



Food and Agriculture  
Organization of the  
United Nations

## **KnoWat:** Knowing water better

Towards a more equitable and sustainable access to  
natural resources to achieve food security

# Project results in Rwanda









## Project results in Rwanda



### Further information

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Around the world, countries struggle to adapt agricultural and food systems to conditions of water scarcity, climate change and increased competition between resource users. These struggles are only expected to increase. Smallholder farmers are particularly vulnerable to changes in water access and availability because it can mean a sudden loss of income and food.

A greater focus on water accounting and water governance is crucial for addressing water scarcity in a changing climate to ensure food and water security for all. Our capacity to manage and use water resources efficiently and equitably requires us to understand the quantity and quality of water that is available and the rules that govern access to water.

In response to these challenges, a project led by the **Food and Agriculture Organization of the United Nations (FAO)** – ‘Knowing water better: towards fairer and more sustainable access to natural resources’ (KnoWat) – has built stronger water governance processes in Rwanda, Senegal and Sri Lanka. The project has strengthened national capacities in water accounting and water productivity in agriculture, using the latest remote sensing technologies and training hundreds of water experts. KnoWat has developed and tested a methodology for assessing water tenure to shed light on the rules and regulations governing access and allocation of water resources. This information is crucial for improving water use, ensuring the equitable allocation of water resources and increasing the resilience of societies to climate change.

The KnoWat project is implemented by FAO in close cooperation with partners at global, country and local levels. KnoWat is funded by the **Federal Ministry of Food and Agriculture of Germany (BMEL)**. In Rwanda, the project is implemented in partnership with the **Rwanda Agriculture and Animal Resources Development Board (RAB)** and the **Rwanda Water Resources Board (RWB)**.

This short publication summarizes the key accomplishments of the KnoWat project in Rwanda. It is hoped that the project will improve our understanding of water and will strengthen the institutions and people responsible for managing a resource that is critical to the livelihoods and food security of all people and a foundation of natural ecosystems.

### Background and challenges

Rwanda is a land-locked country of 26 338 km<sup>2</sup>, which borders Uganda, the United Republic of Tanzania, Burundi, and the Democratic Republic of the Congo. It is divided into four provinces and the capital city of Kigali, with 30 districts and a total population of nearly 13 million.

The country has a temperate tropical climate and two main rainy seasons (February–May; September–December) that determine planting and harvesting cycles. Rainfall varies geographically, with the East and Southeast receiving less precipitation (700–1100 mm annually) than the west and northwest (1300–1600 mm annually).

Rwanda is a water-rich country, and the agriculture is the backbone of the country's economy: it employs around 70 percent of the population. The populated "land of a thousand hills", Rwanda is characterized by a dense system of lakes, rivers, marshlands, groundwater and soil water, which are frequently replenished by abundant rainfalls.

Rwanda is challenged by climate variability, from changes in rainfall patterns to more extreme weather events. In addition, there is an increase pressure on natural resources (such as water and land) due to population growth, intensification of agriculture, rapid urbanization and industrialization, leading to intensified competition between water users and reduction in water quality.

These challenges need to be addressed by Rwanda's water governance institutions to ensure an equitable, sustainable and climate proof system of water allocation.

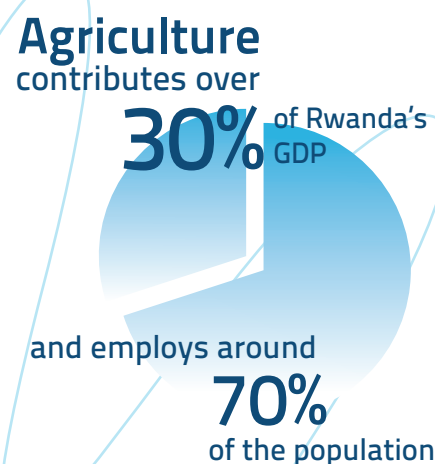
### Results

The KnoWat project aimed to review the water resource management framework and then formulate recommendations to address the increased competition on water resources in the country. The ultimate goal is to ensure equitable access to water resources.

It is essential to increase awareness and initiate a dialogue on issues of water access and allocation with the national stakeholders from government, civil society, private sector and media.

The project worked to improve the capacities of the technical staff in water and agricultural sector institutions on data management for water resources assessment.

Finally, the project team worked with farmers in the Yanze catchment, Rulindo district, to increase their capacities in water management and better access to water through solar pumps, and to diversify their sources of income such as aquaculture.





## Project area

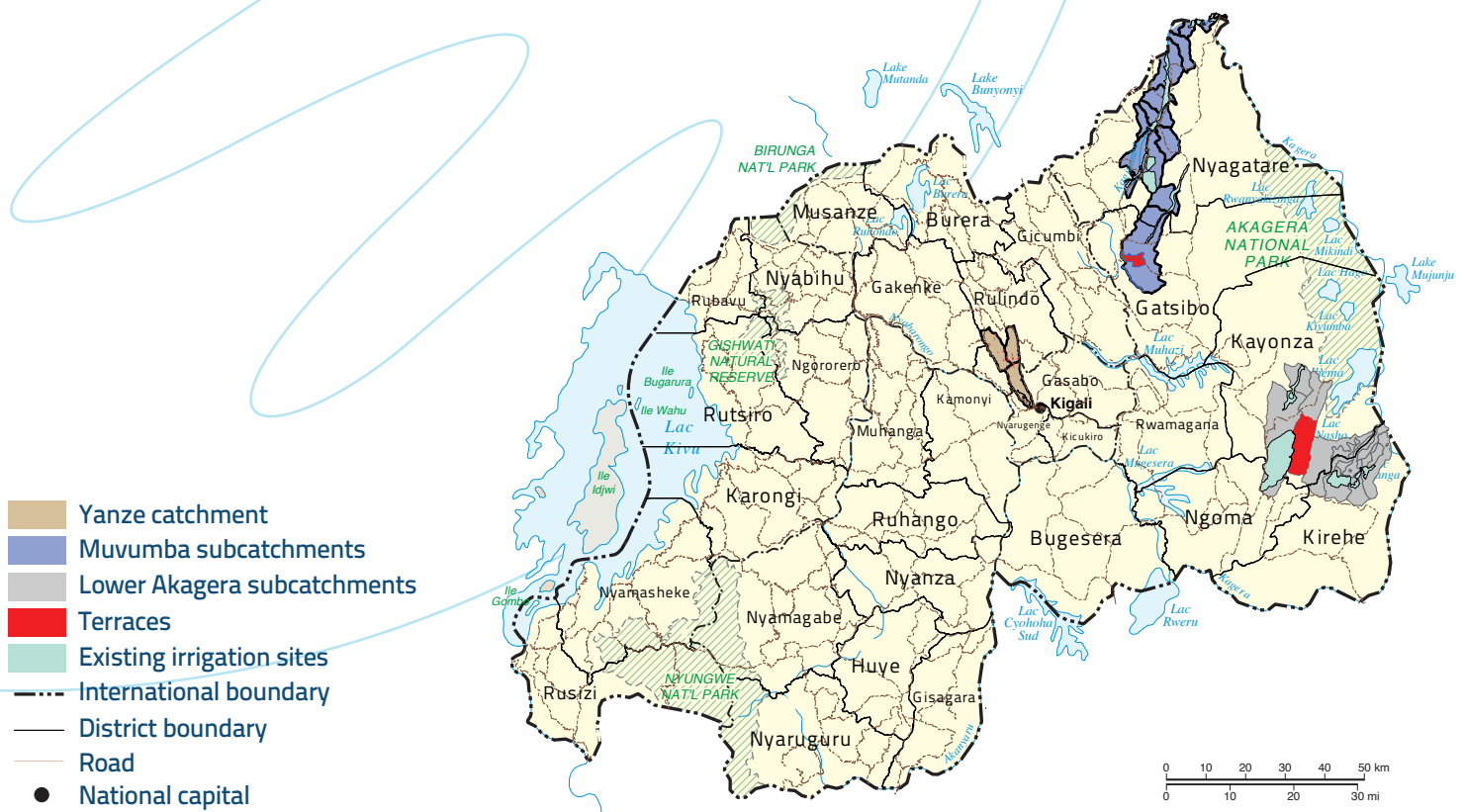
The **Yanze** river in central Rwanda is one of the main water sources for Kigali, in addition to serving the needs of small-scale farmers, pastoralists and fisher folk.

The catchment is characterized by a variety of water users, including: vegetable and fruit production in the valley bottoms, maize and potato production on the hillsides, small scale farmers, coffee washing stations, water treatment plants, mineral extraction sites and small scale irrigation.

The **Lower Akagera** and **Muvumba** rivers are located in the Eastern part of Rwanda. Their catchments are characterized by a wide range of irrigation schemes and cattle farms which depend on sufficient surface water.

The two catchments suffer from severe precipitation-deficit and/or frequent, severe water shortage particularly in the dry season. Irrigation development has taken place by government and private investors with a view towards improving access to water for all, as well as food security.

## Rwanda: Yanze, Muvumba and Lower Akagera catchments



Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the author. Catchment data from Rwanda Water Resources Board (RWB).

## Geospatial database for agricultural water use and productivity: Better data for better decisions

KnoWat established a geospatial database based on the water monitoring tool developed for the FAO's Water Productivity through Open-access of Remotely sensed derived data (WaPOR) project.

The database was used to assess agricultural water consumption and water productivity in Rwanda by interpreting satellite images in the Yanze, Muvumba and Lower Akagera catchments. It includes eight years of data on the catchments (2015-2022) at 30 metres resolution, and data at 100 metres resolution is available for all of Rwanda. The data are freely available on FAO's WaPOR portal.

Twenty experts from FAO's partner institutions in Rwanda were trained to interpret WaPOR datasets produced for the project, such as water resource assessments and scheme-level information.

The use of WaPOR has been introduced by key institutions, including RWB to support water resources planning, management, as well as development of irrigation projects. In the future, farmers will benefit from getting reliable information on water productivity on their farms leading to enhanced water resource management and increased production.

### Assessing water productivity

To demonstrate the application of WaPOR data at the scheme level, the KnoWat project conducted a water productivity assessment in the Nasho irrigation scheme in the Lower Akagera catchment. The scheme comprises an area of 1 173 hectares irrigated by pivot systems, serving 2 099 smallholder farmers.

The assessment focused on maize that was cultivated in Season B (February–June) during the period 2016–2021. In this area, maize has an average yield of 6.5 tonnes per hectare and it is mainly irrigated through centre pivot sprinkler systems. The maximum yield is 10 tonnes per hectare. The study revealed a high spatial variability in both yield and water productivity throughout the six years under examination. This appears to be due to the varied levels of expertise of farmers working in the scheme and the different agricultural practices applied during the growing season.

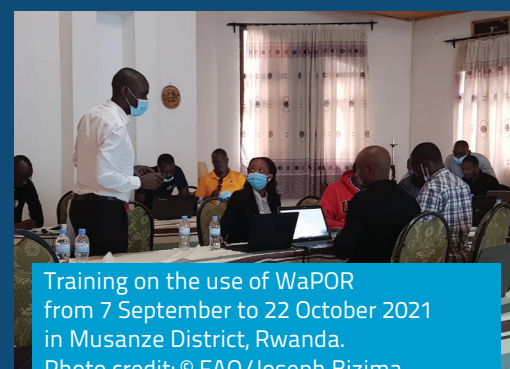
**128,560 Ha**

covered in the three catchments:  
Yanze, Muvumba and Akagera Lower



### Water Productivity through Open-access of Remotely sensed derived data (WaPOR)

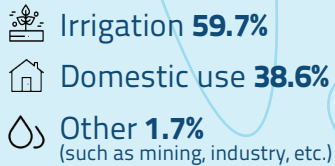
WaPOR is the FAO's portal that monitors water productivity in near-real time through remote sensing, identifies water productivity gaps and proposes solutions to address these gaps. Water productivity is assessed in a different way for the three spatial levels: level I (continental level - 250 m ground resolution), level II (national and sub-national level - 100 m ground resolution) and level III (irrigation scheme and sub-basin - 30 m ground resolution).



Training on the use of WaPOR  
from 7 September to 22 October 2021  
in Musanze District, Rwanda.  
Photo credit: © FAO/Joseph Bizima



### Water abstraction in Rwanda (2019)



## Water users and uses assessment: Updated information for water resources planning

The KnoWat project developed an approach to water users and uses assessment that allows information collected in the field to be entered directly into a central database from smartphones or tablets. The approach enables the RWB, to continually update national-level data on water users and users.

RWB staff received on-the-job training in using and maintaining the software and tools for data collection and update. Data were collected in the twenty Level 2 catchments<sup>1</sup> in Rwanda and used to update the national database.

The assessment recorded annual water use of about 608 million m<sup>3</sup> in 2019 compared to 499 million m<sup>3</sup> registered in 2017, an increase of 22 percent. This increase was partly due to higher water abstraction and partly to improved assessment methodology.

Hydropower is by far the biggest user of water resources, accounting for more than 3 382 million m<sup>3</sup>/year. The hydropower sector contributes about 55 percent of Rwanda's capacity in energy production, particularly in the western part of the country. Water use for hydropower is considered non-consumptive.

Excluding hydropower, water is mainly abstracted for irrigation (363 million m<sup>3</sup>/year, 59.7 percent), and domestic water supply (235 million m<sup>3</sup>/year, 38.6 percent). The high abstraction by the agricultural sector can be explained by the importance of agriculture to Rwanda: agriculture contributes over 30 percent of the country's gross domestic product; about 48 500 hectares of agricultural land are irrigated.

[1] Level 2 catchments are hydrographic units defined by RWB as a basis for water resources management in Rwanda.



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"Rwanda's rapid population growth and industrial development as well as the implementation of the National Strategy for Transformation (NST) are likely to increase the demand for water. Based on current trends, the level of water scarcity will increase. For this reason, it is important for the central and local governments to have accurate data on the various users of water, water uses and sources, and to be able to monitor the extent to which water users are operating with water abstraction permits. Appropriate decisions on water use management require consistent, comprehensive and reliable water use data."

**Alsaad Ndayizeye**, River Flood Control Specialist at the Rwanda Water Resources Board (RWB)

## Water tenure assessment: Assessing water tenure for food security, equity and climate adaptation

The KnoWat project developed a water tenure assessment methodology to identify and analyse the diversity of water tenure arrangements that may exist within a catchment or community. The methodology includes desk research and field data collection as well as capacity building and consultations with decision-makers, national stakeholders and local people that depend on water for their livelihoods.

The assessment methodology allows water tenure arrangements to be categorized; determines their perceived security; and permits the analysis of governance institutions and the identification of potential conflicts and their resolution through the application and revision of legal frameworks and local practices.

In Rwanda, the assessment was carried out in the Muvumba catchment area in Nyagatare District and the Yanze subcatchment area in Rulindo District.

### Key recommendations for the governance of water tenure in Rwanda:

- Taking into consideration the mandate of the newly created National Consultative Committee on Water (NCCW), create (or embed within the NCCW) a technical, inter-agency working group. The group should focus on key areas of legislative reform under the current water law, with reference to the findings of this water tenure assessment.
- Finalize the preparation of ministerial orders on water use permits and water use fees to create a comprehensive regulatory package that can be rapidly implemented once any necessary revisions to the law are enacted. If legislative reform should prove to be untenable, key issues highlighted in the report could be included in a ministerial order as an alternative.
- Assess capacities and needs to enable the rapid, systematic and comprehensive implementation of the permitting regime as well as possible funding sources and a detailed implementation plan.
- Finalize a water fee structure based on water use category so that high impact users pay according to use levels and increase the financial capacity of the water service institutions.



### Assessment methodology

01 Preparation

02 Scoping

03 Research

04 Analysis

05 Validation


06 Reporting


Water Tenure can be defined as the **relationship**, whether legally or customarily defined, between people, as individuals or groups, with respect to water resources.



## Local water management solutions: Supporting water governance and management to address water scarcity


The KnoWat project worked with Yanze Horticulture Production Cooperative (YAHOPROC), a cooperative of vegetable growers, to support sustainable water resources management options:

 **Clean energy to benefit people and nature.** Vegetable farmers found it difficult to distribute adequate irrigation water using watering cans and treadle pumps, limiting their production. In response, the project distributed three solar-powered irrigation pumps to the YAHOPROC cooperative, and trained farmers to operate and maintain them. The solar-power pumps allow farmers to grow crops throughout the year. Because the pumps are simple to operate and maintain, they can be used by all farmers, regardless of age.

 **Integration of fish farming and pig rearing.** The KnoWat project piloted two strategies to diversify income. Farmers stocked three irrigation ponds with Tilapia fingerlings, and the project supported the YAHOPROC cooperative in pig rearing. As a result, the cooperative has so far harvested 376.5 kilograms of Tilapia fish worth USD 750. Starting with the 30 pigs supplied by the project, members of the cooperative have raised around 300 pigs. The farmers have raised their incomes by selling both fish and pigs. The project supported these activities by providing training on improving market access. As a further benefit, the manure from fish and pig production serves as organic fertilizer, reducing the need to buy inorganic fertilizer, which cuts the cost of vegetable production. Furthermore, fish and meat diversify the diets and improve the nutrition of local families.



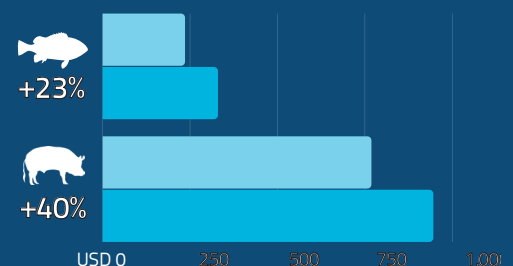
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 **Building institutions to improve water governance.** The KnoWat project worked with the YAHOPROC cooperative and local leaders to build their capacity to establish a water users' association in the Yanze subcatchment. Through the association, farmers will be able to obtain a water permit, providing long-term sure access to water resources to sustain their production systems.

### Annual income increment on average from pig and fish production from 2020 to 2022

245 beneficiary families, received 5,000 fish fingerlings.  
Cooperative's annual income increased by 23% due to sales.

80 beneficiary families received 30 pigs. Their annual income increased by 40% on average due to sales.



## Stories from the field: Harnessing source of life in Rwanda

The Yanze catchment is located close to Kigali, capital of Rwanda. The scenery is mountainous, as can be expected in the 'Land of a Thousand Hills'. Cultivation on terraces shape the hillsides like big stairs, with small farms every here and there.

A 31-year-old farmer Marcel Munyawera sits next to a fishpond in Yanze and frowns. "Before the [FAO] project provided the dams, we used to have conflicts due to water scarcity. Everyone was fighting for the wetland," he describes how the situation was before FAO supported the construction of water harvesting dams through a project in the area before KnoWat. The dams now also work as fishponds.

The Yanze catchment is a source of life for its over 68 100 inhabitants: the water from the catchment is used for drinking, cooking and bathing, and for agriculture. Most of its rural population are vegetable farmers, and around 40 percent are considered as poor. Without water, crops do not grow, there is nothing to sell and families cannot afford food.

Due to its proximity with the capital, a greater part of water used in Kigali City is abstracted directly from the Yanze River. The capital's population is growing and the city uses more water, reducing the water available for farmers in the catchment.

### Sustainable solutions

From 2019 to 2022, the KnoWat project worked together with Action for Environment Protection and Promotion of Agricultural Sector (APEFA) to tackle water scarcity and improve local water management solutions in the Yanze catchment. The six dams acquired from FAO were used to collect water for irrigating vegetables in the area, but the farmers found it difficult to irrigate the fields adequately using watering cans and treadle pumps, thus limiting their production.

The KnoWat project leveraged on the FAO's previous support and improved the irrigation system by distributing three solar-powered irrigation pumps to the local vegetable producing cooperative (Yanze Horticulture Promotion Cooperative, YAHOPROC), which has 245 members.

"We no longer sit idly during the sunny season, worrying about how we can irrigate. There is no such problem now, we have water and a machine which automatically pumps it for us," tells Jean d'Arc Mubaranyanga, a broccoli farmer and a member of YAHOPROC. She is watering a farmland with one of the new light solar irrigation pumps.

With the previous equipment, irrigation was too physical, especially for some women. Today, thanks to the new solar pumps, farmers can cultivate all year round and have higher yields. "Before, I could barely harvest 60 kilograms of broccoli per season on two acres. Since I started using this solar-powered pump, I easily harvest 200 kilograms," Jean d'Arc describes the results.



Watch the video

**Sustainable water management solutions in Yanze river basin, Rwanda**





The increased yields have generated more income too. Jean d'Arc looks positively toward her future. "Before getting this technology and have increased yield, I didn't have a bank account and I had no idea of where banks were. Now, I have an account, I save and have money to buy an asset for my development so I will have a better life when I am old and unable to work."

Even farmers' diets have improved. "We could not eat vegetables before, now our nutrition is improved. We no longer have malnutrition issues. Children don't suffer from *Kwashiorkor* (severe malnutrition)," she adds.

Another project innovation concentrated on two strategies to diversify income, by supplying 30 pigs and 5 000 fingerlings to stock in three dams. The cooperative has now raised around 300 pigs and farmers' income has increased from selling both fish and pigs.

"One year after I received the pig, I have earned 150 000 RWF (USD 150). I managed to pay the school fees of my child, I was able to cover other basic needs and my house has solar electricity, with manure I harvest more vegetables. Life is good," Louise Mukatumusenge, a farmer, describes her life now.

To ensure the sustainable use of water, more than 700 farmers in Yanze were trained to sustainably use the available water.

### Safeguarding water rights for future

However, as the effects of climate change and population growth are expected to increase, so will the competition on water. How to make sure the water in Yanze will be allocated in an equitable manner for all users?

These types of policy-decisions, plans and investments can be made only if we know, how people, communities and organizations gain access to, and use water resources, how much of the water can be used, for how long, for what purpose and under what conditions. In short: we need to know the water tenure.

The KnoWat project launched a pioneering water tenure assessment in Yanze to identify and analyse the different water tenure arrangements in the country, working closely with YAHOPROC and its members.

"One of the key findings in Yanze was that the vegetable farmers use the water resources in an informal way and are not always aware of its legal requirements. If the water is used for small scale irrigation activities, you don't need a permit for that. However, as the farmers use water from the dams, they should be under the permit regime. For example, what would happen if the city of Kigali requires so much water that there is not enough for the small farmers in Yanze?," explains the KnoWat project's National Coordinator, Joseph Bizima.

The overall findings and recommendations of the assessment which address key water resources management issues (in Yanze and another pilot location) were presented and validated in March 2022. Different key stakeholders participated in the water tenure validation workshop including the Rwanda Water Resources Board, Rwanda Agriculture and Animal Resources Board, Water and Sanitation

"Thanks to **KnoWat project**, I am now benefiting from both aquaculture and agriculture production, all from this water. I am currently feeding 2 000 fish in one fishpond and if I take good care of it, after seven months I will harvest 500 kgs of fish. Before the project supported us with water dams, we used to have conflicts due to water scarcity, however this problem is now resolved."

**Marcel Munyawera,**  
fish farmer in Yanze  
subcatchment

Corporation, representatives of the local authorities, water engineers, and other actors in the water sector. International experts of FAO also participated in the event virtually.

The recommendations of the assessment include a water fee structure based on water use category so that high impact users pay according to use levels, and awareness campaigns and capacity building to raise water users' understanding of existing legal requirements governing land and water resources.

Bernard Musana, Head of Knowledge and Forecasting Hub Department at Rwanda Water Resources Board, welcomed the water tenure assessment report and commended the work done by FAO under the KnoWat project. The project already took action and worked with the YAHOPROC cooperative and local leaders to build their capacity to establish a water users' association in the Yanze catchment.

"Through the association, farmers will be able to obtain a water permit, providing long-term secure access to water resources to sustain their production systems", Bizima continues. But naturally the project team hopes that the recommendations would inspire action on other levels too. Because to combat water scarcity, concerted actions are needed at local, regional, national and international levels.

"Through our KnoWat project in Rwanda, Senegal and Sri Lanka, we have aimed to improve water governance processes with different activities, put the topic of water tenure on to political agendas and acknowledge it as a crucial element of development. Besides the three countries, we have wanted to contribute to the global work and discourse on water tenure", tells Benjamin Kiersch, Global Coordinator of the project. "Secure water tenure rights, especially for rural people living in water scarce areas, are essential for food security – and basically for inclusive and just development" summarizes Kiersch.

Meanwhile in Yanze, the river flows forward, as well as the people in the catchment, thanks to the new water solutions.

"We no longer sit idly during sunny season worrying about how we can irrigate our crops."

Jean d'Arc Mubaranyanga, vegetable farmer





# KnoWat: Knowing water better

## Towards fairer and more sustainable access to natural resources for greater food security

Rwanda, Senegal and Sri Lanka (2019–2022)



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All around the world, countries are struggling to adapt their agricultural and food systems to conditions of climate change and to extreme weather events such as long periods of drought or heavy rains. Water scarcity is expected to increase as is competition for water resources among users. Smallholder farmers are particularly vulnerable to changes in water access and availability: a sudden lack of water due to drought can mean lost income and food, threatening their lives and those of their families. For these reasons, major efforts are needed to address the links between water scarcity, food security and livelihoods in our changing climate.

The KnoWat project takes an integrated approach to water resources management that includes water accounting, water productivity, water governance and water tenure assessments. Water accounting is the systematic study of current status and future trends in water supply and demand in a given spatial domain. Water productivity in agriculture signifies the ratio between yield and the water consumed by a crop. To support water accounting and productivity assessments, the KnoWat project built the capacities of key partners to apply FAO's Water Productivity Open-access Portal (WaPOR). This tool assesses water consumption in agriculture and the water productivity of agricultural production using remote sensing.

Water governance assessment looks at the broad framework of institutions, finance and the political economy. To better understand water governance processes, the project developed and tested a new methodology to assess water tenure, the formal and informal arrangements used to access water. The assessment of water tenure aims to understand the different relationships between people and water resources.

Enriching our knowledge around water through accounting, productivity, governance and tenure assessments helps policy and decision-makers to plan and implement better policies, with the ultimate goal of ensuring equitable water allocation for better livelihoods, food security and healthy ecosystems, even under conditions of growing water scarcity.



## Further information

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