009:

- Final draft of TWUF Constitution prepared and approved, and submitted to the LVBC; continued capacity building of the TWUF (WWF-ESARPO)
- Final BSAP document developed and adopted by Lake Victoria Basin Sectoral Council of Ministers; document available upon request to FIU at glows@fiu.edu (WWF-ESARPO)
- First version of Strategic Environmental Assessment developed and presented to LVBC; later identified need for further revision (WWF-ESARPO)
- Multiple capacity building and awareness raising events for local communities in Serengeti District, Tanzania, on safe water, sanitation, and hygiene promotion, including the concept of multiple uses of water and mechanisms for financial sustainability of WASH interventions (CARE)
- Preparation and dissemination of posters and informational materials with hygiene messages (CARE)
- Construction of VIP latrines and rainwater harvesting structures at schools in Serengeti District, Tanzania (CARE)
- Construction of gravity water system for two villages in Serengeti District, Tanzania (CARE)
- Support for capacity building of the MRWUA and for construction of water supply service delivery systems for schools (e.g., rainwater harvesting, spring protection), with additional support from a new project launched under the Mara Water and Development Alliance (WADA) initiative (FIU; MRWUA)
- Ongoing monitoring of water quantity and quality at multiple sites in the Mara River Basin, including twice monthly collection of data on basic water quality parameters (in situ, and nutrients for later laboratory analyses) as well as benthic

- macroinvertebrate collection once monthly; data to support development of recommendations for environmental flows for the Mara River (FIU)
- Started preparation and circulation of a monthly newsletter to project collaborators to maintain them updated on TWB-MRB activities and topics of interest on water resources in the larger Mara River Basin (FIU)
 - Support for graduate-level research by students from FIU, local universities, and UNESCO-IHE (FIU; WWF-ESARPO)
 - Networking and collaboration with local, national, and regional governance structures to inform them about BSAP, EFA, and other integrated water resources management initiatives in the Mara River Basin, and encouragement for implementation of recommendations from these initiatives (FIU; WWF-ESARPO)
 - Workshop on PES/EPWS, facilitated by international experts on PES, and development of a handbook for PES in the Mara River Basin (FIU; WWF-ESARPO)
 - Involvement of World Vision in the TWB-MRB partnership, and initial planning and implementation of WASH-related activities by World Vision in Kirindon, Kenya, including hydrogeological surveys, selection of schools for WASH interventions, and selection of communities for WASH interventions (World Vision)
 - Construction of hand washing facilities in schools in Kirindon, Kenya (World Vision)
 - Capacity building of water user committees and community health workers on WASH-related topics, including leadership skills, health and hygiene, and the PHAST methodology (World Vision)

Year 5, October 1, 2009 – September 30, 2010:

- Series of capacity building workshops to continue the development of the TWUF, including incorporation of the recommendations of the EFA into the TWUF's mandate
- Publication of the results of the first phase of the Mara River EFA, including all studies from Kenya, and adoption of the report by LVBC/EAC (FIU)
- Stakeholder workshops towards the establishment of a PES mechanism in the Mara Basin, including contracting of consultants for the development of detailed analyses on key aspects for PES: hydrology, legal issues, livelihoods, and cost-benefit analyses (WWF-ESARPO)
- Capacity building workshops for the MRWUA and the Mara River Catchment Committee (MRCC), focused on governance, action plan development, and sustainability (WWF-ESARPO)

- Capacity building of stakeholders in Serengeti District, Tanzania, on WASH-related topics, including gender, policy analysis, and advocacy, formation of village savings and loan groups in Serengeti District, Tanzania (CARE)
- Construction of improved water supply and sanitation service delivery facilities at multiple locations in Serengeti District, including schools (CARE)
- Establishment of tree seedling nurseries in primary schools in Serengeti District (CARE)
- Continued production and circulation of Mara newsletter to stakeholders and collaborators in the Mara Basin (FIU)
- Support for graduate-level research by students from FIU, local universities, and UNESCO-IHE (FIU; WWF-ESARPO)
- Ongoing monitoring of water quantity and quality at multiple sites in the Mara River Basin, including twice monthly collection of data on basic water quality parameters (in situ, and nutrients for later laboratory analyses) as well as benthic macroinvertebrate collection once monthly; data to support development of recommendations for environmental flows for the Mara River; ceased in June 2010 (FIU)
- Increased access to improved water supply service delivery facilities in Kiridon, Kenya, through construction of rock catchments and rain water harvesting tanks in schools (World Vision)
- Increased access to improved sanitation facilities through the construction of new latrine slabs, VIP latrines in schools, and household demonstration latrines (World Vision)
- Capacity building of stakeholders and teachers on topics related to management of water resources, WASH, and the interactions between environment, water and health (World Vision)

Year 6, October 1, 2010 – September 30, 2011:

- Construction of improved water supply service delivery facilities in Serengeti District, Tanzania, including rainwater harvesting systems at schools, community water supply systems, and cattle troughs (CARE)
- Construction of improved sanitation facilities in Serengeti District, Tanzania, including VIP latrines, hand washing facilities, SanPlat latrines (CARE)
- Formation of health clubs and child-to-child clubs in schools to promote hygiene and awareness of important WASH related issues in Serengeti District, Tanzania (CARE)
- Capacity building for local stakeholders in Serengeti District, Tanzania, on topics as related to WASH and natural resources management through workshops and dissemination of educational / awareness building materials (CARE)

- Synthesis of existing data as related to Environmental Flow Assessment in the Mara Basin and preparation for expansion of EFA-related studies into Tanzania, including analysis of water quality samples and preparation of an updated EFA report and research database (FIU)
- Support to US, Kenyan and Tanzanian graduate students for research in the Mara River Basin (FIU)
- Continued production and circulation of Mara newsletter to stakeholders and collaborators in the Mara Basin (FIU)
- Planning and initial work towards construction of rainwater harvesting tanks in schools in Mulot and Longisa, Kenya (MRWUA)
- Preparation and initial work towards construction of improved water supply and sanitation facilities in Kirindon, Kenya, including water treatment systems, water kiosks, water distribution lines, masonry tanks, boreholes, and VIP latrines (World Vision)
- Capacity building for water users committees and water service providers in Kirindon, Kenya, including review of water policy and legal issues, leadership, WASH, natural resources management, and monitoring and evaluation (World Vision)
- Continued capacity building of the MRWUA through strategic planning workshops and development of a strategic plan (WWF-ESARPO; MRWUA)
- Continued capacity building of the TWUF (WWF-ESARPO)
- Review of the SEA document, contracting of a new consultant for improvement and additional work towards the SEA, and a series of stakeholder workshops towards the development of the final SEA (WWF-ESARPO)

Year 7, October 1, 2011 – September 30, 2012:

- Support for graduate-level research by students from FIU, local universities, and UNESCO-IHE (FIU; WWF-ESARPO)
- Expansion of EFA into Tanzania and review of previous EF recommendations for the upper Mara River Basin, through a series of workshops, scientific meetings, and three field sampling campaigns (FIU)
- Production of the final, consolidated EFA report, detailing recommendations for entire Mara River Basin; available upon request from glows@fiu.edu (FIU)
- Increased access to improved water supply facilities through the rehabilitation of a borehole, improvement and protection of natural springs, construction of rainwater harvesting systems in schools, and rainwater harvesting systems in communities in Serengeti District, Tanzania (CARE)
- Increased access to improved sanitation facilities in Serengeti District through the construction of VIP latrines in villages and schools, and sanitary toilets with handwashing facilities (CARE)

- Facilitate formation of health clubs, child-to-child clubs, and other vehicles for disseminating information on the importance of water, sanitation and hygiene in Serengeti District, Tanzania (CARE)
- Capacity building for local stakeholders in WASH and natural resources related topics, including governance of water services, management of facilities, and leadership skills (CARE)
- Continued production and circulation of Mara newsletter to stakeholders and collaborators in the Mara Basin (FIU)
- Increased access to improved water supply in Mulot and Longisa, Kenya, through the construction of rainwater harvesting tanks, masonry tanks, protection of springs, and cattle troughs (MRWUA)
- Capacity building of spring management committees and formation of drama clubs with messages promoting improved sanitation and hygiene in Kenya (MRWUA)
- Finalization of the SEA document for the Mara Basin and endorsement by LVBC; document available upon request from LVBC or at glows@fiu.edu (WWF-ESARPO)
- Continued collaboration with LVBC on the roles and obligations under the TWUF (WWF-ESARPO)
- Completion of the final document for the design of a EPWS/PES mechanism in the Mara Basin through a series of reviews and stakeholder consultations; available upon request from glows@fiu.edu (WWF-ESARPO)
- Increased access to improved water supply in Kirindon, Kenya, through the construction of a water treatment system, a water pan, and a borehole (World Vision)
- Increased access to improved sanitation through the construction of VIP latrines in schools in Kirindon, Kenya (World Vision)
- Support to health clubs and capacity building of water users committees in Kirindon, Kenya, on WASH and natural resources management related issues (World Vision Kenya)
- Mara closing conference held in Dar es Salaam, Tanzania, in August 2012, including representatives from all partner organizations and major stakeholders in the basin; conference proceedings document available at www.globalwaters.net or upon request to glows@fiu.edu (FIU)

Challenges and Lessons Learned

This section provides a general overview of some of the main challenges of the TWB-MRB project and some of the key lessons learned in three primary areas: overall project coordination; integrated water resources management in a transboundary context; and

water, sanitation and hygiene initiatives. More detail on challenges and lessons learned year-by-year can be found in the TWB-MRB project's annual reports, available upon request to glows@fiu.edu.

Overall project coordination

The TWB-MRB project included multiple partners and took place at a basin-scale, and both of these characteristics brought challenges. Each of the main organizations that collaborated on this project had its own institutional culture, protocols, forms, and financial structures; asking all organizations to adopt a similar ways of doing business and administrative procedures for the sake of this one project proved to be a substantial task. At many points in the TWB-MRB project, spending appeared not to be on the anticipated schedule, sometimes due to a delay in implementation of activities, but more often due to lags in the time between implementation, sharing of financial reports between field offices and headquarters in the US of key partners and then submission of invoices to FIU. The basin scale meant that many times activities were geographically distant and difficult to reach via road. Parts of the lower Mara Basin are much more easily accessed from Tanzania by plane or sometimes by road, while the upper basin is much more easily accessed by road from Nairobi.

In the latter implementation phases of the TWB-MRB project (2009-2012), FIU addressed some of these challenges by instituting a full time coordinator in the region, and making sure that this coordinator convened quarterly meetings of all partners, and periodic visits to all partner sites. This ensured regular face-to-face communication between partners and allowed for exchange of experiences and lessons learned. FIU also instituted a new set of project specific forms for financial and technical reporting in 2010, and the TWB-MRB coordinator thoroughly worked through these forms and their timelines with the partner organizations. These forms and new timelines helped to speed up the process of partners' submission of invoices and reports, and make administrative aspects of the project run more smoothly. Finally, support from USAID/East Africa staff and especially their regular attendance at quarterly meetings allowed for the TWB-MRB project team to be attuned to the interests in the larger region, and also provided opportunity for the project to receive valuable feedback and guidance from USAID on both technical and administrative aspects of TWB-MRB.

It's also worth mentioning that during the course of the TWB-MRB project, partners involved many different consultants for individual tasks or studies, and also many different university scientists for collection and analysis of baseline data on the Mara River Basin. Experiences with consultants indicated that there is a wide range in what are considered to be acceptable levels of quality for a finished product. On some occasions, the TWB-MRB project was very pleased with the kind of products received from consultants—examples include the BSAP and the EFA reports. On other occasions, the project team was put in situations where there was a need to conduct complete or very major revision of a product submitted by a consultant. Involvement of university scientists sometimes led to a different, but related challenge. While quality of reports or analyses tended to be quite high when realized by university scientists, this group tended

to operate on different timelines, more attuned with academic years or experience with scientific journal publications. In later years of the project, efforts were made to very clearly state expectations for levels of quality and for timelines for deliverables in all agreements with outside consultants and university scientists. The TWB-MRB coordinator was then tasked with ensuring compliance with these guidelines. In the future, the creation or institution of a technical review committee for documents submitted by consultants or scientists could further address these earlier challenges.

Many of the activities under the TWB-MRB project were conducted in close collaboration with the water authorities in Kenya and Tanzania. The challenge here was that sometimes the equipment, data, and/or staff capacity within the respective basin water offices was not always enough to ensure the desired level of scientific quality for an activity. In this case, the Mara EFA is a good example. The EFA was a study that is under the legal mandate of the basin water offices, but there was still a need to build capacity and informational resources to be able to complete an EFA to a high scientific standard in the Mara Basin. The TWB-MRB project addressed this challenge by forming an experts' team of local Kenyan and Tanzanian scientists, most from universities, to work side-by-side with staff from basin water offices on data collection and analysis for the Mara EFA. These scientists and the whole EFA team were also supported by international EFA experts. Therefore, the Mara EFA became not only an exercise in responding to a need for information for water resources management, but it became a solid opportunity for capacity building in the region as well. Following the TWB-MRB project, the basin water offices and many scientists in the region who were part of the Mara EFA initiative have since lent their expertise in EFA to other basins, including the Wami, Ruvu, Pangani, and Ruaha Basins in Tanzania.

Finally, in terms of lessons learned, the importance and position of the Lake Victoria Basin Commission (LVBC) were an underlying theme throughout the life of the TWB-MRB project, and conscious efforts were made to form a strong collaborative relationship between LVBC, FIU and other project partners. The LVBC has the legal mandate for coordinating the joint management of the environmental resources of the Lake Victoria Basin for the five partner states (Burundi, Kenya, Rwanda, Tanzania and Uganda). The LVBC has adopted many of the primary reports generated by this project and will be implementing the findings to assist with the sustainable management of the Mara River Basin. Formation and nurturing of the relationship between TWB-MRB project partners and the LVBC was therefore one of the most critical aspects for the success and long-term sustainability of initiatives begun under TWB-MRB, and the lesson for future projects is to then seek out similar coordinating bodies early on in project design and implementation, to make sure that activities are context-appropriate and have a potentially long future.

Integrated water resources management in a trans-boundary context

The TWB-MRB project aimed to strengthen and create enabling conditions for integrated water resources management in the Mara River Basin. Overall, the goal from the beginning of the project was to address issues in both the Kenyan and Tanzanian sides of

the basin. However, working at a basin scale in a trans-boundary context proved somewhat challenging in practice. The first phases of the project therefore focused on the upper and middle Mara Basin in Kenya, where there was already good presence of partner organizations, particularly WWF-ESARPO. There were then stronger efforts after a few years to expand into Tanzania. The lesson here perhaps was that the focus on Kenya at the start allowed the project to get its feet on the ground and gain some momentum, which then may have allowed for the smoother expansion into Tanzania. Several events were held in Kenya in the first few years of the project in which representatives from Tanzania were in attendance, as made possible by the TWB-MRB project; examples were stakeholder forums and workshops, and presentations of results of the first round of EFA. Some activities, like the mapping of the Mara and water quality assessments, considered the whole basin, and these also helped for project collaborators to understand the importance of working at that scale. Nevertheless, the project was challenged with working within institutional and legal frameworks that were nation-specific. Examples here were the basin water offices and the water policies that were unique to Kenya and Tanzania. Fortunately, both countries have recently (in the past decade) undergone similar changes to the institutional and legislative frameworks as related to water resources management, and were both challenged to begin implementation of new policies and were open to support from the TWB-MRB project to make this happen. Therefore, these recent changes actually offered a good opportunity for the TWB-MRB project to have a strong impact on the future for water resources management in the region, and to facilitate collaboration and shared learning between both countries. Here again, the LVBC's role as a collaborator cannot be emphasized enough. The LVBC helped with scaling up the TWB-MRB project to the basin level, and also nesting the TWB-MRB project's initiatives in a much larger framework.

Water supply, sanitation, and hygiene promotion

Water supply, sanitation, and hygiene promotion (WASH) depends not only on the technology and appropriateness of the interventions, but also on the buy-in from local communities. Under the TWB-MRB project, three partner organizations (CARE, World Vision, and MRWUA) were tasked with improving access to water supply and/or sanitation, and also building awareness about the importance of hygiene and access to basic water services. CARE and World Vision have shared some of their challenges in this area.

For instance, CARE Tanzania found that, in several of the villages, there was difficulty in getting the appropriate community contribution for the planned WASH infrastructure. Additionally, lack of a land use plan in villages at the project sites often delayed the initial acquisition of the land required for larger water schemes. Working within institutional frameworks also presented challenges: these manifested in delays in registering community level water organizations and ineffective coordination of water resources at the local to basin levels. Some fundamental challenges were the fact that socio-cultural norms in Tanzania impede the use of sanitation and hygiene facilities, and that there is a lack of policy that emphasizes the construction of classrooms in tandem with WASH facilities at schools. From their experiences in Serengeti District compared with other areas, CARE Tanzania noted that WASH solutions vary between different geographical areas due to different socio-cultural norms. Based on lessons learned from

the TWB-MRB project, keys to success for adopting WASH solutions in different areas could be:

- Create an enabling environment and institutional framework
- Utilize a variable approach to promoting sustained hygiene and sanitation behavioral change by using trained facilitators
- Promote a land use plan at the village level to plan for WASH infrastructure
- Promote good governance by improving the monitoring capability of the district water and sanitation team to ensure sustainability of activities

Similarly, World Vision noted several challenges as related to implementation of WASH activities under the TWB-MRB project, in the Kirindon region of Kenya. For World Vision, most challenges were associated with the water supply aspects of interventions. In their case, high population density in villages made it difficult to secure land for larger projects. World Vision addressed this challenge through technological solutions, opting for pipeline distribution projects from spring and rainwater harvesting tanks. Another challenge for World Vision was the presence of human / wildlife conflicts near water pans. Finally, where World Vision began concentrating on boreholes, once elevated levels of fluoride were encountered, they were tasked with changing their original approach and transitioning to the use of technologies like spring abstraction and rainwater harvesting as the main focus of water supply interventions. Additionally, for water supplied from boreholes, World Vision implemented a system for utilizing local technology (bone char) for treating water with elevated fluoride levels. In terms of community buy-in, World Vision's activities under the TWB-MRB project overlapped geographically with a program area where World Vision is active and will have a heavy presence for the next several years. This meant that there was already some relationship with local communities at the start of TWB-MRB project interventions, and there will be a longer history of support in Kirindon than is typical of many WASH projects. World Vision has adopted this same model of 10-15 year, or even longer, interventions throughout the world.

The Way Forward

Although the TWB-MRB project officially ended in 2012, many of the partners will continue collaborating and working within the Mara River Basin.

FIU continues to support local partners through regular communication, and through synthesis and publication of many of the final products from the TWB-MRB project. These publications include the EFA final report, the PES document, a compendium of student theses, and success stories as related to the EFA and student research in the basin. All of these publications will be made available to anyone interested upon request to glows@fiu.edu. Several FIU scientists who began research in the Mara under the TWB-MRB project continue to have students working in the region and even in the basin, and additional funding sources have been tapped to bolster research efforts in the region. FIU has also facilitated the selection and purchase of water quality and quantity monitoring equipment for the Mara River Basin, which is being installed and will benefit basin water

offices in water resources management on both sides of the basin, with support from LVBC. Additionally, FIU has had much discussion with the LVBC about providing technical and scientific support for their initiatives in the future. One of the ways that FIU/GLOWS is helping to make this happen currently has been by linking LVBC with others that have experience managing international lake/reservoir basins, particularly a group from Brazil that works with the Itaipu Hydropower Project and reservoir, and has faced some of the same challenges as related to water quality and community involvement as LVBC. FIU has facilitated meetings between LVBC and Itaipu HP, and several teleconferences have recently taken place to plan for a specific agenda of collaboration in 2013. FIU's presence in other projects in the East Africa region (e.g., Tanzania iWASH) will enable continued involvement in the Mara.

In the case of WWF-ESARPO, the organization will continue to support Mara River Basin initiatives in multiple ways. WWF-ESARPO will continue to work with LVBC and the East African Community through capacity building and through working toward implementation of the EFA, BSAP, SEA, and EPWS/PES documents. WWF-ESARPO is also committed to implementing new investments and policies on WASH, and water and food security issues. WWF-ESARPO also hopes to continue supporting development and implementation of sustainable mining, agriculture, settlement, and investment policies that are in line with the protection of ecosystems in the region, and will continue to strengthen grassroots institutions to mitigate emerging challenges as related to water resources. As of 2012, WWF-ESARPO is committed to at least five more years of concentrated activity in the Mara River Basin.

Although CARE Tanzania's Serengeti District office operations and main activities in the Mara River Basin will cease with the closing of the TWB-MRB project, CARE maintains a strong regional presence, with headquarter offices in Dar es Salaam, Tanzania, and satellite offices in other areas of the country. The project activities of CARE Tanzania will be sustained through several venues. For example, district water and sanitation offices have committed to monitor and maintain WASH infrastructures, and school committees will monitor and maintain the WASH infrastructures at schools. Additionally, the district council will continue to support village savings and loan groups. These follow-ups are made possible by the strong collaborative relationships built by CARE in the Serengeti District during the course of the TWB-MRB project.

The MRWUA is working to ensure the sustainability of their activities by providing capacity building training sessions and ensuring that the local communities take ownership of all projects. The MRWUA will continue to work in their community by continuing to build capacity of local institutions and working to find ways to influence inherent attitudes and cultures that are contrary to safe sanitation and hygiene practices. The MRWUA also will actively seek funding for further WASH activities and diversify the kinds of programs that it offers to the community. The fact that the MRWUA is based in the region, and from the basin, is a strong positive for sustainability of its interventions and continuation into the future.

World Vision, like WWF-ESARPO, is also committed to at least five more years of activity in the basin. World Vision will continue working in the Kirindon area through their Integrated Development Program. Among their major objectives in the coming years, World Vision will strive to reduce walking distance to the water points and add additional points, monitor the management committees from the large projects already completed under the TWB-MRB project, and utilize a community-focused approach for improving good sanitation in the future. This new approach will build upon the work done by World Vision under the TWB-MRB project with the school-focused approach.

Finally, GLOWS as a whole will actively look for ways to share the experiences learned within the Mara River Basin with the other GLOWS projects and partner organizations, particularly those in Africa. Although the Mara River Basin is but a small portion of the entire Lake Victoria Basin, many of the experiences learned in the Mara can be easily translated throughout the region and continent. The Mara River Basin is a perfect microcosm of all the complex issues surrounding the social, environmental and economic sustainability of a rapidly growing population in the region. The strong legal and policy environment in East Africa coupled with the close collaborative work of the GLOWS partners can aid the sustainable development of the region while preserving the world-class biodiversity within. The same challenges that are faced in the Mara River Basin happen throughout Africa and future funding opportunities should be pursued with this in mind.