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 Senegal

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Project results in Senegal

Further information

Use the QR code to learn more about the activities implemented in Senegal.

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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 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 Senegal, the project is implemented in partnership with the **Ministry of Agriculture and Rural Equipment**, the **Ministry of Water and Sanitation** and producer organizations.

This short publication summarizes the key accomplishments of the KnoWat project in Senegal. 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

In Senegal, agriculture supports the livelihoods of many family farmers. Corporate and industrial agriculture is developing in areas with access to irrigation and Dakar's main urban and export markets.

Since 2003, the government has stimulated the development of irrigation in strategic areas in order to reduce cereal deficits such as rice. The Senegal River basin delta is of strategic importance for the irrigated production of rice, vegetables and other food crops, and is the pilot area chosen for the KnoWat project.

The water sector in the Senegal River Delta faces many challenges that affect the sustainability of water resources, including competition and conflict between users, overexploitation of groundwater, insufficient infrastructure and lack of clarity of access rights. In addition, there is an increase in extreme weather events such as floods and droughts, exacerbated by climate change. In rural areas, poverty and food insecurity remain high.

Project area

The KnoWat project focuses on the Senegal River Basin, an area of strategic importance for the irrigated production of rice, vegetables and other food crops.

Due to multiple challenges, such as climate change, population growth and increasing food needs, there have been significant deficits in cereal production, especially rice, in recent years. To reduce these deficits, the government started to promote irrigation development in the basin in 2003.

Source: United Nations Geospatial. 2020. Map geodata [shapefiles]. New York, USA, United Nations, modified by the author. Lakes and rivers data from from Natural Earth. Catchment data from Global Delta Risk and Hydrosheds.

Efficient use of water in agriculture: water productivity using satellite data

The KnoWat project created a geospatial database based on remote sensing data gathered through the Food and Agriculture Organization of the United Nation's WaPOR (WAter Productivity through Open-access of Remotely-sensed derived data) tool.

The database was used to assess agricultural water consumption and water productivity by interpreting satellite images in the Senegal River Basin. It includes eight years of data (2015–2022) covering the entire Senegal River Basin (426 139 km2), including parts of Guinea, Mali, Mauritania and Senegal – at a 100 metre resolution, and the Ross Bethio section of the Senegal River Delta (611 km2) at a 30 metre resolution. Data on evapotranspiration, biomass production and land cover for these areas are freely available on FAO's WaPOR portal for the period 2015-2022.

To calibrate land cover data to 30 metres, the project conducted a land cover assessment in the pilot area during three seasons: winter season 2020/2021, cold dry season and hot dry season 2021.

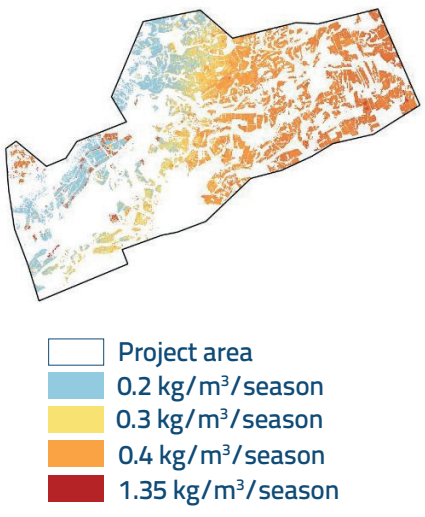
Water productivity assessment

To demonstrate the usefulness of the WaPOR portal in areas of scarce water resources, the KnoWat project carried out a crop water productivity assessment for rice cultivation in the Ross Bethio area during the winter season (July–November) and hot dry seasons (February–July) 2015–2021. The assessment calculated crop yield, water productivity and irrigation performance indicators such as water uniformity and adequacy.

The assessment showed that yields in the hot dry season are higher than in the winter months. The yields reported by the WaPOR-based model are generally lower than those reported by the Société d'Aménagement et d'Exploitation des terres du Delta et de la Vallée du fleuve Sénégal (SAED), which manages the irrigation systems in the pilot area.

Water productivity shows a steep gradient from upstream to downstream fields, particularly in the hot season. This shows that there is considerable potential to improve the performance of irrigation, particularly towards the tail end of the system.

Water productivity in Ross Bethio project area (2019)



FAO. 2022. Water Productivity through Open-access of Remotely sensed derived data. In: FAO. Cited 13 December 2022. https://wapor.apps.fao.org/

Capacity building to ensure the sustainability of the project's achievements

The KnoWat project trained thirty experts from partner institutions in Senegal to interpret WaPOR data and to use the tool for water resources assessment and system-level applications, including water productivity analysis.

In May 2021, a virtual training session for 15 technical staff of partner institutions was held on the WaPOR and PROGRES databases.

The project also supported the organization of a major capacity building programme from 21 to 24 September 2021 in Saly, Senegal, as part of the joint project "Improving Land and Water Productivity in the Sudano-Sahelian Belt," funded by FAO. The session assisted about twenty national experts to strengthen their capacities in the practical use of the WaPOR tool.

Expanding the application of remote sensing techniques

Thanks to the KnoWat project, key actors in Senegal now fully recognize the importance of the WaPOR tool for their work, particularly for providing useful evidence for decision-making.

Through the KnoWat project, FAO has signed letters of agreement with public organizations such as SAED and the Directorate of Management and Planning of Water Resources (DGPRE), as well as with civil society organizations, such as the National Council for Consultation and Cooperation of Rural People (CNCR), in order to foster synergy of action.

In the future, for example, WaPOR can be used in water balance studies in the Senegal River Basin and elsewhere, to support water accounting, where available data are limited. This will further inform rational water resources planning and management.

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

www.fao.org/in-action/remote-sensing-for-water-productivity

WATER PRODUCTIVITY

Better information on water for better decisions

Between April 2021 and January 2022, Senegal's Directorate of Water Resources Management and Planning (DGPRE), supported by the KnoWat project, carried out an inventory of hydraulic works and water withdrawals in the Senegal River Delta. DGPRE carried out three missions in the delta. The inventory included water accounting and auditing and was undertaken to improve the available information and knowledge about water resources and withdrawals.

The inventory made it possible to update information on 67 percent of the hydraulic structures listed in the Senegal River Delta, as well as the volume of water withdrawals. It found that almost all freshwater withdrawals in the area are used either for agriculture or for drinking water. Water users mostly rely on surface water to meet their needs.

The inventory of water resources in the Senegal River Delta will facilitate evidence-based decision-making to improve water governance in Senegal. Based on new knowledge on water catchment points, DGPRE can advise decision-makers on how to protect these water sources from pollution and the proliferation of aquatic invasive plants. In addition, DGPRE aims to support water supply and agricultural enterprises, including family farms and business led by women and young people, through training and providing water-saving technologies.

Capacity building for informed use of water information

Training is a fundamental to improving information dissemination on water resources and, ultimately, to enhancing water use. In July 2021, DGPRE organized a training session on monitoring Sustainable Development Goal (SDG) Indicator 6.4 (increase water-use efficiency across, sustainable withdrawals and supply of freshwater and reduce the number of people suffering from water scarcity) and the AQUASTAT platform, as well as FAO's WaPOR and PROGRES databases.

As a result, more than fifty national experts from Senegal were able to improve their knowledge of methodologies for calculating indicators related to water use efficiency and water stress levels.

The management of data and information related to water resources is also of critical importance. To date, Senegal has established the PROGRES database, which contains data on all hydraulic structures and their hydrogeological and hydrological characteristics as well as their localization. DGPRE, with support from KnoWat, updated this database and created a link to FAO's AQUASTAT information system on water and agriculture. As a result, the PROGRES database now better meets information needs on water resources in Senegal and facilitates international reporting requirements under the SDGs.

A group of experts – drawn from several organizations – has been established to coordinate the monitoring of water resources and withdrawals in Senegal and to ensure the regular updating of information on Senegal in the AQUASTAT global information system. The group facilitates the collection, tracking and analysis of data on water resources.

Long-term availability and up-to-date data

The KnoWat project and its national partners in Senegal have designed and adopted an action plan to strengthen and sustain the achievements of the project in Senegal in terms of water accounting and auditing.

This action plan provides for considerably improving the system for collecting, monitoring and using data and information on water resources. Other data collection missions are planned regularly to cover the whole country.

Voices from the field

"In Senegal, the achievements of the KnoWAT project have been very useful for the water and sanitation sector, in particular for the DGPRE, one of the main beneficiaries of the project. This project has made it possible to improve knowledge on the withdrawals of surface and underground water resources in the Senegal River delta area through inventory missions, to identify all the agricultural users of the area, to categorize them depending on the volumes withdrawn, but also to monitor the variables of the water resources of the AQUASTAT platform."

Mr. Bocar Abdallah SALL, Agronomist, Water and Sanitation Operations Officer for Program Planning, Coordination and Monitoring (CPCSP) of the Ministry of Water and Sanitation.

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Water tenure assessment for improved policy development

> Water tenure can be defined as the **relationship**, **whether legally or customarily defined, between people, as individuals or groups, with respect to water resources**.
>
> See: Hodgson, S. 2016. Exploring the Concept of Water Tenure. FAO Land and Water Discussion Paper 10. **Food and Agriculture Organization of the United Nations**.

Water tenure determines how people obtain rights to water resources, including the right to access, impound, use and manage water, gain access to information and participate in decisions on water resources management. To ensure equitable distribution to all legitimate rights holders and to protect natural ecosystems, it is important that existing water tenure arrangements are coherent and all legitimate tenure rights are recognized by national legislation.

Water tenure arrangements can be very complex and vary considerably, including within the same country, influenced by local and social practices, traditions and status, geography, environment and livelihood practices. Different water tenure arrangements may coexist and/or overlap in the same region and water tenure holders may belong to more than one water tenure arrangement.

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.

What can we learn from the assessment of water tenure in the Senegal River Basin?

The water tenure assessment in the **Senegal River Basin** focused on institutional and legal frameworks as well as customary water governance. Three field missions took place in the research areas in Podor and the Gorom-Lampsar axis in Saint-Louis. The results of the assessment were validated at local and national levels by key stakeholders.

The assessment found that:

- Formal law and customary provisions governing tenure relationships coexist in the research area.
- Some local water users are unaware of water laws and regulations, and some local authorities lack the capacity to implement and enforce water legislation.
- Current legislation is not adapted to new challenges, such as the intensification of agribusiness, climate change and population growth, all of which are putting increased pressure on water use.
- Current legislation around water resources management does not take into account local customs and practices, nor does it consider the circumstances of women, young people and marginalized groups. This leads to unequal access to water resources for some people, negatively affecting their livelihoods, food security and sanitation.
- The large number of water stakeholders and the lack of synergy between them create major constraints for integrated water management.
- Users have little involvement in water policy development and management.
- There is no operational framework for dialogue between actors.

Based on these findings, it was recommended that decision-makers take steps to raise awareness among water users of existing water legislation. Water legislation should be reconciled with the local customs and good practices of water users. A further recommendation was to strengthen the participation of water users in decision-making and reforming the water sector, and to include access to water as a human right in the Senegalese constitution.

Above all, measures should be taken to reduce conflicts between water users and to ensure availability and more equitable access to water resources for everyone. Stakeholders from government and civil society and research, technical and financial partners have proposed that the water tenure assessment results be disseminated widely. The results should also inform the process of revising Senegal's new water law.

Field mission, October 2019.
Photo credit: © FAO/Lamine Samake

Promoting water tenure for governance at the local level

Exchange meeting with the religious authorities of Podor, October 2021. Photo credit: © FAO/Lamine Samake

To strengthen the capacities of local actors in water tenure governance, the National Council for Consultation and Cooperation of Rural People (CNCR), with support from the KnoWat project, trained five local facilitators in water governance concepts and instruments, including the current water law.

The facilitators have contributed to building capacity in their respective localities on the local governance of water resources. Supported by educational material adapted to the local context, the training has strengthened local knowledge of water tenure and water governance concepts, as well as providing practical advice, for example, how to apply for a water permit and how to resolve water resource conflicts.

The training has thus far reached more than a hundred people in the two research locations (Saint Louis and Podor), including young people and women.

The need for local water governance platforms was discussed during the training sessions, which led to the initiation of consultations with broad stakeholder participation. CNCR continues to promote this process. Next steps will include the formal establishment of governance platforms, capacity building for the members and networking at the national level.

CNCR, with support from the KnoWat project, organized meetings on national challenges and issues related to water governance with the Steering Committee of the Voluntary Guidelines on the Governance of Lands, Forests and Fisheries in Senegal (COPIL DV/GF) and the Platform of Civil Society Organizations for Water and Sanitation in Senegal (POSCEAS).

The meetings strengthened the link between existing work on land governance in Senegal and the KnoWat approach to assessing water tenure. Land stakeholders recognized the relevance of taking water governance into account in their advocacy and awareness-raising work on climate change adaptation.

The KnoWat project has strongly supported CNCR's involvement in the World Water Forum, which enabled the mobilization of rural stakeholders and the development of a position paper on their concerns around water management and governance.

These interventions and promising results have enabled the KnoWat project to contribute to the revision of the water law in Senegal.

Stories from the field

Poems and a project for peace

In northern Senegal there is a fishing village called Ngaolé next to the Senegal River. The river partly marks the border between Senegal and Mauritania and is only a short distance from the Sahara – the world's largest hot desert. Wooden canoes used by fishermen can often be seen on the red banks of the river, which is famously occupied by crocodiles. But the fishermen are not afraid. During local ceremonies, 'pekaans' or long poems are sung to the water spirits to protect the fishermen and the community from harm.

This protection is needed now more than ever as communities face new challenges from climate change, prolonged droughts and population growth. The overexploitation of groundwater and pollution have led to water scarcity. This has greatly aggravated the already difficult lives of many people in the rural north. Poverty and food insecurity are prevalent in the area, where most people engage in fishing, livestock rearing or subsistence farming.

Combined with a lack of clarity over water access and management rights, the scarcity of water resources often leads to conflict between herders and farmers. Moving from one place to another, pastoralists need water for their livestock, but farmers are not always willing to share their limited water resources.

Ousmane Ly, 59, is a pastoralist who lives in Guia, close to Ngaolé. According to Ly, because of climate change, the livestock in the area has been considerably reduced as the grazing space has shrunk. Due to the scarcity of fodder and water points, early and prolonged transhumance is the only alternative for local pastoralists. This can cause tension – and even conflict – between farmers and herders.

Mr Samba BA, called "Ngary Ngaolé" Sings during traditional "Pekaans" ceremonies to glorify the actors, encourage them and remind them of the exploits of their ancestors.

According to Ly, "The reduction of grazing areas and the distance to water points are due, on the one hand, to the galloping demography with the consequences of the extension of villages and small towns (Taredji, Ndioum) on the cattle routes for access to water or grazing areas; on the other hand, to the hydroagricultural developments (Ngallenka, Nianga casier, etc.)."

The FAO KnoWAT project has provided a concrete solution to this problem through the evaluation of water tenure. This assessment should be extended to all of Senegal and the countries of the Senegal River Basin to promote social cohesion and peace between different water users.

FAO's work on equitable water access and use

The KnoWat project carried out a water tenure assessment in two areas of the Senegal River Basin, Podor (adjacent to Ngaolé village) and the Gorom-Lampsar axis in Saint-Louis, to support the equitable allocation of water to users in these areas. In addition, a WaPOR database on water consumption and productivity was developed and the project team conducted capacity building activities on water resources assessment for technical staff in the country from 2019 to 2022.

Formal laws give people legal rights to use and access water, but these rights are often also determined by local habits and customs. The problem is that these customs do not guarantee people's right to use and access water. According to Sofia Espinosa, a land and water specialist at FAO and one of the supervisors of the water tenure assessment in Senegal:

"During the assessment, we discovered that some rivers in the Senegal River Basin are considered sacred by the local population and have not been touched for generations. But there is no document that gives them this right. Imagine if these rivers were suddenly used, for example for irrigation, by someone who had acquired a legal right to them? That would be terrible for the local people. That's why we need to study these different tenures, in order to protect local people's access to and use of water."

Since water tenure assessment is a new concept, the KnoWat project developed a methodology for the process. The methodology is a balanced approach that employs desk research, fieldwork for data collection, training and participatory consultations with policymakers, national stakeholders and local people that depend on water for their livelihoods. It examines official laws and policies, their implementation and enforcement.

In Senegal, the assessment found that there are many other types of water tenure that are legitimate based on custom or religious belief but do not fall within the country's legal framework.

"Besides this example of customary use of water resources, people have a practice of fishing in the Senegal River, but the legal framework does not recognize this type of custom, and the fishermen are not yet aware of it. Similarly, some farmers in the region are involved in flood recession farming, but if there are dams in certain areas, this type of farming will be threatened and reduced to a minimum," said Sofia Espinosa.

Protecting and securing local practices by including them in the legal framework, or finding an alternative solution, would bring greater security to people by protecting their livelihoods and customs.

"The advantage of [the KnoWat] project is that we have interrogated the traditional and legal arrangements of water governance and we have many [...] difficulties related to water management in the Senegal River Basin. A deep understanding of these difficulties has therefore been [made] possible thanks to the water tenure assessment study and our aim now is to ensure that this approach and the results obtained are disseminated and known to the public, in particular to decision-makers at national and local levels," said Babacar Diop, an agropastoralist in Ross Bethio and administrator of the Conseil National de Concertation des Ruraux (CNCR).

Perfect timing

Senegal is currently involved in the process of revising its water law. The water tenure assessment, and its recommendations, are expected to contribute to this process.

"We held a validation workshop at both local and national levels with stakeholders, some of whom are also already involved in the revision of the water code. At the end of these workshops, the evaluation report was validated in May 2022 in Dakar by all the actors involved, which is promising," explained Lamine Samaké, KnoWat's National Coordinator.

Younoussa Mballo, Technical Advisor to the Senegalese Ministry of Agriculture, Rural Equipment and Food Sovereignty, considers the project's work to have been useful: "We believe that the KnoWat project has helped to refine our water governance policies, programmes and strategies and directed them towards a more effective and efficient use of water resources. Senegal is endowed with a large amount of water resources and these resources will be managed even better considering the results obtained throughout the KnoWAT project. In the end, we believe that if there are still issues to be clarified in this process, we should see how to continue this work and especially how to scale it up."

While Senegal is on track to address its water challenges, the situation remains alarming at the global level.

"More than 733 million people currently live in areas of high or critical water stress, and global water demand is expected to increase by 30 percent by 2050. Agriculture is by far the biggest user, accounting for 72 percent of global water withdrawals. The question is how to solve this puzzle for sustainable development for people and the planet? We believe that responsible water governance, including work on water tenure, is an important tool to address the challenge of the decade," concluded Benjamin Kiersch, global coordinator of the KnoWat project.

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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.

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Federal Ministry of Food and Agriculture

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National activities were implemented in collaboration with the National Council for Consultation and Cooperation of Rural People (CNCR), the Directorate of Management and Planning of Water Resources (DGPRE) and the *Société d'Aménagement et d'Exploitation des terres du Delta et de la Vallée du fleuve Sénégal* (SAED).

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