Author: Anne-Teresa Birthwright, 2016

Pathway of Jamaica towards IWRM Approach: Case Study of the Rio Minho Watershed in Clarendon

Author: Anne-Teresa Birthwright

Edited by

Danka Thalmeinerova, Senior Knowledge Management Officer

&

Kenge James Gunya, Knowledge Management Officer

Author: Anne-Teresa Birthwright, 2016

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Introduction

Watersheds are essential to the livelihoods of humans. A significant portion of a society's economic gain and overall survival is acquired through the ecosystem goods and services provided by watersheds. Jamaica as a Small Island Developing State (SIDS) has recently been facing increased stress and vulnerability to its water resources. Consequently, the future availability of quality freshwater resources has been of great concern, especially given the increasing levels of demand from water users associated with domestic, agriculture, manufacturing and services sectors, and expected changes in rainfall patterns brought on by climate variability and climate change.

The island is divided into twenty-six (26) Watershed Management Units (WMUs) which comprises over 100 streams and rivers (Figure 1). With steep slopes usually in excess of 20 degrees, generally 65% of the land in the upper part of these WMUs is characterised by limestone derived soils, with the remaining areas being composed of soils from weathered igneous and metamorphic parent material, (National Environmental and Planning Agency-NEPA, 2003). Generally, previous work has been done in many of these WMUs with varying degree of success; for example the IDB and GEF funded Yallahs/Hope River Watershed Management Project, the USAID funded Jamaica Ridge to Reef Watershed Project, and the Eastern Jamaica Agricultural Support Project funded by the EU, among many others. However these project-based interventions may have been short-lived due to a lack of monitoring, evaluation and enforcement of suggested interventions.

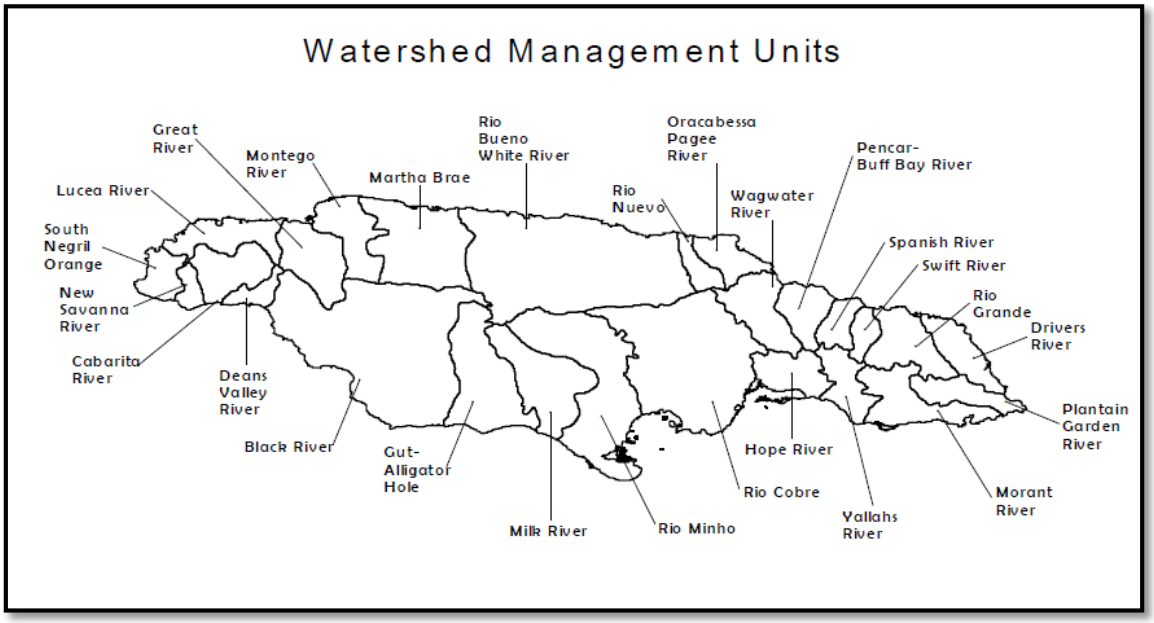

Figure 1: Watershed management Units in Jamaica (*National Environmental and Planning Agency-NEPA, 2003)*

This report presents a summarized profile of the Rio Minho Watershed, which is one of the more severely degraded units in the island. It documents some of the main features and problems within the watershed, as well as current actions and lessons learnt. The Rio Minho Hydrological Basin is found in Clarendon, which is one of the most southern parishes in the island. The basin is divided into three WMUs of which the Rio Minho Watershed hosts the island's longest river at 92.8 kilometres (57.7 mi). The Rio Minho River and its associated tributaries rise close to the mainland's geographic centre, where it flows from the steep mountainous limestone slopes in the north to the flat coastal alluvial

plains in the south. On the banks of the river, lies the town of May Pen. The Rio Minho not only produces one of the highest ground water discharges (Climate Studies Group Mona, 2014), second to the Black River WMU in St. Elizabeth, it is also the main source of surface water for water supply in Clarendon.

Description of the Rio Minho Watershed

Environmental

Rainfall is the main source of water in the Rio Minho Watershed Management Unit, where it yields three basic water resource types: direct rainwater, surface water and ground water. The average annual rainfall is 1530mm, with a high of >1780mm occurring in the mountainous areas and a low of 1000mm on the low alluvial plains (Evelyn, 2009). The upper areas of the watershed are characterised by dendritic drainage patterns where numerous small tributaries feed a larger stream. However within the lower area of the watershed (below the town of May Pen), the drainage density is very low. Soils of shales, conglomerates and igneous uplands often become well drained, shallow and easily eroded, where as soils of limestone uplands are characterized by slow internal drainage. Even though alluvial soils occur throughout the rugged relief of the watershed, they are mostly confined to the valleys of major and minor streams, and are generally fertile, (Evelyn, 2009; Forestry Department, 2002). The longitudinal profiles of the Rio Minho and its major tributaries as well as its hydraulic properties are shown in Figure 2 and 3 respectively.

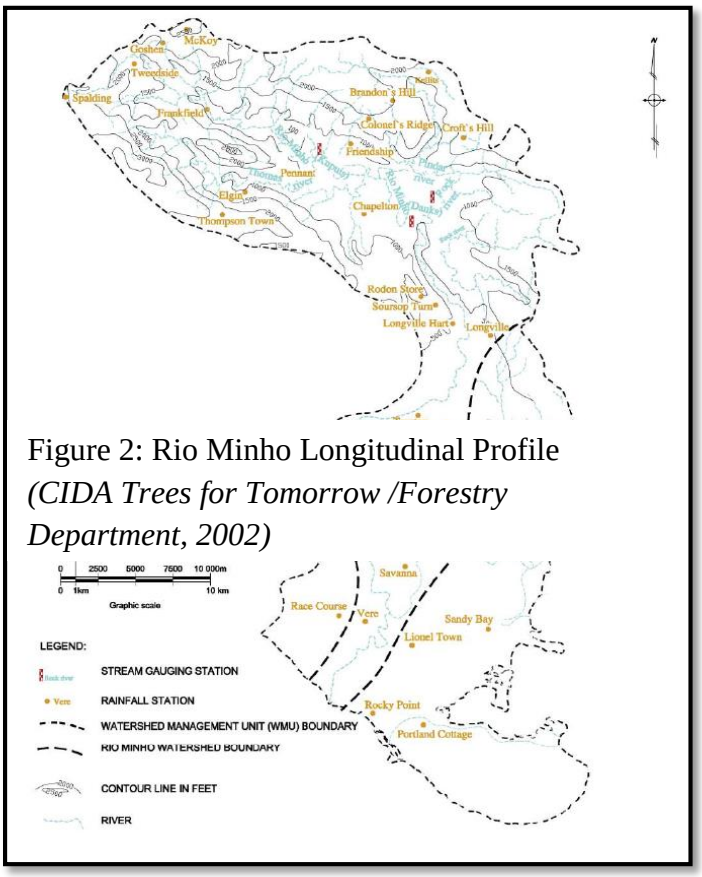

Figure 2: Rio Minho Longitudinal Profile *(CIDA Trees for Tomorrow /Forestry Department, 2002)*

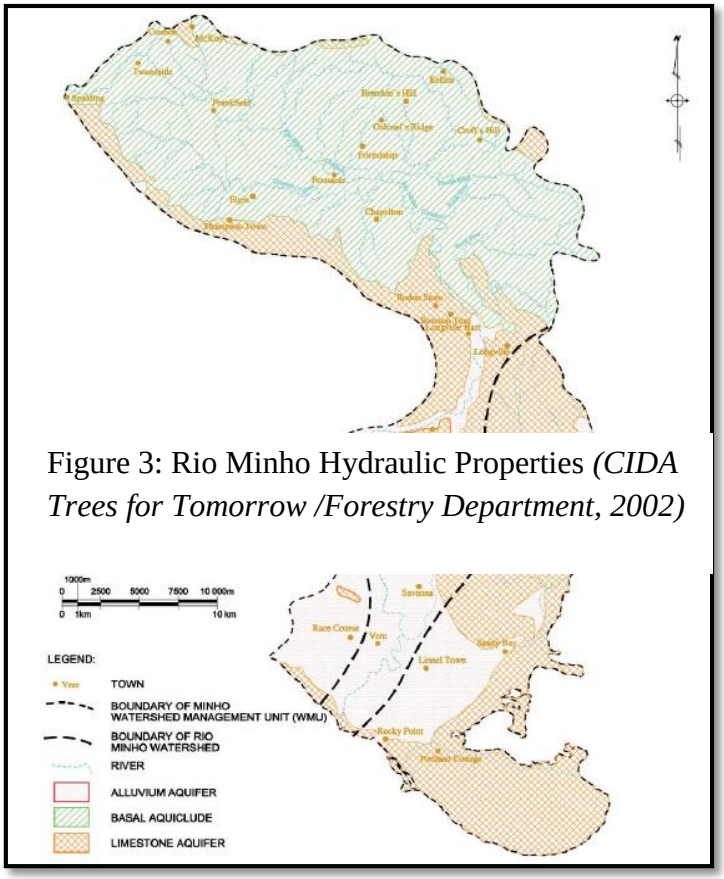

Figure 3: Rio Minho Hydraulic Properties *(CIDA Trees for Tomorrow /Forestry Department, 2002)*

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Land Use & Economic Activities

The Rio Minho WMU is characterized by various land use practices which often supports livelihoods within local communities. One of the major industrial activities located in the area is a bauxite processing plant. Known to be one of Jamaica's major mineral resources, bauxite can be found extensively in Clarendon. Similarly, two main sources of aggregate are alluvial sand and gravel, and crushed limestone. These are important materials used for the construction of buildings and roads and actually forms the bulk of quarry production in Jamaica. Quarrying and sand mining are found extensively throughout the watershed. Another major economic activity which dominates the Rio Minho Watershed is agriculture. With a mixture of smallholder farms and plantations, crops such as bananas, citrus, yams, coffee, cocoa, sugar cane etc are grown for both the local and international market. Most small farmers also own livestock, while on the coast, there are active fishing villages where fishermen and women make their livelihood.

All communities have access to electricity and cooking gas, although fuels such as wood, charcoal and kerosene lamps are still utilized. Solid waste is collected by trucks provided by the National Solid Waste Authority (NSWA), however many persons still burn or dump their garbage. Due to poor water supply, there is a high use of pit latrines and flush toilets which are not linked to an official sewage sysytem. The majority of the residents rely on private catchment systems, public standpipes and rivers and streams, however when possible, residents may purchase water from private trucking companies or the National Water Commission (NWC). The main social issues include high unermployment, poor water supply, poor roads and inadequate training opportunities.

Major Problems in the Rio Minho Watershed

For many years the Rio Minho Watershed has been recognized as a unit requiring critical intervention, especially since it has been constantly ranked as "severely degraded" by the National Environment and Planning Agency (NEPA) in 2002, 2009, and 2010 to 2015. Generally, key areas of livelihood strategies within the watershed are heavily dependent on the natural resources of the area, resulting in a fragile balance between environmental stability and economic survival. With the latter often times outweighing the former, some of the factors that have contributed to the degradation of the watershed include, among others, deforestation, poor agricultural practices, and mineral exploitation. Some of the resulting environmental impacts arising from these unsuitable land use practices include soil erosion, modification of the stream flow regime and reduced water quality. It is therefore essential to understand the land-use/water linkages so as to ensure the supply of quality water resources, the productivity of the land and the biodiversity of the watershed are not compromised, (Forestry Department, 2002). Some of the main problems identified within the Rio Minho Watershed are examined in detail below.

a) Unsuitable farming practices

Over-cultivation of steep slopes has contributed to increased soil erosion. There are 7 forest reserves (Stepheny John's, Pecknam, Douces, Peace River, Kellits-Camperdown, Bull Head, and Pennants), along with a protected bird sanctuary and RAMSAR Site (Mason River Protected Area) located in the upper regions of the Rio Minho Watershed. The Bull Head area is a critical part of the headwater system of the Rio Minho with many of its tributaries and streams flowing into the main river, while the Mason River habitat preserves some of the island's rare and more indigenous plants. However over the years, several of these forest reserves have experienced encroachment by individuals clearing new land for agricultural production; an activity which is illegal against the protected of forested lands. This change in the vegetation/soil complex not only leads to

increased sediment load and a quicker flood peak discharge, but also disrupts the biological diversity within the area.

Land on which agricultural production takes place is usually characterised by steep slopes which are highly fragmented (where a single farm consists of numerous spatially separated parcels) and possess shallow soils. In clearing lands for cultivation, the vegetation on slopes and in fields are often burned (slash and burn), which can cause soil degradation. Haphazard methods of cultivation on these slopes by smallholder farmers, together with intense rainfall eventually facilitate and accelerate soil erosion. Additionally the grazing of cattle, goats and donkeys on steep slopes, also caters to soil erosion problems. In contrast, the alluvial plains in the lower area of the watershed experience little erosion with the exception of when lands are over-grazed during the dry season.

b) High rate of deforestation

Large scale removal of trees to facilitate housing programmes and squatter settlements have contributed to the high rate of deforestation. Trees are used for fuel wood and charcoal production, yam sticks and lumber. Lands designated as forest cover have been cleared for uses incompatible with soil and water conservation measures. Forest reserves have been facing intense pressure from individuals who remove trees to accommodate the production of yam sticks, charcoal, logging operations (both legal and illegal) and residential development. Due to the use of slash and burn techniques, often times destructive forest fires occur. Paired with the lack of soil and water conservation measures, deforestation has led to high rates of surface run-off, loss of nutrients, reduction of water retention capacity, decreased initial rainfall abstraction, decreased soil permeability and infiltration rates in the watershed. Settlements in the lowland urban areas and unplanned hillside communities are characteristics which have shaped Jamaica's environment. Within areas of the Rio Minho Watershed, this has resulted in little supply of domestic water and organized sewage facilities.

c) Destruction of aquatic life

Sediment accumulation in mangrove wetlands occurs due to erosion on upstream lands which affect important nursery areas for aquatic life. In Jamaica, as with other Small Island Developing States (SIDS), there is an extremely close and intrinsic relationship between the terrestrial and marine ecosystems. Flowing water is the link that ties the terrestrial ecosystems with marine habitats and lowland urban areas. Regardless of this, soil degradation in the upper area of the Rio Minho Watershed has constantly been expressed through the damages acknowledged on marine resources, particularly in mangrove wetlands, coral reefs and other related ecosystems. The loss of mangroves may have serious negative impact on the survival of some aquatic species which depend on the protection of the mangroves for certain periods in their life cycle. It is known that the southern portion of the watershed forms part of the Portland Bight Protected Area which spans 32 square miles, inclusive of wetlands on the island, and coastlines of mangroves, as well as sea-grass beds that serve as a nursery for fish and shellfish breeding.

d) Deterioration of groundwater quality

The deteriorating quality of ground water due to chemical fertilizers, human and animal wastes, sediment and other pollutants, which affect downstream users. According to CIDA Trees for Tomorrow /Forestry Department (2002; 27) “the lack of pertinent data does not allow for any detailed analysis or quantitative assessment on the level of pollutants in the streams and aquifers”. The Rio Minho is the main sources of surface water for water supply in the watershed. Presently, approximately 80% of the total water supply is ground water from the limestone and alluvial aquifers in the plains (Figure 3). Currently the entire watershed has 214 wells, the source of which

stems from the upper regions of the watershed and from the activities of upstream users. According to national agencies such as the Water Resources Authority (WRA) and the Underground Water Authority (UWA), the quality of the groundwater in the Rio Minho Watershed has been deteriorating in recent years. This has mainly been due to the increase in agricultural runoff and industrial pollutants. Generally conventional farming methods which include the widespread use of chemical fertilisers in crop production have polluted groundwater resources, while industrial effluent and emission standards have not been adhered to. This has adversely impacted downstream users within the Rio Minho Watershed.

e) Lack adequate drainage capacity

The majority of the roads in the upper watershed area lack adequate drainage capacity to evacuate the flood discharge safely. There are numerous roads in the Rio Minho Watershed. However the majority of the road networks in the hilly terrain lack the adequate drainage capacity to safely evacuate the flood discharge. A consequence of this is that the roads are subjected to surface erosion, bank slips and flooding.

Current Actions in the Rio Minho Watershed

Historically, Jamaica has always institutionalized its environmental concerns by legislating measures to address them. Over the years, many laws have been passed which give several agencies the authority to regulate and manage the environment. However the fragmentary basis on which these laws were created has resulted in the overlapping of responsibilities of some institutions, making it difficult for these organizations to embrace some level of direct accountability.

In terms of watershed management there have been concerns over the years about the increasing degradation of Jamaica's watersheds. This has led to a series of project-based interventions aimed at mitigating and preventing the environmental and human factors which impact negatively on watershed areas. These interventions were carried out mainly through bilateral and multilateral assistance, with some varying degrees of success, (NEPA, 2003). However these projects and watershed management actions undertaken by policy makers, NGOs and organizations within the private sector were often done in silos and were unrelated, as there was no unifying set of principles to provide guidance and ensure a coherent approach to watershed management. It was acknowledged in the Watershed Policy of Jamaica by NEPA (2003) that a project-based rather than programme-based approach resulted in the gains from previous interventions being short-lived and rarely sustained by investments in long-term programmes. Institutional instability, the loss of trained staff and lack of data/information have also minimized the gains from interventions.

In addition to overlapping responsibilities and an absence of coordinated governance due to project based interventions being conducted in silos, there is also a lack of proper documentation by the various institutions carrying out these interventions. Generally the management of Jamaica's freshwater resources is primarily the domain and responsibility of the National Water Commission (NWC) and the Water Resources Authority (WRA). Aspects of this responsibility are also shared by the Forestry Department, the National Environment and Planning Agency (NEPA) and a myriad of other public and private organizations. Therefore documentation of the various interventions and actions taken within watersheds are often either simply unrecorded or assumed to be recorded by one of the many agencies with overlapping responsibilities. As it relates to the Rio Minho Watershed, insufficient information was found to be documented on the current interventions implemented to combat the previously highlighted problems. Being one of the most degraded watersheds in the island, this was unexpected. One of the few detailed reports on the watershed came from the CIDA/Forestry

Department Trees for Tomorrow Project (2002). Therefore the current interventions in the Rio Minho Watershed discussed below were compiled where possible, from various sources and press releases.

Actions on Deforestation and Soil Erosion

Agencies and policy makers have tried to address the degrading levels of soil erosion within the Rio Minho Watershed, caused mainly by deforestation and the activities of hillside farmers. The approach taken to address these problems and protect upland slopes has been dominated by both biological/cultural and engineered soil conservation methods. These were implemented to allow farmers to continue to produce annual crops but with reduced erosion. The most popular biological/cultural soil conservation methods which have been used in the watershed include, intercropping, vegetative barriers and mulching; while engineered structures include retaining walls and diversion channels.

Actions on Quarrying and Sand Mining

In 2003, the UK Department of International Development (DFID) funded the joint Effective Development of River Mining Project between the British Geological Survey and the Jamaica Mines and Geology Division. The objectives of the project among others were to evaluate the renewability and sustainability of fluvial sand and gravel resources, as well as the socio-economic and biophysical impacts of sand and gravel extraction on host communities and the environment. The result showed major disturbances to the overall biodiversity to the benthic macroinvertebrate fauna as one moves downstream, due to an increase in suspended sediments resulting in high turbidity and siltation. The only recommendation given was a need for further longer term study. However recent press releases (Bennet, 2014; Serju, 2014) indicated that the Mines and Geology Division have instituted restrictions on all sand-mining operations along the course of the Rio Minho due to the chronic depletion of sand resources in the river. The regulating division suggests operators/miners consider other possibilities such as manufacturing sand by crushing stones, thus giving the river enough time to accumulate more sand.

The Rio Minho Watershed Management Actions

Programme Title: Enhancing the Resilience of the Agriculture Sector and Coastal Areas to Protect Livelihoods and Improve Food Security (Jamaica Adaptation Fund Programme, 2012)

This programme was launched in 2012 and aimed to protect the livelihoods and food security in vulnerable communities by improving land and water management for the agricultural sector as well as strengthening coastal protection and building institutional and local capacity for climate change adaptation. The project ends in March 2016 and is being financed (USD 9.995 mil) by the Adaptation Fund, which was established under the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC). The implementing and executing entities include the Planning Institute of Jamaica (PIOJ), National Environment and Planning Agency (NEPA), Ministry of Agriculture and Fisheries and Ministry of Tourism. The interventions will support a "ridge to reef" approach and will include infrastructures such as:

- Green gullies, minimum or zero tillage, intercropping, contour ridges and vegetative and trash contour barriers, mulching and composting, all to improve the soil nutrient content, infiltration and soil permeability, and help to control runoff and reduce soil erosion and land slips within the watershed. Expected outputs also include reduction in downstream flooding as well as reduced turbidity and pollution of coastal waters.
- Water catchment facilities such as rainwater harvesting, a micro dam and small scale drip irrigation systems will be established to provide a source of water during the dry periods. Also the establishment of productivity programmes using climate-smart agriculture. Overall the

increased availability of and access to domestic and irrigation water supplies leads to increased productivity and increased food security.

- Establishment of water-user groups (WUGs) in the farming communities – The WUGs will have direct responsibility for managing the irrigation assets supported under the programme. This will help to ensure the sustainability of the water catchment systems.
- Training of local communities and entities in disaster risk reduction (DRR) and natural resources management. It is expected that from this intervention there will be increased knowledge of climate change and adaptation options at the local level as well as an enhancement of local capacity for the sustainable use of environmental resources.
- Building capacity of vulnerable farming communities by conducting workshops and field visits for farmer training in water and land management and climate smart agriculture, as well as establishing farmer field schools to develop solutions and demonstrate good practices led by farmers, leading to better informed decision making among farmers and local residents and reduced exposure to climate-related risks.

Programme Title: Rapid Characterization of the Upper Rio Minho Watershed prepared for the Strategic Programme on Climate Resilience (SPCR, 2013)

The Pilot Program for Climate Resilience (PPCR) is a part of the Strategic Climate Fund (SCF), which operates under the umbrella of the global Climate Investment Funds (CIFs). The SPCR was launched in an effort to climate proof Jamaica's development. Financed by the (Inter-American Development Bank (IDB) at USD 15 mil grant and 10 mil loan, the SPCR is aligned to Vision 2030 Jamaica-National Development Plan, and also builds on gaps and challenges identified in Jamaica's Second National Communication (SNC) to the United Nations Framework Convention on Climate Change (UNFCCC). Being one of the three investment projects under the SPCR, this Rio Minho programme examines in detail, the character of the Upper Rio Minho Watershed so as to understand the issues related to weather and climatic changes, to develop appropriate strategies and baseline information for monitoring the interventions of the SPCR. The implementing entity is the Planning Institute of Jamaica (PIOJ). Infrastructural recommendations under this project are climate change specific and include interventions such as:

- The design of new climate resilient cropping systems which are best suited for the limited water supply and rainy seasons being experienced currently and that expected in the future. This intervention will undergo specific considerations including the effect of crop rooting on hillside stabilisation, marketability, and effect on soil, water and chemical requirements.
- Rainwater harvesting and re-use of water are affordable and effective methods for storing and retaining water.
- Artificial recharge of the Rio Minho Basin's Limestone Aquifer which is expected to buffer the impacts of climate extremes (droughts and floods) and regulate variability on the temporal aspects. These engineered plans will be designed to preserve or enhance groundwater resources, through increasing the natural replenishment or percolation of surface waters into the aquifer. This results in an increase in groundwater available for abstraction.
- Check dams, contour planting of pineapples and guinea grass mulching will assist in slope stabilization, soil loss reduction, reduce soil temperature and increased water infiltration.

Programme Title: Adaptation Program and Financial Mechanisms under the Pilot Program for Climate Resilience (PPCR, 2015)

This is a recently Inter-American Development Bank approved and financed investment operation which will include a pilot implementation of interventions in selected communities located in the

Upper Rio Minho Watershed. This is a continuation from the *Rapid Characterization of the Upper Rio Minho Watershed prepared for the Strategic Programme on Climate Resilience (SPCR,* **2013)** where the baseline information collected will be used in this project. The executing agency is the Ministry of Water, Land, Environment and Climate Change (MWLECC) with coordination from the Planning Institute of Jamaica (PIOJ). The physical infrastructures which will be implemented include:

- Construction of 1800 check dams ($1m^3$ each) for erosion control with associated live vegetation barriers (e.g. use of pineapples)
- Rehabilitation of three (2 hectares each) rainwater ponds
- Establishment of communal rainwater harvesting water systems (250 units)
- Retrofitting of a post-harvest storage and processing facility incorporating climate change resilient considerations and design concepts
- Construction of three community operated greenhouses/shade houses
- Installation of five (5) aquaponics systems.

Discussion

The process of Integrated and Adaptive Water Resource Management (I/AWRM) requires the coordinated management of water, land and related resources so as to ensure public participation, economic efficiency, social equity and ecological sustainability in the midst of potentially uncertain futures. Deforestation and soil erosion have been a constant issue in watersheds. However, since the 1980s, greater emphasis has been placed on utilizing an integrated approach, which combines soil conservation and rural development elements with strategies to improve both land and people, (NEPA, 2003). Whether directly or indirectly, farmers have always implemented biological/cultural controls as a means of soil conservation; however deforestation and soil erosion continues to be a major contributor to the degradation of the Rio Minho Watershed. This is due to the fact that most of these biological controls surround ensuring some level of economic benefit and not necessarily environmental/natural resource protection. For example biological controls such as contouring, intercropping and mulching are all implemented to initially maintain livelihoods in farming, with reduction in soil erosion being a secondary benefit. Therefore the importance of maintaining forest cover and reducing the encroachment in protected forest reserves are not widely communicated to residents and farmers. With regards to quarrying and sand mining, the laws and regulations governing the issuing of licenses are enforced, where illegal activities in these areas are open to prosecution. There is also some level of monitoring with these activities where the regulatory division issues restrictions on all sand mining and quarrying activities so as to ensure sustainability of the industry through environmentally sound business practices.

However in recognizing this approach, these current ongoing activities highlight the inefficient institutional and human-resource capacity to effectively address current and future issues in water resources management. For example the Watersheds Protection Act, 1963, is the principal law governing watersheds in Jamaica and is overseen by the National Environmental Planning Agency (NEPA). The primary focus of the Act is the conservation of water resources by protecting land in or adjoining the watersheds. The Act works with other related legislation such as the Forest Act (1996), Water Resources Act (1995), Natural Resources Conservation Authority Act (1991), Rural Agricultural Development Act (1990), Land Development & Utilization Act (1966), the Mining Act (1947) and the Wildlife Protection Act (1945). However, the Watersheds Protection Act has not benefited from any substantial revision since its implementation and requires updating with respect to participatory approaches, as it lacks adequate incentives to encourage watersheds development and makes no provision for education and the involvement of local communities in watersheds

management (NEPA, 2003). Additionally, policies related to the Watershed Protection Act are rarely enforced which further limits the effectiveness and sustainability of these ongoing activities.

Over the years it has been acknowledged that the institutional structure which needs to be enabled to effectively implement an I/AWRM plan is time consuming and expensive, and is therefore beyond the financial, technical, and human-resource capacity of the island. However in light of the objectives outlined in the Vision 2030 Jamaica-National Development Plan and developments in the water sector since 2004, a recent 2014 revision of the island's Water Sector Policy (2004) has been conducted, known as the Water Sector Policy and Implementation Plan (2014). One of the major additions to this new Policy is a strong commitment to integrated water resources management and efforts to ensure that the sector adapts to climate change and is resilient to climate variability. Additionally, wastewater management is also addressed, where 99.5% of all Jamaicans have access to improved sanitation facilities. However even though these may be safe for the users of these facilities, many do not protect other people's health or the environment. The policy therefore seeks to ensure safe sanitation facilities by 2020. The policy also addresses public-private partnerships within the water sector where government –owned service providers contract private companies to improve water supply services. It is not documented exactly when this Policy will be implemented however until then UNEP (2012) suggests starting small by using pressing water-related issues as "entry points", and fine-tuning IWRM strategies from experience.

With regards to the current programmes being implemented in the Rio Minho Watershed, which can be considered as "entry points", it is recognized that concerns have been more so about the impacts of climate variability and climate change on the livelihoods, food security and natural resources. These are of course necessary within an I/AWRM plan; however these programmes may be more holistic if they addressed coordinated and guided priorities related specifically to improving the quality and/or quantity of freshwater resources in the entire watershed and not only in its upper reaches. Additionally, with the known tradition of projects being operated in silos, the island made progress in that in 2013 it reorganised ministerial responsibilities and created the Ministry of Water, Land, Environment and Climate Change (MWLECC), thereby providing oversight and responsibility for policy, legislation, and monitoring of all water agencies. The inclusion of water, land, the environment, and climate change under one ministry, in addition to the revised Water Sector Policy and Implementation Plan (2014) which ensures holistic, cross-sectoral and participatory decision making process, signals a commitment to an integrated approach to water management (Global Water Partnership, 2014,). It is therefore expected that stakeholders and agencies/entities whose responsibilities specifically surround water resources management will be involved in the coordination and implementation process of these current programmes in the Rio Minho Watershed. Especially since the programmes also appear to be a part of the larger developmental goal for the island - Vision 2030. The actions from the current programmes being implemented in the Rio Minho Watershed can be therefore considered to be effective and sustainable, especially since the majority of the actions being considered may be characterized as "no regret" interventions, along with engineered structures and capacity building of communities and farmer groups.

Unaddressed Problems

- Regardless of the ongoing actions, and the anticipated actions from recent programmes to be implemented, the Rio Minho Watershed still has major issues which have yet to be addressed. One of which is where the majority of the roads in the upper watershed area lack adequate drainage capacity to evacuate the flood discharge safely.

- Another issue which is in the process of being partially addressed is the sediment accumulation in mangrove wetlands due to erosion on upstream lands which can affect important nursery

areas for aquatic life. Based on the programmes highlighted, it appears that measures will be put in place to reduce erosion on upland areas of the watershed. However, nothing has been mentioned about rehabilitating the current situation facing the mangrove wetlands due to the overloading of sediments.

Lessons Learned

What was found to be a part of the current programmes being implemented in the Rio Minho Watershed were components addressing the social, economic and environmental aspects of the watershed and its use of water resources. One of the vital requirements in implementing aspects of I/AWRM which these programmes also addressed, is the improvement of institutional and local level capacity building in relation to adaptation. Activities under these interventions seek to improve the capacity of key stakeholders (educating and training vulnerable farming communities and community groups), by demonstrating best-practices in climate-resilient agricultural production for sustainable improvement of food security; creating tools as well as the transfer of appropriate technology to improve climate resilient development planning and increase the awareness and access to information about climate change and adaptation options. These activities are facilitated through the strengthening of existing community–based organizations (CBOs) and nongovernmental organizations (NGOs) where they will be able to translate important information as well as provide on-the-ground assistance. This will ensure that the community benefits in the long-term and the practices are sustained in future generations of farmers.

Even though the current programmes to be implemented possess aspects of I/AWRM, there are still recommendations which can be made to improve the process. It is necessary to note that based on the Watershed Policy for Jamaica by NEPA (2003), agencies involved in watershed management are responsible for securing adequate financing for watershed management activities, through the development of programmes and projects for donor funding.

Contact Details

Name: Anne-Teresa Birthwright
Organization: The University of the West Indies, Mona Campus, Kingston 7, Jamaica
Home Address:
Lilliput Little Rive Rose Hall,
Montego Bay,
St. James, Jamaica
Postal Code: JMCJS09
Phone Number: 1-876-365-6104
Email: annetbirthwright@yahoo.com

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