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Ecosystem Restoration Maintenance of Hydropower Potential in Rwanda Through

World Resources Report Case Study

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OVERVIEW

amount to a five-fold increase in energy demand in areas and rural agro-processing investments. Only expanding population,' industries/factories in urban play in achieving its economic development and widely recognized as having a significant role to In Rwanda, hydroelectric power production is seven years (MINIFRA, 2010a). have access to electricity by 2017, which would sets a target of ensuring 50 percent of households Rwanda's 2011-2017 Energy Policy and Strategy households are located in the capital of Kigali. have access to electricity-and 60 percent of these 10 to 11 percent of households in Rwanda presently the growing demand for electricity from its suited to the establishment of hydropower to meet Hills," with its numerous rivers and lakes, is highly poverty reduction goals. The "Land of a Thousand

country vulnerable to changing hydrological reliance upon this energy source presents some production costs for electricity in Rwanda, its conditions-whether caused by climate change or challenges. Among these is that it makes the Although hydropower plants have the lowest

¹ Rwanda's current population is just over 11 million and growing at an estimated rate of 2.82 percent per year (CIA, 2010).

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to human activity; poor maintenance of the station; and reduced precipitation in prior years. surrounding Rugezi-Bulera-Ruhondo watershed due combination of factors, including: poor Ntaruka's reduced electricity generation was along with the downstream Mukungwa station, capacity at Ntaruka hydropower station which, electricity supply crisis that adversely affected its in the mid-2000s when Rwanda experienced an other factors. This vulnerability was demonstrated headwaters of the watershed; degradation of the management of the upstream Rugezi Wetlands, the decline in water levels in turn was precipitated by a Bulera, which acts as the station's reservoir. This attributed to a significant drop in the depth of Lake provided 90 percent of the country's electricity. large measure by a steep decline in generation development prospects. This crisis was spurred in

in the country (particularly in the southeastern climate change will likely cause prolonged droughts regarding future changes in precipitation (SEI 3.0° C by the 2050s, but there is less certainty temperatures will increase in Rwanda by 1.5 to projections suggest that average maximum annual future impact of climate change in Rwanda. Climate 2009). Although some researchers have stated that reduction in precipitation might foreshadow the At the time, concern was expressed that this

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confidence how climate change may alter 2009). Although it is not possible to state with potentially leading to flooding, increased risk of intensification of rainfall during the rainy season. most models do agree that there will be an Despite these divergences between projections, average annual rainfall will increase (SEI, 2009) region; MLEFWM, 2005), others suggest that landslides and erosion (MLEFWM, 2005; SEI

precipitation on an annual and increases or decreases in hydroelectric system to enable needs to be built into the capacity of its hydroelectric management and generation process will affect the it to adapt to either future sector in the future. Resiliency Rwanda, it is clear that this precipitation patterns in

the Rugezi Wetlands and on-going drainage activities in degraded Rugezi-Buleracrisis, the Government of banning agricultural and Ruhondo watershed by halting Rwanda sought to restore the In response to its electricity

country's existing Environment Policy (2003) and policies and render rural livelihoods more initial adverse impacts of their watershed protection and watershed management measures to offset the to access key resources, adversely affecting the rural households in the region were no longer able subsequently by its National Land Policy (2004), pastoral activities within and along its shores, as the Government implemented a suite of agricultural productivity of their livelihoods. Recognizing this, These response measures, however, also meant that Ruhondo. These actions were enabled first by the well as along the shores of Lakes Bulera and Environment Law (2005) and Land Law (2005).

generating activities such as beekeeping. sound farming practices; and promotion of incomethe promotion of integrated and environmentally hillsides; the distribution of improved cookstoves; Wetlands; planting of trees on the surrounding and Pennisetem grasses around the Rugezi structures; the establishment of a belt of bamboo included the construction of erosion control sustainable in the longer-term. These measures



seasonal basis.

energy and promotion of the country's abundant energy security. Through appropriate investment problems and, in particular, the importance of for diverse approaches to addressing complex Rwanda's electricity sector demonstrates the need peat deposits for electricity production. The story of of methane gas from Lake Kivu, use of geothermal private sector. These initiatives include the capture diversify its energy portfolio with support from the the electricity crisis also spurred Rwanda to plant has returned to full operational capacity. But surrounding the Ntaruka hydropower station, the integrated watershed management in promoting Today, through protection of the watershed

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vulnerability to future climate changes that may maximized. These actions also help reduce sustainability of hydropower sources are adversely affect the country's hydro-potential lakes can be improved such that the efficiency and strategies, the well-being of the watershed and its

SETTING

percent of rural households in Rwanda had access to commercial, institutional and household activities in energy came from electricity generated by seven 97 percent of the country's total energy was cooking, lighting and other needs. Approximately of Rwanda was dominated by the use of biomass The primary generators of hydroelectricity in figure in urban areas was 23 percent (CITT, 2006). electricity for lighting, while the corresponding Kigali. By way of illustration, in 2006, only 0.5 Rwanda's urban areas—particularly in the capital, and continues to be used, primarily to support generated through these hydro stations was used, western half of the country. The electricity hydropower production stations located in the (MINIFRA, 2009). The remainder of the country's supplied through these traditional sources (firewood, charcoal and agricultural residues) for In the early part of this century, the energy profile

production capacity of 48 GWh of electricity.² supplied 90 percent of Rwanda's domestic Mukungwa power stations located in Rwanda's an installed capacity of 12 MW for an annual 11.25 MW. Mukungwa was built in 1982 and has Belgium in 1959, and has an installed capacity of the country's first hydropower station, built by hydroelectric capacity (CITT, 2006). Ntaruka was Northern Province. Together, these two stations Rwanda were, and remain, the Ntaruka and

within and rely upon the Rugezi-Bulera-Ruhondo The Ntaruka and Mukungwa stations are located

² The country's two other significant hydropower stations in the 2000s were Gihira (1.8 MW) and Gisenyi (1.2 MW) (MINIFRA, 2010a).

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security and economic development. they are intrinsically tied to Rwanda's energy Ruhondo' before entering the Mukungwa River. Rwanda. Water from the Rugezi Wetlands flows catchment area of 190.70 km2 (Hategekimana and Wetlands cover an area of 67.35 km² with a country's water (Hategekimana and Twarabamenye, Rwanda's surface area and holds 90 percent of the River Basin, which covers about two-thirds of recognized Wetland of International Importance. of Rwanda's Northern Province, this watershed is potential of its downstream power stations. As such, the rate, quantity and quality of water flow into The Rugezi Wetlands play a key role in determining Ruhondo on the Mukungwa River (UNEP, 2006). Mukungwa plant is situated downstream from Lake between Lakes Bulera and Ruhondo, and the The Ntaruka hydroelectricity plant is located nearly half of its inflow⁺—and then into Lake Twarabamenye, 2007), all of which is located in 2007; Liu, 2008; RMNR n.d.). The Rugezi The wetlands is one of the headwaters of the Nile dominated by the Rugezi Wetlands, a Ramsarwatershed (see Figure 1). Located in the highlands Lake Bulera and, therefore, the hydropower

in Africa (RMNR, n.d.). Burera District, which 517,715 people, and expanding (Hategekimana and Rugezi Wetlands' catchment area was about contains much of the watershed, currently has a which in turn is the most densely populated country of the most densely populated regions of Rwandapromoted tragmentation of land holdings; the Twarabamenye, 2007).⁶ This situation has kilometer (Burera, n.d). In 2000 the population the population density of about 522 people per square The Rugezi-Bulera-Ruhundo watershed is also one

³ Lake of Bulera occupies a total area of 5,280 hectares and has a maximum depth of 174 meters (CITT, 2006). Lake Ruhondo has a total area of 2,610 hectares and a maximum depth of 68 Source: Hategekimana and Twarabamenye, 2007.

⁶ Between 1978 and 2000, the population density in the Rugezi area grew by over 70 percent, rising from 337 to 577 inhabitants per square kilometer (UNEP, 2006; Hategekimana and Twarabamenye, 2007). neters (CITT, 2006).

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malnourished (REMA, 2009). with 60 percent of the population considered to be is among the most impoverished in the country, declining agricultural productivity and deepening downward spiral of deforestation, soil degradation, 2010). Collectively the region has experienced a only exacerbated this degradation by putting productivity that further push farmers to seek new season, causing declines in crop and livestock slopes are easily eroded by runoff during the rainy degrees (CITT, 2006). The fragile soils on these the growing population to increasingly cultivate the upon agricultural activities for their livelihoods, this population surrounding the wetlands depending household (CITT, 2006). With 90 percent of the of Rwanda ranges from 0.15 to 0.2 hectares per average size of land holdings in the highland zone poverty. Indeed, the population surrounding Rugezi forest cover has been depleted since 1960 (FAO approximately two-thirds of Rwanda's natural immense pressure on the country's forest resources; dependency on biomass for cooking and light has land for cultivation (CITT, 2006). Rural watershed's steep slopes, some of which exceed 60 has led to soil degradation. This, in turn, has pushed land fragmentation combined with over-cultivation

CRISIS FACTORS LEADING TO THE 2004 ENERGY

country's hydropower resources and degradation of one turbine at a time. The potential for an electricity fallen too low for Ntaruka's three turbines to be station. As the depth of water in Lake Bulera had reduce production from the Ntaruka hydropower (now known as RECO-RASCO), to significantly crisis. This crisis was triggered by a decision by electricity supply—and by extension, economicyears due to the continued over-exploitation of the supply crisis had been looming for a number of safely operated, Electrogaz began to operate only produce and distribute power and water in Rwanda Electrogaz, a parastatal organization mandated to In 2003-04, Rwanda experienced a significant

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produce sufficient energy to meet its growing needs. collectively undermined Rwanda's capacity to of a series of events and circumstances that Electrogaz's decision was therefore the culmination the Rugezi-Bulera-Rohundo watershed.

2006). Government had not invested in the Mukungwa a combination of poor planning and limited human existing capacity to meet growing demand (CITT, economy began to grow, leading to over-use of compounded in the late 1980s when Rwanda's being overbuilt for the average inflow it receives. situation was compounded by the Ntaruka station station was built in 1982 (CITT, 2006). This and financial resources. For example, the from inadequate servicing and maintenance, due to capacity. Existing hydropower stations suffered declining state of Rwanda's electricity generation A central contributing factor to this crisis was the The fragility of the country's electricity system was

growth, limited governance capacity and unclear (CITT, 2006). Furthermore, eucalyptus trees, which caused water loss through evapotranspiration and other aquatic weeds that increased turbidity and watershed has also been infested by water hyacinth irrigation canals had been built in certain arms of of the wetlands. In addition, since the 1960s, increased surface runoff, soil erosion and siltation slopes which, combined with deforestation, tenure regimes contributed to cultivation on steep Rugezi-Bulera-Ruhondo watershed. Population electricity crisis was land degradation within the A second factor contributing to the country's (Hategekimana and Twarabamenye, 2007).⁸ The the wetlands to support the cultivation of cash crops

⁷ Bailb by the Belginst during colonialism, the Ntarak station contains three nurbines that require a flow rate of 12 cubic meters per second for the station to achieve its full capacity of 112.2 MW. However, the Rauson tributary to achieve the Ragezi Wedmds to Lake Baitera has a flow rate of only 2 cubic meters per second during the train yeason. As such should the station be operated at its full potential it has the potential to directly combute to a decline of the varie trevel in Lake Bablen (CITT, 2006). For example, in 2000, the Baberaka Raral Spaces Management project created a deep rentral canal in two arms of the Ragezi Wedmds to enable potato and com production (Hategokimana and Twarabamenye, 2007).

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and Twarabamenye, 2007). The declining health of wetlands' water table (CITT, 2006; Hategekimana evapotranspiration contributed to a decline in the within and around these water bodies. Collectively draw significant amounts of water, were planted activities.3 handicrafts, and other important local livelihood the wetlands disrupted fishing, transportation, these processes of drainage, siltation and greater

data,10 a meteorological station at Kigali airport, the at Rwanda's only source of long-term climate in preceding years. Based on information collected (Mukubwa, 2009). period of 1991 to 2000 was the driest since 1961 An additional source of stress was declining rainfall

> of their average depth between 1957 and 1970 production from Ntaruka station. Electrogaz was forced to significantly restrict power water levels in Rugezi, opening up new areas of the 2007). This shortsighted measure further reduced decline in the lake levels. By 2004, water levels in Bulera in subsequent years, resulting in a further reduced the supply of water from Rugezi to Lake wetlands for cultivation and cattle grazing.¹¹ It also Wetlands (Hategekimana and Twarabamenye, additional efforts in 2000 to drain the Rugezi turbines. In response, Electrogaz undertook plant that prevented efficient operation of its three (UNEP, 2006). Under these circumstances, Lakes Bulera and Ruhondo had fallen to 50 percent

With a significant drop in its internal capacity to

water levels in

Lakes Bulera and

led to a drop in



stations declined

experiencing

Electrogaz was illustrated in Table 1998-2000, as substantially from Mukungwa Ntaruka and capacity at production Hydroelectric Ruhondo.

l. By 2000,

the Ntaruka power water shortages at

⁹ According to a report by UREP (2006), fishing activity in the area fell by 87 percent, and 72 percent canceists stopped their duily activity and lost their normes, among other factors, asymptother factors, and the stopped percent contribution of the Cargorian and the Cargorian and the Cargorian and the Cargorian and Cargorian ana

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country. Electricity rates doubled in 2004-05, from generation in 2005, and 56 percent in 2006. had significant immediate economic costs for the Operation of these generators cost the country up to constituted 30 percent of the country's power JSD 65,000 per day (UNEP 2006). These events

¹¹ Personal communication, representation provident 1 Personal communication, ntative of the Rwandan Ministry of the

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among the most expensive electricity rates in the world (GoR, 2010).¹² 22 US cents/kWh. Rwandans continue to have 7 to 14 US cents/kWh, and rose again in 2005-06 to

RESTORATION EFFORTS

issues and emerging policies developed since the late the enactment of certain provisions within existing the situation.¹³ In doing so, the Ministry called for restoring the Rugezi Wetlands would help address approached the Cabinet to make the case that Ministry of Environment, Lands and Mines the cost of accessing electricity increased, the As Rwanda's hydroelectric potential decreased and 1990s to address environmental and land tenure

events leading to the electricity crisis, the Ministry¹⁴ establishment of wetlands as state-owned property and prevent their further degradation; and including establishing measures to protect wetlands management, and other measures (MLRE, 2003). entails a series of policy statements and options for civil society to formulate an environmental institutions, United Nations agencies, and Rwandan undertook a series of consultations with state natural environment, and especially on its wetlands (MLRE, 2003). which a number of commitments are made, The policy contains an entire section on wetlands in land-use management, natural resource the restoration of the natural environment through Policy was subsequently released in 2003, and protection policy. Rwanda's National Environment As a result, in the early 2000s and parallel to the land use practices were placing on the country's had long recognized the strain that unsustainable The Ministry of the Environment, Lands and Mines

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is "forbidden to construct houses in wetlands and 50 meters from the banks of lakes (GoR, rural areas" (GoR, 2005a). (rivers, lakes, big or small swamps) in urban or 2005a). Article 87 of this law also stipulates that it of 10 meters from the banks of streams and rivers requiring these activities be undertaken at a distance and pastoral activities around bodies of water, and 86 of the Environment Law limit agricultural degradation of wetlands. In particular, articles 85 number of specific measures aimed at reversing the Environment Law (GoR, 2005a). The law entails a the Modalities of Protection, Conservation, and Rwanda's Organic Law N° 04/2005: "Determining Many of these principles were later promulgated in Promotion of the Environment in Rwanda" or the

marshlands found on high land which often should be avoided, such as highly peaty zones and disturbance of very fragile environmental sites Wetlands and other similar ecosystems should be assessment. And the policy implies that the Rugezi adequate planning and environmental impact agricultural purposes they must first undergo an that although certain wetlands may be used for legislation which must be vigorously enforced" (MLEFWM, 2004, p. 44). The policy acknowledges "all marshlands must be governed by a special of the Ministry of Lands and Environment, and that land, the classification of which is the responsibility wetlands constitute a special category of public (MLEFWM, 2004). The land policy states that rational and planned use of land ... " in the country stable form of land tenure, and bring about a stated purpose of which is to "guarantee a safe and formulate the Rwanda Land Policy in 2004, the and external consultations were undertaken to to formalize land ownership. A series of internal were being developed, Rwanda was pursuing efforts At the same time the environment policy and law left undisturbed through the statement: "any form of

¹⁴ Still, the production of macro hydropower remains among the least cost options in Rwanda. The production cost of macro hydropower (1 MW and above) ranges from 5.4 to 10 US cents per kWh, compared to: micro hydro (less than 1 MW) at an average of 15 cents per kWh; methane gas at 12 cents per KWh; and geothemal at 50 to 10 cents per kWh (MINIFRA, 2010). ¹⁵ Personal communication, representative of the Rwandan Ministry of the Environment, December 4, 2010. ¹⁴ Then called the Ministry of Lands, Resettlements and Environment.

constitute water reservoirs or water towers" (MLEFWM, 2004, p. 45).¹⁵

modernize Rwanda's agricultural sector. Among other measures, this law designates lakes and controversial assertion that land may be confiscated swamps as state land. The law also makes the complement customary law, and aimed to management practices in the country that would sought to establish more formalized land tenure and 08/2005) "Determining the Use and Management of unsustainable manner.16 if its owners are found to be managing it in an Land in Rwanda," or the Land Law. This legislation Rwanda's parliament passed the Organic Law (N° Following publication of the Land Policy in 2004

agricultural activities within and surrounding the implementation of the provisions restricting country's electricity crisis. In particular, Ministry restoration of the Rugezi Wetlands-and thereby 2003 to enact some of its provisions to ensure Ministry of Environment called upon the Cabinet in Cabinet. 17 approval of this plan of action was granted by the channels. On the basis of the Environment Policy, wetlands and the removal of existing drainage their further degradation. These actions included dramatic action to protect the wetlands and prevent officials argued that the scale of the crisis required address one of the critical factors leading to the With Rwanda's Environment Policy in place, the

of the government to control activities within the Rugezi Wetlands and along the shores of Lakes The subsequent passage of the Environment Law on May 2005 further strengthened the legal authority

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declared the Rugezi Wetlands a protected area. the government to restrict agricultural and pastoral banks of lakes. In 2008 the Government also streams and rivers and 50 meters away from the activities to 10 meters away from the banks of Bulera and Ruhondo. Specifically, this law enabled

rules were not provided compensation for their Ruhondo led to a 10 percent increase in the landless government's interventions (Willetts, 2008) land in or near the wetlands prior to the of the population of Rugezi cultivated a parcel of upon the wetlands, including some large cooperation of the population living in and relying population in these areas (CITT, 2006). Those who cultivation near the shores of Lakes Bulera and 2007). According to one source, nearly 70 percent cultivation and grazing purposes (McGray et al, had depended on the wetlands and lake shores for short-term on the livelihoods of the population that naturally had a significant adverse impact in the landholders. The introduction of these restrictions decision was the need to gain the support and Government as it began to act upon its Cabinet Perhaps the most significant challenge facing the lost access to land due to the enforcement of these Another source suggests that restrictions on

communautaires UMUGANDA") within Rugezi on World Environment Day on 5 June 2004. This by leading community work ("travaux Building upon prevailing practices in Rwanda, remove the roots of eucalyptus trees. This step was fill in existing drainage ditches and cut down and involved engaging the local population in efforts to local awareness and initiate community engagement Environment to address this situation was to raise among the first steps taken by the Ministry of

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environment, agriculture, livestock, forestry and these activities involved various government defense ministries, including those responsible for the Bulera-Ruhondo watershed. Implementation of hillsides and diversifying incomes in the Rugeziimproving agricultural production, protecting followed by a number of initiatives aimed at

projects in the Rugezi area aimed at restoring the and Hydropower International have implemented Agroforestry Centre, OXFAM, Care International employment for around 13,000 people by March conservation efforts, the project had created rehabilitation of the hillsides surrounding the focusing on reforestation, anti-erosion measures and governmental organization, to undertake a project provided funding to Helpage Rwanda, a local nonmeasures and social development (REMA, 2009) agroforestry, sustainable pastoralism, anti-erosion wetlands, including activities related to 2009 (Helpage, 2010). In addition, the World Rugezi wetlands (REMA, 2009). Through these For example, the Ministry of the Environment

community-based management plans for promoted through the Integrated Management of Critical Ecosystems (IMCE) project.²⁰ Implemented established a belt of bamboo and Pennisetum construction of terraces to reduce soil erosion endangered swamps. It has also supported the management committees and developed to implement sustainable agriculture measures and around four critical ecosystems, including Rugezi, through the Rwanda Environmental Management decrease the flow of water through the wetlands' grasses around Rugezi, and put in place a system to Rwanda has established local watershed improve their livelihoods. Through this project Authority, the IMCE project aims to assist farmers Restoration of the Rugezi Wetlands has further been

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management practices, and enhance the sustainability of local livelihoods. the watershed, improve agricultural and land watershed in an effort to simultaneously rehabilitate initiatives continue to be implemented in the central channel (Uramutse, 2009). These and other

OUTCOMES

2010) nearly full capacity, reducing by half the use of diesel generators." (Kagire, Rugezi marshland are operating at hydropower plants supported by the previously ceased to operate. Today the economic infrastructure that had biodiversity recovering, so is the Kagame said. "Not only is the other socioeconomic sectors," President national asset with multiplier effects on planting has seen the resurgence of this population, removal of cattle, and tree Rugezi Wetlands, resettlement of human business as usual. In the case of the "We simply could not continue with

key milestone in Rwanda's efforts occurred in October 2007 when the Ntaruka hydropower station enhanced their filtering capacity, reducing siltation country. The actions taken within the wetlands achievements with respect to restoration of the station's was 11 MW (MINIFRA, 2009). Rwanda's production had reached 7 MW and the Mukungwa again began to operate fully. By 2009, its power turbines, water levels in Lake Bulera have risen. A power station by alternating use of one of its three particular, restricting generation from the Ntaruka Combined with strong rains in 2006-07 and, in rates and increasing water flow into Lake Bulera. increase in hydroelectricity production in the by Rwanda in 2004 has contributed to the gradual and complementary restoration activities initiated Over time, the combination of policy interventions rehabilitation of the Rugezi Wetlands and an

¹⁵ The policy also discusses the factors that hindered the effective use of land in Rwanda at the time, including: limited land resources, the country's dependence on agriculture, a land tenure system characterized by customary law, landless persons, and issues (MLEFWM, 2004). , and antiquated land registration systems, among other

For information regarding Rwanda's water, agriculture and energy policies this time, see Willetts (2008). Personal communication, representative of the Rwandan Ministry of the

constant communication, representative of the Rwandan Ministry of the rironment, December 4, 2010.

³⁸ The government has introduced similar restrictions on the cultivation of lands near other water bodies, such as Like Kyvu. In this case, the government watered compensation to local populations: displaced as a result of the implementation of the 10 and 50 meter rule. Compensation was not provided to fammes in the Ruggel-Buken-Rhondo watershed (personal to fammes in the Ruggel-Buken-Rhondo watershed (personal) cation, ibid)

¹⁹ Personal communication, representative of the Rwandan Ministry of the Environment, December 4, 2010. ²⁰ Funding for this project was provided by the Global Environment Facility, and is being implemented through the World Bank.

Rugezi Wetlands were internationally recognized in (Kagire, 2010). 2010 when it was awarded the Green Globe Award

rules within Rwanda's wetlands as a whole admission with respect to the application of these State of the Environment report makes the same ecosystem's restoration is debatable; certain sources specific laws of 2005 are responsible for the It should be noted that the degree to which the broader energy concerns. Rugezi given its importance to the country's provision contained in the Environment Law in possibility for more strict enforcement of the implementation of laws (Pottier, 2006), creating the considerable discretion over the interpretation and been suggested that local authorities have (RMNR, n.d.; Willetts, 2008). However, it has also following their adoption, and the government's not adequately enforced in Rugezi in the years indicate that the 10 meter and 50 meter rules were

are now visiting the area.²¹ Thus although the local country's improved production of electricity,²² population largely did not benefit from the efforts appear to have started to provide some cultivation. Since this time, however, the restoration affected as households lost access to land for livelihoods that were lost due to the degradation of these changes have the potential to restore increased in the Rugezi Wetlands; and eco-tourists providing fodder for livestock; flora and fauna has planted on managed terraces and lake banks are activities have increased crop productivity; grasses benefits. Radical terracing and agroforestry livelihoods of many in the area were adverse more challenging question to answer. Initially, the Ruhondo watershed on the local population is a The impact of efforts to restore the Rugezi-Bulera-

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may also further improve livelihoods and increase combined with the on-going process of land titling, region. growth and socio-economic factors within the and will depend in part on broader population the local population will only be known over time climate change. The full consequences of efforts to capacity to deal with future climate shocks and Efforts to improve agricultural production, production, etc.) as well as introduce new the Rugezi Wetlands (fishing, handicrafts, honey restore the Rugezi-Bulera-Ruhondo watershed on opportunities (in the area of tourism, for instance).

ADVANCE THE INTERVENTION **GOVERNMENT'S ABILITY TO ADOPT AND** FACTORS THAT LED TO THE

executive arm of Rwanda's government over legal created an environment ripe for considering strong alternatives and the disruption in economic activity Rugezi Wetlands, as witnessed by the number of international interest in efforts to rehabilitate the areas. In addition, there was considerable national concern in Rwanda, and the government management and its impact on natural resources had action. As well, discussion around land use diesel-powered electricity, the lack of energy by the 2004 electricity crisis. The high cost of Wetlands may be attributed to a number of sources ecological services provided by the Rugezi Bulera-Ruhondo watershed) in order to restore the as resettlement of people living within the Rugezidecisive and, at the time, controversial actions (such implementation of the country's Environment and would serve to reinforce and enhance international donors willing to fund projects that was expected to establish new measures in these formed. Land use management was (and is) of great National Land Policy and Land Law were being ensued for a number of years in the country as its First and most prominently was the urgency created The ability of Rwanda to act swiftly and implement Land Laws. The considerable authority of the

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the advancement of these policy decisions. decisions and policy implementation also enabled

INTERVENTION AND ADVANCEMENT OF THE BARRIERS TO GOVERNMENT'S ADOPTION

implementation more onerous. government's interventions and made their these barriers were generally overcome, it is efforts to restore its northern watershed. Although government's adoption and advancement of its A number of barriers may have interfered with the possible that they slowed adoption of the

more timely interventions. with respect to water resources, may have led to on current power demand, and corresponding needs (Willetts, 2008). Greater exchange of information environment, agriculture, economic planning etc. Ministries responsible for infrastructure, of coordination between Electrogaz and Rwanda's electricity crisis might have been impeded by a lack Early action by the government to prevent the

adaptation priority (MLEFWM, 2006), and a project this objective. Country Fund is contributing to the achievement of this chiever ²³ currently being funded by the Least Developed hydrological and meteorological stations as a key have made it difficult for the Ministry of and other relevant data. Following the crisis, this absence of meteorological information in the identified the installation and rehabilitation of National Adaptation Programme of Action Rwanda interventions undertaken in the wetlands. In its Environment to effectively monitor and enforce lack of meteorological and hydrological data may Rugezi area, along with information on water flow This situation may have been compounded by the

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times of this century also created challenges (Willetts, environment policy framework since the beginning resulting in unclear designations of responsibility at considerably in the years preceding the intervention, 2008). Government ministries had been shuffled The "continuous modification" of Rwanda's

interventions on the local population. a greater commitment to ensuring compliance with noted as a barrier to the effective implementation of assessment of the impact of the government's monitoring also impedes a comprehensive the country's Environment Law.²⁴ The absence of the 10 and 50 meter rule by certain sources (ARD implement and monitor the intervention is also A lack of institutional capacity to oversee, Inc., 2005), although the government has indicated

with funding from international donors-had a a number of agricultural projects in the area-some arable land in the country and, as mentioned above, stake in the ongoing cultivation of the wetlands the cultivation and drainage of wetlands to expand country's agricultural policy at the time encouraged management measures in the Rugezi Wetlands. The adoption and implementation of land use for local livelihoods was a key barrier to the of the area and the country's reliance on agriculture In addition to the above, the high population density Wetlands land use management policies in the Rugezi interfered with the adoption and implementation of likely that the combination of these factors (Hategekimana and Twarabamenye, 2007). It is

³¹ Personal communication, representative of the Integrated Management of Critical Ecosystems project. Desember 2010. Critical Ecosystems project. Desember 2010. ²² As noted previously, about 10 to 11 percent of households in Rwanda have access to electricity, and the majority of these households are in Kigali and other urban centres (MNIFRA, 2010). The rutal communities in the Rugal-tical access and the statement of the Rugal-Access and the Rugal-Access and

Bulera-Ruhundo watershed generally do not have access to electricity.

³² This project is entitled "Reducing Vulnerability to Climate Change by Establishing Early Warning and Disaster Preparedness Systems and Support for Integrated Watershed Management in Flood Prone Areas," and is being implemented by UNEP and UNDP. Further information is available here: http://www.thegef.org/gef/node/3340

²⁴ In a February 2011 announcement by the Revandan Policy Force and the Rwanda Environmental Management Authority (REMA), the government committed itself to enforcing the Betwronment Law. The Director General of REMA note that "We have been sensitizing the public about this have but some people decided to give us deaf ears," and that pumping about the law been sensitized to have a responsibility to protect and prevent environmental degradation through the Environment Protection Unit under the Criminal Investigation (Section 1997). Section 2007 (Section 2007). http://www.police.gov.rw/spip.php?article237)

CONCLUSIONS AND LESSONS LEARNED

between the national, district and local levels for sector to improve its performance and management. complemented by actions within the electricity economic and cultural issues, and needed to be interlinked efforts to address ecological, social, of the Rugezi-Bulera-Ruhondo watershed required approach to solving complex problems. Restoration One of these lessons is the value of an integrated Government in response, provide a number of crisis, and the multiple actions taken by the success to be achieved. interaction and cooperation across ministries and This situation also points to the need for effective lessons-learned for adaptation decision-making. The factors leading to Rwanda's 2004 electricity

making progress towards achievement of this target.²⁶ Hydropower remains an important pa diversifying its energy portfolio. Since this time, country's total electricity generation capacity country has set a goal of generating 1,000 MW of geothermal, peat, solar and biogas resources.25 The Rwanda has embarked on an ambitious and (which is now 85 MW (MINIFRA, 2010a). Rwanda Rwanda's energy mix, providing half of the power for domestic use and export by 2017, and is through development of its methane gas, progressive effort to diversify its energy supply for and reinforced Rwanda's commitment to The 2004 electricity crisis also emphasized the need Hydropower remains an important part of

³⁸ For example, Rwanda has begun to «solidi the potential generation of 300 MW of methane gas from Lake Kovicu a pharu producing 4.7 MW of energy is now operational. The country is also seeking opportunities to exploit the gendermal potential west of the Karisimbi Vokano, which has an estimated potential of more than 300 MW, and its 139 million tons of peet that could potential of more than 300 MW, and its 139 million tons of peet that could potential of more than 300 MW. produce more than 100 MW. Biomass remains the country's largest source of energy, accounting for about 86 percent of the energy balance in Rwanda and over 95 percent of households energy demand (MINIFRA, 2010a).

were lost due to its degradation

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government targets (MINIFRA, 2010a). existing power plants. Today Rwanda's electricity electricity. The Government has also put in place access needs to speed up to meet a number of sector is one of the most effective by regional rehabilitation and replacement of spare parts for all strategies to ensure effective routine maintenance, provide the country with an additional 20 MW of these sites are currently under construction and will combined capacity of 96 MW. Twenty-eight of has also identified 333 micro-hydro sites that have a standards, although progress in generation and

country more resilient to the longer-term effects of hydropower potential also support adaptation to climate change, Similarly, integrated watershed management can ecosystems are often critical to reducing that minimize soil erosion and protect sensitive climate change. Land-use management practices explicitly designed to promote adaptation to climate particularly with respect to the maintenance of vulnerability to future climate shocks and stresses Rugezi-Bulera-Ruhondo watershed should make the change, improving the health and function of the policies and actions taken by Rwanda were not Finally, it should be recognized that although the

productivity as well as the restoration of other through enhanced soil quality and agricultural to contribute to improved livelihoods in the area with efforts to diversify the local economy, these some of the adverse short-term impacts. The loss of and the need for intermediary measures to mitigate offs between short- and long-term adaptation goals. wetland-based livelihoods (such as fishing) that land use management measures have the potential However, over the longer term and if combined short-term economic costs for the community. agricultural plots in and around the wetlands led to This case study also points to the potential for trade-

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REFERENCES

review by the United State Agency for International Development. ARD, Inc. (2005), Rwanda: Assistance with Land Law and Implementing Laws and Regulations, Produced for

ang-en Burera District (n.d.). About the district. Burera District web site. Retrieved from: http://www.burera.gov.rw/index.php?option=com_content&view=category&layout=blog&id=34&Itemid=27&Itemid=27&Itemid

Submitted to the International Institute for Sustainable Development. Project on reducing the vulnerability of the energy sector to the impacts of climate change in Rwanda Centre for Innovations and Technology Transfer [CITT] (2006). Energy Baseline for the UNEP-GEF Pilot

https://www.cia.gov/library/publications/the-world-factbook/geos/rw.html Central Intelligence Agency [CIA]. (2010). World Factbook: Rwanda. Accessed December 2010 at:

Rapport nationale de Rwanda. Accessed January 2011 at: http://www.fao.org/docrep/013/a1609F/a1609F.pdf Food and Agriculture Organization [FAO] (2010). Evaluation des ressources forestières mondiales 2010:

Framework Convention on Climate Change. unpublished. Government of Rwanda [GoR]. 2010. Energy. In draft Second National Communication to the United Nations

and promotion of the environment in Rwanda. GoR (2005a). Organic Law no. 04/2005 of 08/04/2005 determining the modalities of protection, conservation.

GoR (2005b). Organic Law no. 08/2005 determining the use and management of land in Rwanda

Hategekimana, S. and Twarabamenye, E. (2007). The Impacts of Wetland Degradation on Water Resources

Management in Rwanda: The case of Rugezi Marsh. Prepared for the International Symposium on Hydrology

Economique Durable. Accessible at: http://www.helpagecrgl. Helpage Rwanda (2010). Sustainable Economic and Development Program – Programme de Developpement .org/en/pded.php

at: http://allafrica.com/stories/201010290146.html Kigaire, E. (2010). Rwanda: Nation receives Green Globe Award. The New Times. 29 October 2010. Accessible

Education Media Project. Liu, J.D. (2008). Potential Rehabilitation of Rugezi Highland Wetlands. Produced for the Environmental

McGray, H., Hammill, A. and Bradley. R., with Schipper, E. L. and Parry, JE. (2007). Weathering the Storm: Options for Framing Adaptation and Development. Washington, D.C.: World Resources Institute.

unpublished. Ministry of Infrastructure [MINIFRA]. (2010a). MININFRA Energy Sector Strategic Plan 2011-2017.

WORLD RESOURCES REPORT

http://www.worldresourcesreport.org/

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of the Ministry of Infrastructure, February 2011). ³ It is intended that these energy sources will be used as follows: (1) methane gas. For electricity, fertilizer and converted to fujuid for use as gaschine and diesel; (2) gothermal - for electricity and for production of heat and seam for meating, dryng, food processing, etc.; (3) peat – for electricity charcoal/brquettes suitable for households, and peat/reid seam/heat charcoal/brquettes suitable as inhose for households. and peat/reid seam/heat charcoal/brquettes suitable for households. generation for processing industries (boilers); (4) solar – for electricity and heating (e.g., solar water heaters); and (5) biogas – for lighting and heating at the household and institutional level (Personal communication, representative the hou

http://www.worldresourcesreport.org/	WORLD RESOURCES REPORT	WORLD RESOURCES REPORT	
		Willetts, Elizabeth (2008), Watershed Payments for Ecosystem Services and Climate Change Adaptation Case Study: Rugezi Wetlands, Rwanda. Masters thesis for Duke University Nicolas School of the Environment and Earth Sciences.	
		Uramutse, C. (2009). Domestic adaptation to climate change in Rwanda. Presented at the Annex 1 Expert Global Forum on Sustainable Development: Key Issues for the Post-2012 Climate Change Framework, Organization for Economic Cooperation and Development, Paris, 4-5 March 2009.	
		United Nations Environment Programme [UNEP]. (2006). Economic Analysis of Natural Resource Management in Rwanda. Kenya: UNEP.	
		Stockholm Environment Institute [SEI] (2009). Economics of Adaptation in Rwanda. Accessible at: http://www.rema.gov.rw/ccr/Final%20report.pdf	
		Rwanda Ministry of Natural Resources [RMNR] (n.d). Rwanda State of Environment and Outlook: Our Environment for Economic Development. Accessible at: http://www.unep.org/pdf/wanda_outlook.pdf	
		Rwanda Environment Management Authority [REMA] (2009). Plan de'amenagement du basin versant et plans de gestion a base communautaire du marais de Rugezi (2009-2023). Volume 4, Rapport Finale.	
		RECO (2011). Internal Report: Electricity Generation, Import, and Export (KWh) (1998-2010). Unpublished.	
		Pottier, J. (2006). Land Reform for Peace? Rwanda's 2005 Land Law in Context. <i>Journal of Agrarian Change</i> . Vol. 6, No. 4, pp. 509-537.	
		Mukumbwa, A. (2009). Potential Climate Change Impact on Hydropower Generation in Rwanda. Draft, unpublished report.	
		Ministry of Lands, Resettlement and Environment [MLRE] (2003). Rwanda Environment Policy. Accessible at : http://www.minela.gov.rw/IMG/pdf/POLITIOUE ENVIRON- Anglais .pdf	
		MLEFWM (2004). National Land Policy. Accessible at: http://www.minela.gov.rw/IMG/pdf/National Land Policy.pdf	
		Ministry of Lands, Environment, Forestry, Water, and Mines (2006). National Adaptation Programme of Action to Climate Change. Accessed February 2011: <u>http://unfccc.int/resource/docs/napa/rwa01e.pdf</u>	
		Ministry of Lands, Environment, Forestry, Water, and Mines [MLEFWM] (2005). Initial National Communication under the United Nations Framework Convention for Climate Change. Accessible here: http://unfccc.int/resource/docs/natc/rwancl.pdf	
housand Hills for 9 Million People – Land Reform in Rwanda: Restoration of Feudal mation? FAST Country Risk Profile Rwanda. Swisspeace Working Paper.	Wyss, Kathrin (2006). A T Order or Genuine Transfor	MINIFRA (2010b). Power System Master Plan (PSMP): 2011-2025, Final Draft. Unpublished. MINIFRA. (2009). <i>Rwanda National Energy Policy and National Energy Strategy 2008-2012</i> . Kigali: Government of Rwanda. Accessible at: http://www.rema.gov.rw/index.php?option=com_content&view=article&id=26&Itemid=38&Iang=en	
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