**NYAMAGABE:** Felicita Niyigena, 48, who has more than two decades of experience growing maize at Mubuga, a mountainous village from Nyamagabe, a district in Southern Rwanda, is very confident in her water-saving irrigation practice.

While other farmers across Rwanda lament the dry season for lack of rain, Niyigena, like many smallholding farmers in this remote rural area, have adopted small-scale irrigation schemes to meet crop demand while reducing water wastage from over-application in this part of Rwanda's Nile Basin.

Small-scale rural irrigation schemes along Nyabarongo river are transforming the lives of rural farmers in Rwanda

In this remote rural area, water is channeled via open furrows, canals from Nyabarongo river, which is part of the upper headwaters of the Nile, and its large tributaries, including Mwogo, Rukarara, and Mbirurume rivers, into the farmland in various ways to minimize the impact of the drought on their agricultural production.

"Water is pumped to these maize plantations, and with the current type of irrigation, less water is required, and less energy is wasted as it needs less pump operation," Niyigena said in an exclusive interview.

### *Irrigated agriculture*

Official estimates indicate that Rwanda's 7,000 hectares of cropped area are equipped with the necessary infrastructure for irrigation. Still, not all areas might be cultivated in any given year or growing season.

According to the study conducted by the Nile Basin Initiative on the current and project demand and water used in the Nile Basin, the current estimation of the water requirement of crops in Rwanda stands at 28.71 million cubic meters.

While irrigation is the biggest consumer of water, estimates by researchers show that the growth in water demand in the Nile Basin largely depends on the expansion of irrigated agriculture, whereby out of 58.6 million cubic meters of water demand for irrigation, Rwanda is only able to extract 97.9 % of the available resources mainly water from the river.

The irrigation upgrade on the Nyabarongo River is part of Rwanda’s efforts for water conservation in the agricultural sector and expanding the total area equipped for irrigation which is currently estimated at 48,500 hectares against a target of 102,000 hectares by 2024.

### *Cropping patterns*

The total estimated area fully equipped for irrigation in Rwanda is 8,900 ha against an estimated cropped area of 7,700 ha, according to data compiled from various official sources.

The updated irrigated (cropped) area in the Nile Basin part of Rwanda is estimated at 7,698 ha compared to 7,053 ha in 2015, primarily using a gravity irrigation system.

According to the official data, rice accounts for 100% of the cropping pattern in Rwanda for the two wet seasons (Season A and Season B), where 88.9% and 84.3% of the farmers are engaged in rice production.

Reports indicate that vegetables are the dominant crops during the dry season. Of the 26 irrigation schemes identified, 13 schemes (4,627 ha out of 7,698 ha or 60%) are swamp-based schemes used for growing rice over two seasons a year; then, the schemes are used for mainly producing vegetables in the dry season (Season C).

### *Mapping land sustainability*

The land suitability for irrigation in the Nile Basin was estimated at 92 million hectares. The land suitability estimates for the entire basin and each country are provided separately.

37.5 percent of the land in Rwanda needs to be managed before being cultivated.

Except for Sudan, South Sudan, Uganda, and Rwanda, most countries fall predominantly outside the basin. Latest official estimates show that at least 37.5 percent of the Land in Rwanda needs to be managed before being cultivated. Overall, an estimated 39.1 percent of the Land has a high erosion risk, especially on the Rwandan side of the Nile Basin.

The land cover of the planned irrigation schemes in the Nile Basin shows that Rwanda has a cover of 71.598 hectares of highly suitable Land for irrigation ahead of Eritrea (12,701 ha) and Burundi, which has the lowest ranking in terms of suitability of Land in the Nile Basin.

The total area equipped for irrigation in Rwanda is estimated at 11467 ha. With an estimated cropped area of 7000 ha, the overall cropping intensity is 61%. The main crop planted in most irrigation schemes is rice. The total estimated irrigation water demand for all schemes is about 58 MCM.

Main crop planted in most irrigation schemes in Rwanda is rice and vegetable crops

Water Resources Board has so far conducted a study to review the water resources supply and demand for major rivers and their catchments, plan the resource allocation to key economic activities and sectors, and prioritize strategic investment that will reduce the risks while building on water resources opportunities that are reflected by the existence of a network of wetlands in various parts of the country.

Rice is an important crop; approximately 62,000 tons are produced annually on about 12,000 ha. Due to the retention of flood flows, the marshlands are important to downstream users as they maintain relatively steady flow rates in the dry season.

### *Irrigation master plan*

Developed in 2010, Rwanda’s irrigation master plan’s primary objective is to develop and manage water resources; promote intensive and sustainable irrigated agriculture; and improve food security with a critical focus on six areas, including runoff for small reservoirs, dams, direct rivers, lake water resources, marshlands, and groundwater.

In terms of historical magnitude, the irrigation area of Rwanda expanded from 150,000 hectares in 1997 to 464,665 hectares in 2020.

The Kagera River Basin is shared by Rwanda, Burundi, Uganda and Tanzania

Rwanda’s irrigation master plan targets about 40,465 ha of potential irrigation areas. Still, estimates show that the contribution of irrigated agriculture to food

security in many upper-riparian countries is almost nil. This phenomenon is related to affordability and the lack of irrigation technology.

The value of irrigation water for maize was staggeringly high in Burundi and low in Tanzania, with values of 2.75 and 0.02 USD /m3, respectively.

Sweet potato and rice are main crops along the Nile basin, creating a value ranging between 0.20 and 0.03 US dollars by consuming one cubic meter of water each year in four countries namely Kenya, Rwanda, Tanzania and Uganda

***Boosting harvests***

The efficiency of surface irrigation systems is relatively high at 70%, while that of sprinkler and drip is between 50 – 70% and 70–90%, respectively.

Analysis trends show that the value of water for sweet potato in Rwanda is 1.45, 0.31 USD /m3

Groundnuts are grown only in Rwanda, while cassava is grown in Uganda, with values of irrigation water for these crops being 0.02 and 0.09 USD /m3, respectively.

The value of irrigation water of vegetables in Kenya and Tanzania are 0.37 and 0.05 USD /m3, respectively. Rice in Kenya and Burundi has a water value of 0.03 and 01.0 USD /m3, while it is infeasible in Rwanda and Tanzania.

However, Sweet potatoes in Kenya, Rwanda, and Uganda have 0.63, 1.45, and 0.21 USD /m3, respectively, but it is infeasible in Tanzania. The values of irrigation water for groundnuts in Rwanda and cassava in Uganda are 0.03 and 0.09 USD /m3, respectively.

The efficiency of surface irrigation systems is relatively high at 70% in the significant Nile Basin riparian, including Rwanda, while that of sprinkler, pumping, and gravity is mostly between 80 – 90% in Sudan and Ethiopia.

In a business-as-usual scenario, Egypt, which depends mainly on canals that take water from the river Nile, applies modern irrigation techniques, including drip irrigation and sprinklers at 85%.

Past studies show that the productivity of rainfed agriculture across the Nile Basin is among the lowest in the world, which tends to fuel food insecurity.

With the current situation where most countries apply rainfed agriculture, a new study stresses the need to double crop productivity in the Nile upper riparian countries like Rwanda, where the current cereal yield is estimated at 1.28 tons per hectare.

### *Irrigation water use efficiency*

Given these facts, estimates by the World Bank indicate that it is reasonable to assume that yields from rainfed agriculture can potentially be improved by more than 100% in several upper riparian countries.

Furthermore, rainfed agriculture productivity enhancement benefits a more significant number of farmers. Despite the attractive benefits of investment in rainfed agriculture, the total investment cost due to the scale of rainfed agriculture and its vulnerability to climate change shocks may discourage countries from shifting from irrigation to enhanced rainfed agriculture.

High-efficiency water-saving irrigation measures, such as sprinkler and pipeline irrigation by 25% in 2030, are expected to sway Nile basin countries, including Rwanda, into shifting their investment priorities away from irrigation to enhancing rainfed productivity.

In water-stressed regions like the Nile Basin, current cropping patterns are essential points of concern regarding water saving. They must be modified for long-term sustainable use and better irrigation management within a voluntary or legal cooperative framework.

Given the possibility of future water scarcity and the critical need for basin-wide water-use sustainability, priority should be given to introducing optimal cropping patterns, at least partially, by replacing some of the more water-intensive crops with less water-consuming ones.

### *Kagera river basin*

The Nyabarongo is a significant river in Rwanda; it begins in Nyungwe Forest and flows up to the north-western part of the country, then down through the center to the south-east, eventually forming the main tributary of the Kagera River

watershed, the principal affluent of Lake Victoria, which drains into the Nile River.

With 34% annual tributary flow, Kagera, along the border with Rwanda and Tanzania, is the single most significant river part of the upper headwaters of the Nile and carries water from its most distant source that drains into Lake Victoria.

The Kagera is characterized by wetlands and agricultural areas, with the latter increasing and encroaching on both forested and wetland areas, leading to land cover change and, respectively, to changed runoff patterns.

With a total length of 597 km from its source located in Lake Rweru in Rwanda, the new study shows that water abstraction for irrigation is leading to a reduction of flows with respective impacts on the environment, especially during low flow conditions.

### *Incentives for the policy framework*

Although Water and environment policies in all the Nile Basin countries have been evolving over time and invariably have gone through a series of updates, the latest findings show that frequent changes in institutional arrangements may also pose problems for the implementation of policies and strategies due to discontinuities and loss of institutional knowledge.

The process would need to start with a needs assessment exercise followed by a research-based proposal for policy modification, which it said an encompassing awareness-raising campaign might precede.

Development of the Nile is considerable, with intensive development in the downstream part, with new dams emerging in the upstream catchment, e.g., the Grand Ethiopian Renaissance Dam in Ethiopia, Bogagali Dam in Uganda, and Rusumo falls in Rwanda, among many others.

The downstream countries of Sudan and Egypt are primarily irrigation based, while significant rainfed agricultural developments exist in the upper catchment.

### *Water reuse and desalination*

Environmental experts emphasize that water reuse in the Nile Basin can enhance water security through portfolio diversification. This is because of water shortages

and sometimes extreme seasonal droughts within a year.

For example, even if the country decides to pursue water reuse for non-potable purposes, if a certain municipality is under high water stress, the municipality might decide to invest in water reuse for potable purposes within the city rather than diverting the recycled water to agricultural lands nearby.

Transboundary cooperation, according to experts, is necessary to preserve water quality for the common good. If all the Nile Basin Initiative countries could agree to a water resources plan, it would enhance water quality protection for the entire basin.

To prevent uncontrolled irrigation drainage water reuse that could lead to soil salinization problems, experts emphasize the importance of putting in place a structure for knowledgeable parties to monitor the irrigation drainage water quality and determine whether it is suitable for reuse.

Water utilities may desalinate brackish groundwater for regions close to the coast rather than seawater. However, withdrawing groundwater near the coast might lead to saltwater intrusion.

Seawater desalination is another vital aid to steel plants, allowing them to tap into the vast seawater resources and reuse the waste heat to render the production eco-friendlier in the Nile Basin, experts said.

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