FROM OBSERVATIONS TO RESILIENCE:

Unlocking NGO potential for effective weather, water and climate services

Experiences from and guidance for NGOs

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About the Swiss NGO DRR Platform

The Swiss NGO DRR Platform is a network of professionals from non-government organisations (NGOs) dedicated to increasing the resilience of women and men, communities and governments through disaster risk reduction and climate change adaptation. It strives to enhance the quality of services delivered by Swiss NGOs related to disaster risk and climate change, promotes the development of know-how and experience, provides guidance to increase effectiveness and advocates for risk-informed development, disaster risk reduction and climate change adaptation in order to increase resilience.

Under the Swiss NGO DRR Platform's 2019–2025 work programme, a working group on weather, water and climate services (WWCS) has been operating since 2020 with the aim of enhancing the understanding and improving the practices of WWCS member organisations.

With financial contribution from:

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

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Weather, water and climate services in NGO-supported DRR and climate adaptation projects – an introduction

Weather, water and climate services (WWCS) play a crucial role in climate adaptation and disaster risk reduction (DRR). To be effective, they require the collaboration of multiple stakeholders with wide-ranging expertise and skills to manage complex processes. Non-governmental organisations (NGOs) often fill a gap to bridge the last mile to end users but can also assume further complementary roles and responsibilities.

For people in remote, neglected, and vulnerable areas, accessing accurate and reliable information through WWCS can be very difficult for several reasons: service providers may not consider them priority clients, hydrometeorological services may lack the capacity or resources to cover the whole territory, or information may be available but not translated into user-friendly language at local level. NGOs and civil society organisations (CSOs) often step in to address this gap. They work to connect the services available at the national level with the local communities and stakeholders who may otherwise struggle to access them.

However, in many countries, hydrometeorological services face difficulties to fulfil their mandate or meet their international commitments. For example, the observational network may be deficient, data from meteorological stations may be poorly managed, or they simply fail to turn available data into deliverable services due to the institutional mindset. Here, NGOs and CSOs can go beyond the role of broker or intermediary and support local institutions with the logistics and the development of services demanded by their constituencies. Adopting such a role enables a partnership with local institutions that enhances mutual understanding and trust to effectively deliver WWCS to the most vulnerable populations.

Irrespective of the approach adopted, it is essential for NGOs to have a good understanding of WWCS. This includes understanding their value cycle, their users, and key stakeholders and their possible roles. This publication is part of the Swiss NGO DRR Platform's learning journey to enhance the understanding and improve the practice of NGOs working in WWCS. It aims to give basic answers to frequently asked questions while also reflecting on challenges and opportunities that NGOs may encounter. Five case studies from member organisations of the Swiss NGO DRR Platform underline the lessons learned and have guided the recommendations provided. The goal is to offer project managers and practitioners an additional perspective, and to support them in the design and implementation of future WWCS projects.

2

A few fundamentals about WWCS

Weather, water, and climate services (WWCS) provide essential information about past, present, and future hydrometeorological and climate conditions. This information is crucial for understanding climate, adapting to changes, and reducing risks for our environment, agriculture, industry, and society. WWCS are indispensable in diverse decision-making processes, helping professionals to make informed choices that enhance resilience and sustainability.

For milliennia, people have sought to understand and forecast climate and weather patterns. In 650 BC, for example, the Babylonians tried to predict the weather based on cloud patterns observed by the eye. Our capabilities in this regard have improved dramatically in recent centuries so that today, thanks to advances particularly in observation and the use of supercomputers for Earth system modelling, our capacity to deliver WWCS is growing at an unprecedented pace.

Progress in this field draws on a wide range of observation and data collection infrastructure: from locally installed rain gauges and weather balloons, to radars installed on land, in airplanes and on ships, and satellites monitoring the Earth and its atmosphere with great precision. **Did you know that weather radars have been in use since the 1950s, initially to detect water droplets in clouds, but nowadays also able to determine wind speed?** There are more than 1,600 weather radars in 125 countries run by members and partners of the World Meteorological Organization. Weather balloons are also an important source of information. Globally, nearly 1,800 weather balloons are launched daily.

Figure 1: The WMO Integrated Global Observing System (WIGOS) combines the observing capabilities of surface- and space-based platforms and stations to serve a variety of weather and climate needs. (Source: WMO)

Despite progresses in digitalisation and remote data collection, local data from **ground stations** remain critical since they are still much more accurate than satellite data. To improve ground observation, the United Nations (UN) has recently launched the Systematic Observations Financing Facility (SOFF) to support least developed countries in extending or rehabilitating ground stations provided that the collected data is made available internationally.

The **exchange of data** is of paramount importance for modern weather and climate forecasting. While in the past weather forecasters would devise a prediction on paper based on the data points, international centres today run computer simulations which can integrate a huge set of observations. With more observations, current conditions can be better understood, enabling more accurate forecasts that benefit all countries globally. WMO aims to bundle observations from around the world under the umbrella of the Integrated Global Observing System (WIGOS). This system foresees UN member states sharing data freely to overcome global challenges. However, some countries continue to withhold data or lack the capacity to share data through internationally agreed protocols.

Weather, water and climate **forecasts** are produced for a wide variety of **timescales**, ranging from hours to centuries. Box 1 gives an overview of the different timescales and examples of applications of WWCS.

Nowcasting

This is the shortest timescale, extending from "now" until the next six hours. Such forecasts rely on observational data (e.g. from weather stations, radar and satellite pictures) and use methods to project current conditions across the next few hours. Nowcasting is critical for warning of events which are not predictable on the weather forecasting timescale, such as thunderstorms and resulting flash floods. It is thus highly valued, but most countries in the global South are not yet able to capture it since it requires the rapid processing of real-time data.

Weather forecasting

This timescale spans forecasts for 1–15 days (short- to extended-range) and is the most well-known and most widely applied range for numerous sectors. Most weather applications rely on forecast for the short end of this range, since accuracy rapidly decreases as the range extends. Applications include early warning of temperature extremes or prolonged rain that is important for agricultural decision-making, and forecasts of demand for energy for heating or cooling that can aid energy management. Most protocols for proactive measures in response to early warnings (anticipatory action) currently rely on weather forecasting: 1 to 15 days provide a sufficiently long window to take action and at the same time sufficient accuracy to avoid acting in vain.

BOX 1

Overview of forecasting timescales

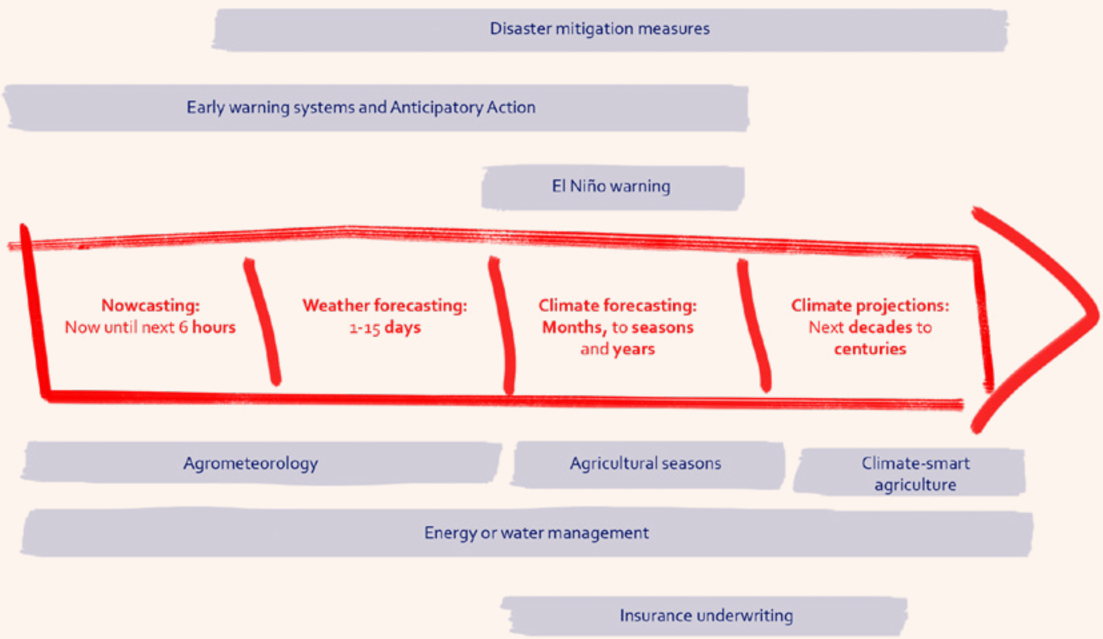


Figure 2: Forecasting timescales and selection of possible uses of WWCS.

Climate forecasting

Forecasting beyond the weather timescale, from months to seasons and multiple years, is known as climate forecasting and has received much attention in recent decades. In this time range, rather than predicting the weather on a particular day, we predict whether average conditions for a given month, season, or year will be above or below those in a normal year. An example is the El Niño phenomenon, which strongly impacts climatic conditions on this timescale in the tropics. Climate forecasting is subject to much larger uncertainty than weather forecasting, and typically finds application with large stakeholders in businesses strongly based on statistics, such as insurance or trading. For an individual smallholder, it is difficult to make decisions based on climate forecasting, although more and more approaches have been proposed in agriculture.

Climate projections

Beyond the scales of seasons to years, the single most important factor that shapes the climate is climate change. Since climate change involves also socioeconomic factors, it is impossible to predict accurately, and hence a scenario approach is used to describe plausible future climates according to different human development trajectories. Scenarios are not forecasts, and we therefore speak of climate change projections or scenarios**.** Climate change projections simulate the evolution of climatic conditions over future decades and centuries. This information is critical for the long-term planning and implementation of measures to adapt to climate change for both small and large stakeholders.

The **accuracy of forecasts** has improved dramatically in recent decades thanks to global observation systems, large-scale computing power and advances in modelling Earth systems, increasingly with the use of artificial intelligence (AI). This is enabling the development of new applications that will become increasingly useful in the Global South. However, a significant degree of **uncertainty** remains because of the immense complexity of Earth systems. It will for instance never be possible to accurately predict the weather on a specific day four weeks in advance. This must be explained well to end users of a service.

The importance of WWCS is uncontested. However, weather and climate information are only useful when it effectively informs a **decision-making process**. For example, it can guide decisions on whether to evacuate a city in the face of forecast heavy rains. Without local, sector-specific and user-oriented service development and dissemination, WWCS will find little application and won't lead to informed action. For a collection of possible uses of WWCS in DRR and climate change adaptation, see Figure 3.

The opportunities to effectively support users' decisions and action are becoming potentially greater thanks to **digitalisation**. For instance, the widespread use of mobile phones greatly increases the potential reach of early warnings of hazardous weather events. This endeavor is for instance currently strongly promoted by the Climate Risk Early Warning Systems (CREWS) initiative of the WMO.

Whatever service an NGO project might support, the reliability of the service and the information provided are key for users and intermediaries. For NGO actors without expertise in data science, WWCS are often a black box, and it is difficult for them to assess the underlying processes and judge whether the forecasts generated are robust and reliable. **Partnership** with scientific institutions or expert collaborators is therefore important for NGOs aiming to engage in the co-development of WWCS in the Global South.

WWCS are used for...

...early-warning systems and anticipatory action to avoid loss of life or injuries at home, on the road or in the field

...risk-informed and climate-smart planning, financing and implementation in construction, agriculture, public health, tourism, energy or water management, urban, regional or land-use planning to avoid damages, loss of agricultural land or increased vulnerability and increase production and improve human well-being

> Researchers use inventories of greenhouse gases to evaluate climate policies

> Public health professionals use climate change scenarios and meteorological information in health early warning systems

> Researchers use hydrological, weather and climate data to constantly improve the accuracy and precision of future scenarios

> Farmers and pastoralists use future temperature and precipitation scenarios to adapt their traditional practices and land use plans

> Farmers use temperature and precipitation information to protect their crops

> Spatial planners use historic data and future climate scenarios to plan the use of urban and rural areas avoiding additional risks

> Engineers, architects and builders use historic data and future scenarios to build resilient houses, roads and infrastructure

> Responsible authority, community leader or a private actors use meteorological and hydrological data to inform that a hazardous event has happened or is about to happen

> Hydropower, solar or wind power managers use weather forecasts and hydrological information for energy production projections

Figure 3: Uses of WWCS in disaster risk reduction and climate change adaptation.

3
Decoding the WWCS value cycle

Rather than seeing the provision of WWCS as a series of individual activities, it is key to understand interdependencies among the services and the responsibilities of each stakeholder. To be effective, service users and service and data providers must work together and support each other throughout the WWCS value cycle.

A value cycle approach to WWCS involves analysing and optimising the entire process, from understanding user needs to end user application. It encompasses stages including observation, data processing and management, forecasting, communication and decision-making, ensuring each step adds value to the overall service (Box 2). User engagement and continuous feedback are critical principles for effective WWCS. The overarching rationale is that WWCS depend on various interconnected activities which create a societal benefit **provided the cycle is closed** – from the services to the user and back to the data generation.

The World Meteorological Organization encourages national meteorological and hydrological services (NMHS) to use the value cycle to strengthen their service mentality and generate greater societal benefits (WMO 2014, No. 1129). Most WWCS providers today structure their activities according to this cycle. This can help them to identify where the largest potential for improvement lies in a given context.

BOX 2

WWCS value cycle – an introduction to the several steps

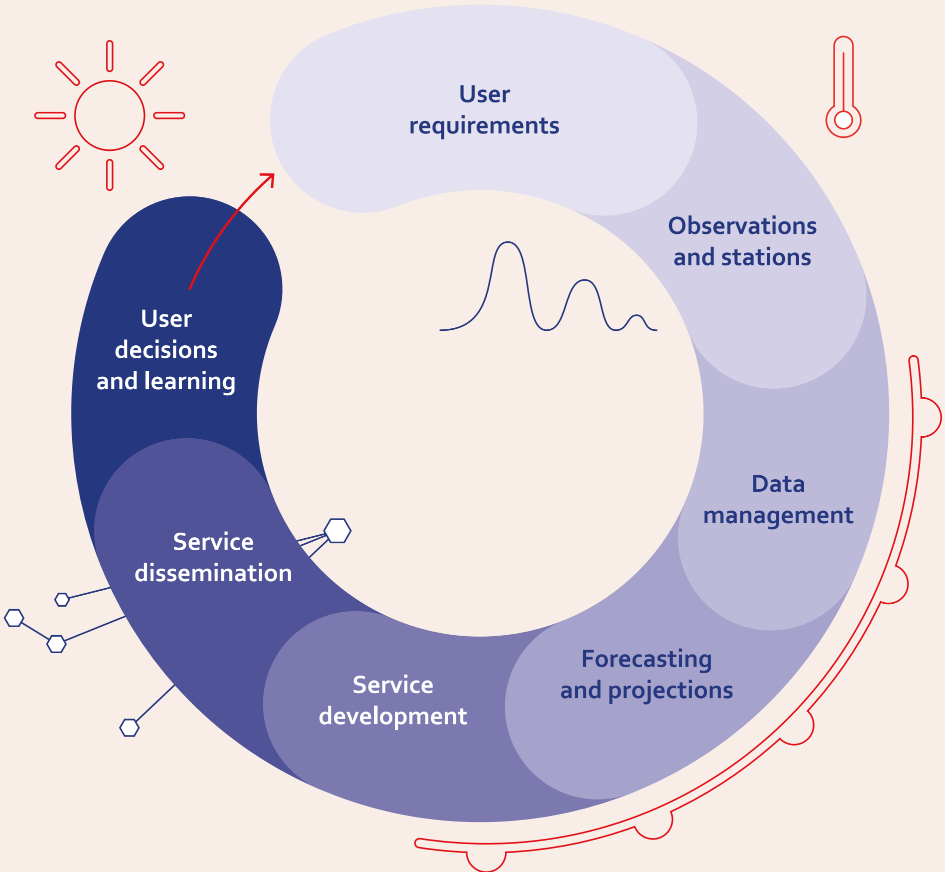


Figure 4: WWCS value cycle (adapted from WMO 2014, No. 1129)

A **value cycle** refers to the continuous process through which value is created, delivered, captured, and then reinvested to generate more value. In other words, it is a loop where value is continuously generated, utilised and reinvested to foster ongoing growth and improvement. In the case of WWCS (Figure 4), the cycle is based on user requirements, with value created progressively through five steps, ultimately enabling better decision-making. Each step of the value cycle is necessary for the creation of usable value.

User requirements

The starting point of any WWCS development is user needs and requirements. As shown in Figure 3, there is a wide range of potential users of WWCS. NGOs often work in remote and underserved areas and in very diverse sectors such as agriculture, health and education. An NGO aiming to strengthen WWCS as one of its activities must also assess the information needs of the sector where those services will be applied at an initial stage of project planning. Service users must also be aware that the services are needed to improve their livelihoods and resilience. Engaging with users is critical to foster acceptance and trust and to transform them into active stakeholders, potentially even contributing to data collection. Further, a thorough assessment of the value cycle is also crucial to identify bottlenecks in delivering the relevant services.

Observations and measurements

Data gaps reflect the lack of resources and attention invested in observation infrastructure in the Global South in recent decades. Filling these gaps requires careful consideration of questions including the nature and density of observations and measurements needed, the infrastructure and networks of measurement stations required to gather them, their physical location, and their custody, operations and maintenance. Answering these questions is challenging and most likely requires collaboration and alignment with government agencies. Data delivered by citizens can complement that from global observation systems. However, it is important that such data meets minimum data integrity standards. Additionally, as data might be exchanged with partners, it must meet certain standards to ensure comparability.

Data management

Data must be stored in a management system which keeps track of how and where the data has been gathered. Data management requires significant IT skills, even when using standard software solutions. It also involves quality assurance checks to filter out implausible data that can negatively impact the quality of the services. Trustworthy data is a real asset for the creation of partnerships and it is important to think about how the data can be exchanged (WMO provides a specific protocol to facilitate exchange). However, there may be legal obstacles in a given country to sharing official data with external stakeholders and to the gathering of data by non-governmental actors. NGOs should therefore enter into dialogue with relevant authorities and stakeholders to understand country-specific regulations and procedures.

Forecasting

Observations can directly translate into a service, such as measurements of precipitation required in previous years before sowing a crop. However, many services become particularly useful if there is an element of anticipation through a forecast. Developing forecasts of any type – from nowcasting to long-term climate forecasting – requires solid meteorological or climatological knowhow, and many national hydrometeorological services in the Global South rely on globally available products.

Service development

Forecasts and observations do not themselves constitute a service. Weather, water, and climate information become a service when they inform a specific decision-making process. This typically requires processing the information in the way that the end-users requires in order to act. This service will be quite different for a hydropower company or a smallholder farmer. Developing services, where for instance forecast data translates into a warning for civil protection, is typically an iterative process performed in close cooperation with end-users. This dialogue is important to clarify the limitations of the service and the specific decision-making process. NGOs can play an important role in the development process, for instance by sharing the findings of initial needs assessments with relevant stakeholders or supporting the provision of services in accessible language.

Service dissemination

Once a service is available it needs to be disseminated effectively to the targeted users. There are many modes of dissemination, and these are highly context specific. Mobile phone penetration has opened up new possibilities and vastly increased the scalability of service provision, supplementing local or national radio and television channels, which remain important channels of communication. NGOs can play a very important role in supporting outreach to underserved and inaccessible regions. Gathering feedback from end users is important in order to ensure information is understood and applied as intended.

User decisions and learnings

User feedback is critical for revising and improving WWCS. Feeback can be collected for instance through surveys or community discussions after delivery of a prototype service in a specific region. Services can also be reviewed after any significant change in local circumstances. It is also crucial to make sure that access to a service is equitable, granted also to the most vulnerable, and doesn't create tensions or conflicts. WWCS can do harm if they become paid services that exclude those that most need them to improve their livelihoods and resilience. NGO can advocate for adherence to values and principles of equity and sustainability and support learning processes including different stakeholders.

A wide range of **stakeholders** is involved in the WWCS value cycle. They include community members and the general public, public authorities responsible for disaster management, public health and land use planning, academia, NGOs, and private companies in different sectors. They are data and service providers and users as well as intermediaries that translate and bridge the gaps between specialised expertise and the needs of various stakeholders. Collaboration among all relevant stakeholders is essential to ensure the effectiveness and accessibility of WWCS. Box 3 gives an overview of relevant stakeholders for WWCS and their involvement in the value cycle.

BOX 3

Relevant stakeholders for WWSC and their role in the value cycle

STAKEHOLDERS AND MAIN ROLES	INVOLVEMENT IN THE VALUE CYCLE
National meteorological and hydrological service (NMHS) Main roles: Service provider User	NMHS is the actor with the public mandate to deliver on the entire value cycle. The budget allocation of an NMHS is typically low in the Global South and the inability to attract and retain skilled technical staff calls for partnerships, particularly around service development and delivery. Setting up such collaboration is usually demanding and bringing other NMHS or WMO on board can be a useful door opener.
WMO and other multilateral organisations Main roles: Policy and decision maker Service provider User Broker or intermediary	WMO is a specialist agency of the United Nations. Its activities include setting international standards and guidelines for meteorological and hydrological observations, data exchange, and forecasting practices. It provides the framework and support for NMHSs to operate effectively and collaboratively. WMO sometimes also plays the role of implementing partner for development projects and increasingly collaborates with other multilateral organisations (e.g. SOFF).
Ministerial departments and other national authorities Main roles: Policy and decision maker User	Ministries of agriculture, civil protection, environment, water, health, energy, transport, defence and territorial planning ideally have agreements with the NMHS in place to share data and services. This is particularly relevant to civil protection for preparedness and prevention activities. But when it comes to adaptation to climate change, a dedicated intersectoral body for climate services is needed, something few countries have established so far. While these stakeholders can be considered as users in the value cycle, they also have the political leverage to strengthen other elements.
Information and communication technology providers (ICTs) Main roles: Service provider	ICT providers are critical for data transmission and the dissemination of WWCS. Without mobile network coverage, it is difficult to operate an automatic weather station since costly satellite communication must be used instead. ICT providers can be useful private sector partners. By appealing to new clients, WWCS can help ICT providers' increase their customer bases.

STAKEHOLDERS AND MAIN ROLES	INVOLVEMENT IN THE VALUE CYCLE
Media Main roles: Service provider	Media is another often private partner that plays an even more central role in the dissemination of WWCS. Radio, television and print media continue to be the most important channels for communicating information on weather and climate. It is common for media to use additional sources of information to the NMHS, particularly if information provided by the latter is weak. In some cases, media may possess relevant qualitative forecasting capabilities of their own. Weather presenters are typically well known personalities and can therefore be effective in promoting new initiatives.
Other private companies Main roles: Service provider User	Numerous private companies provide WWCS at the global or local scale and on many occasions are competing with public service providers. Private providers often run a "freemium" business model, where basic services are free and special services come with a subscription fee. These special services typically target wealthier stakeholders. It is quite common to have parallel measurement networks run by private companies to deliver these special services and hence an engagement in the entire value cycle is possible. Other private companies that operate measurement stations for their own operations (e.g. hydropower plants) are often interested in new WWCS.
Research institutions and academia Main roles: Service provider User Broker or intermediary	Academia plays a crucial role in conducting research to advance understanding in meteorology, hydrology and climate change. They also contribute to the development of new forecasting techniques, data analysis methods and climate projections, and can be very important partners for an NGO. Academia also utilises weather and climate services in their research. Research institutions may run their own observation and measurement networks, but may not make their data and services widely available or translate their research outcomes into real-world solutions and use.
Communities, farmers and pastoralists Main roles: Service provider User	Citizens and smallholders with weather-sensitive livelihoods are typically the users with the greatest need of WWCS but are also the group least likely to receive them in the Global South. Understanding their needs, developing targeted services to meet those needs, strengthening the active role and contribution of local actors, and advocating for improved WWCS are areas where NGOs can have a large impact. However, this user group often has low understanding of the potential benefits of WWCS, and interactive co-development may prove challenging. It is therefore common to first expose smallholders to services and then draw lessons from their ability to understand and act upon them.

BOX 4

FREQUENTLY ASKED QUESTIONS:

How can high-level science support local empowerment and locally led adaptation?

An important goal of WWCS in development projects is to overcome the problem that traditional knowledge on weather and climate is no longer reliable under climate change. Hence, scientific data and knowledge must be brought in and broken down for use in often very traditional contexts with low climate literacy. High-level science will only have added value when it brings benefit to users. Local empowerment is a must: regardless of the quality of the WWCS, it is essential that users are informed about the services and know what to do with the information. A process that starts with local empowerment and ends with the introduction of high-level science is more likely to create sustainable communication between users and service providers and create real value on the ground. At the same time there are an increasing number of innovative approaches that apply modern science to local contexts and create benefits at scale. Profiting from these developments requires NGO staff to have the ability to build bridges between users and science. For NGOs working in the area of WWCS it is crucial to gain an overview of the whole value cycle in a particular context and connect with the relevant stakeholders at every stage of the cycle.

What is the right mix of remotely and locally gathered data?

The use of satellite data offers huge advantages over observation on the ground including broad geographical coverage, few data gaps, almost continuous data availability and no maintenance of weather station equipment. But there are also disadvantages, such as rather low and fixed spatial resolution (currently 3 km, or 1 km with newer satellites), the know-how required to process and interpret remote data, ITC to handle large volumes of data, and generally larger uncertainties in the data. The ideal solution is to have both ground and satellite observations. In most countries in the Global South, the availability of ground data is scarce and hence satellite products can offer an alternative, in particular also to assess long-term changes that have already taken place (e.g. environmental degradation). As of today, the quality of weather and climate data, if correctly generated and managed, is generally strongest for ground observations, followed by radar imagery, followed by satellite products. The relevance of data from these sources depends on the parameters (temperature, precipitation, wind, etc.) to be measured and expert advice is needed to identify a robust combination. Relevant experts may be found at NMHS providers and in research institutions.

What is the state of the art for weather stations?

WMO sets standards for the measurement of hydrometeorological parameters by NMHS. These standards, which are described in the CIMO guidelines, are very demanding for most NMHS and commonly not achieved by private organisations. However, they give relevant recommendations on where to site a measurement station and thereby increase the quality of the measurements obtained.
The list of parameters to measure depends on the service to be developed and in turn defines the measurement device the NMHS or the project wants to support. There are three categories for meteorological stations: low-cost stations (less than USD 500), medium-cost stations (USD 500–5,000) and high-end stations (more than USD 20,000). The latter category is the only one that can achieve WMO standards and is only relevant for NMHS. Low- and medium-cost stations are relevant for supplementary networks which NGOs can support and thereby create enormous benefits, given that in many developing countries the resources to sustain high-end stations are lacking.

How can the private sector be involved as a stakeholder?

Private organisations increasingly deliver WWCS since the services often generate revenue. For example, the weather services that many people access via smartphone usually come from private providers. Private companies are interesting stakeholders for WWCS projects because of their expertise in delivering services and creating a business model that can make a project sustainable. Collaboration with private companies can be in the form of public-private partnerships. The development of targeted services (e.g. through the development of software) and the setting-up and operation of measurement infrastructure are typical areas of successful private sector engagement (e.g. Cambodia EWS 1294). Another way to onboard private companies is to blend WWCS with other products (e.g. advertising) to enable "free" access to end-users. In contrast, the dissemination of weather warnings is an area to which private companies are not ideally suited. Private companies may tend to warn too frequently (to be on the safe side) and be less accountable for errors. Early warnings of hazards should therefore rely on public authoritative channels.

4
Recommendations and opportunities for NGO engagement in WWCS

WWCS are increasingly recognized and supported by NGO and community-based initiatives as important instruments for disaster risk reduction, adaptation to climate change and to decision-making based on hydro- and agro-meteorological advice. NGO-driven projects usually do not address the entire value cycle; it is therefore important for NGOs to identify the areas where their added value is greatest.

The possible actions summarized in Box 5 provide an indication of the opportunities and limits for NGO intervention in the sector. The decision on where to step in may depend primarily on the existence of gaps in local value cycles. Many WWCS development projects have failed because their interventions have been piecemeal and poorly coordinated with other stakeholders and efforts.

The strength of an NGO is its proximity to WWCS users. Technical expertise is available in national or international institutions (e.g. NMHS, WMO regional centres), and NGOs are not expected to become expert in this field but rather to support the efficient delivery of services and benefits for users by strengthening or supporting universal access and outreach, especially in remote and underserved areas. How to get started when developing a WWCS project is summarized in Box 6.

BOX 5

Possible actions and roles for NGOs in the WWCS value cycle

User requirements

NGOs represent or have strong connections with local communities; they are well positioned to make the voice of remote users heard and influence decisions on WWCS design. NGOs can add significant value, especially if their intervention is coordinated with other stakeholders.

Observation data and weather stations

Obtaining appropriate observation data is a must and NGOs can help provide technologies that demand less expertise such as low-cost measurement stations managed by end users who feed data to NMHS.

Recommendations:

- Standards are available on weather station siting and measurement methodology. Apply these standards even for low-cost stations, including simple rain gauges.
- Establish in advance how and to whom you will transmit the collected data.
- Consider the development of a measurement concept which guides decision-making on where additional stations should be placed.
- Always consider the cost-benefit ratio before deciding to invest in additional observation stations.

Data management

Data must be stored in a data management system, maintained and processed. NGOs can assume responsibility for it but need significant expertise even when relying on existing software solutions.

Recommendations:

- All collected data should undergo basic quality checks to make sure the information is plausible.
- Data management requires ICT appropriate to the flow and volume of data. Consider whether your organisation has the expertise to do this in-house, otherwise seek an external provider (e.g. all-in-one station provider with database management).

Forecasting

Data and information gathered through an NGO-supported initiative can improve general or specific forecasts (e.g. local agrometeorological forecasts). Local weather bulletins compiled by an NGO can become a means to deliver value and create dialogue.

Recommendations:

- Substantial knowledge and know-how are required for forecasting and cooperation with national providers (governmental or private) is a must to support the system. It's not possible to develop local weather forecasts based solely on local observation data. This is often misunderstood by communities and by staff.
- Improving forecasts can only be a long-term goal.

Service development

WWCS yield benefits when decision-making is improved. Thus service providers first need an understanding of the decision-making process and the needs of users in order to tailor the services to those needs. This is an activity where NGOs can make a significant contribution.

Recommendations:

- End-users should be the first and primary focus, though other stakeholders might also be interested in the data. These could be research bodies such as universities but also paying customers like insurance companies (e.g. providers of parametric insurance) who can represent additional sources of funding.

Service dissemination

Effective communication that reaches end users through suitable channels is key. NGOs can help ensure that the information is provided in language that is easily understandable for end users.

Recommendations:

- Find ways to convey that WWCS always contain an element of uncertainty and use language this is easily understandable for end users.
- Deliver information directly and free-of-charge to end users, especially emergency warnings. Early warning systems should be treated as an important public service.

User decision-making and feedback

Feedback from users is essential. NGOs can play a strategic role in improving feedback loops and pointing out critical gaps in the WWCS cycle.

Recommendations:

- Coordinating between stakeholders, building capacities and bridging the last mile to the end user is demanding in terms of both time and human resources and should not be underestimated.
- Exploit synergies with international actors (such as WMO) and ideally across national governments and their entities such as NMHS and with academia.

BOX 6

Developing a WWCS project:
How to get started step by step

STEP 1:
Identify needs for improved WWCS in a region or community

Begin by conducting an assessment and engaging with the community and target group to understand their specific challenges and needs and how they could benefit from improved WWCS. In parallel, explore traditional methods of weather and climate forecasting in the region and design from the very beginning a participatory and inclusive approach that allows the combination of traditional knowledge with scientific methods.

STEP 2:
Map existing WWCS and stakeholders involved in the value cycle

Conduct an analysis of existing WWCS, assessing the legal frameworks and identifying key stakeholders involved in their provision and utilisation. Include all possible stakeholders: local authorities, airports, universities and research institutions, hydropower companies, agricultural input suppliers, community radios and many more that are or could be active in the value cycle. The mapping should not only give you a full picture of current use but also an indication of what other stakeholders could potentially get involved.

STEP 3:
Identify strengths and weaknesses from different perspectives

Gather feedback from your target group as well as potential intermediaries and service providers to identify strengths and weaknesses of existing WWCS. Get a precise overview of who provides and uses what service around the value cycle. For your target group, identify unmet needs for climate adaptation and disaster risk reduction. In case of insufficient or entirely absent service provision, consider starting with policy dialogue and advocacy for access for all.

STEP 4:
Prioritise areas of intervention and build cooperation for sustainability

Prioritise interventions based on critical gaps brought to light and focus on areas where you can add value. Design for sustainability from the very beginning, for instance by identifying partners that can improve the service or access to it over the long term. As there are many different stakeholders involved, engage in coordination and cooperation efforts from the outset, drawing on the recognized NGO role of convener and intermediary.

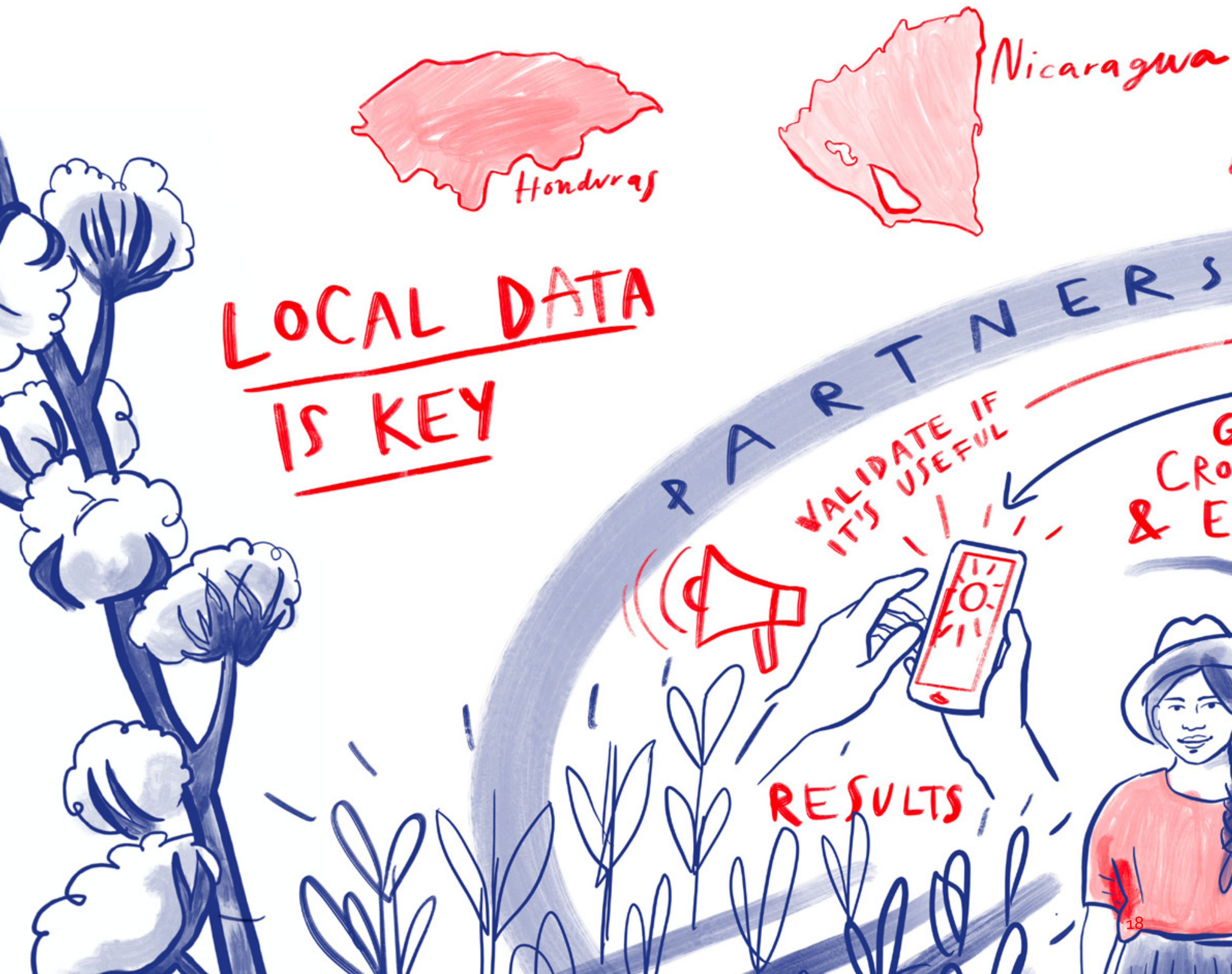
STEP 5:
Establish feedback loops and stay updated

Establish mechanisms for ongoing feedback and communication with your target group and all other relevant stakeholders to ensure that feedback on the accuracy and the use of the services gets back to the providers, and that WWCS initiatives remain responsive to their evolving needs and priorities. Be aware that the WWCS sector is very dynamic, important multilateral programmes are ongoing and private sector stakeholders are active.

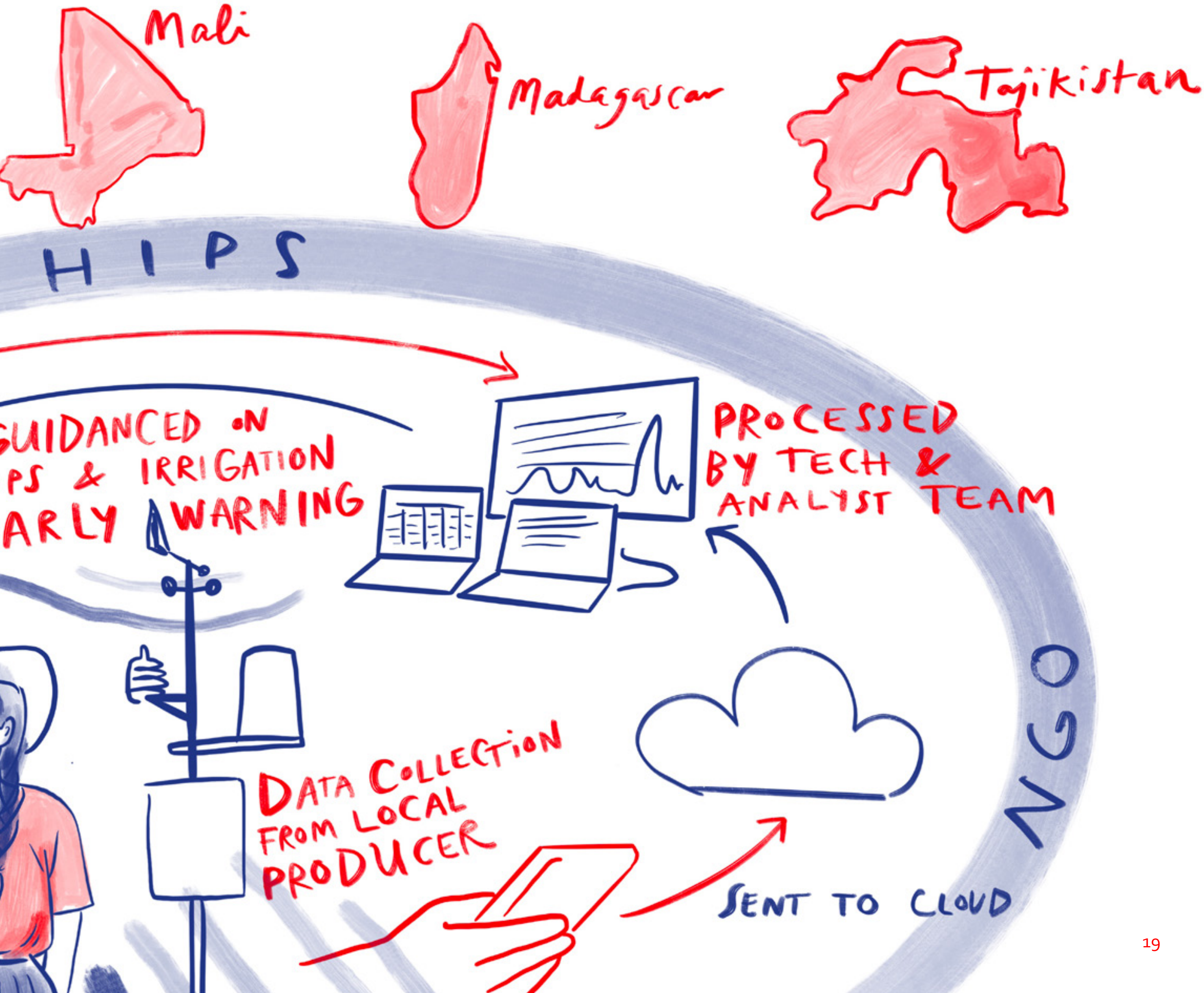
5
Experiences of the Swiss NGO DRR Platform

From national early warning systems to local agrometeorological forecasts, from Central Asia to East Africa and Central America, the range of experiences of member organisations of the Swiss NGO DRR Platform in WWCS is broad. Five member organisations have shared their WWCS project experiences in order to facilitate critical analysis and discussion that can inform and improve future efforts in this field.

The following chapter contains short summaries of the five case studies created for the platform's learning journey on WWCS. The range of approaches applied, partners involved, and final services provided is very broad. The same applies to the challenges faced in planning, coordination and implementation. The case studies clearly show that NGOs can play an essential role in this complex system, especially in bridging the last mile, but very often also in knowledge transfer and translation work and as a coordinator recognised and appreciated by all stakeholders.




Host of weather station
DATA


Mali
Madagascar
Tajikistan
HIPS
GUIDANCED ON
PS & IRRIGATION
ARLY WARNING
PROCESSED BY TECH & ANALYST TEAM
DATA COLLECTION FROM LOCAL PRODUCER
SENT TO CLOUD
NGO

CASE STUDY

TAJIKISTAN:

Circular WWCS value chain boosts agricultural productivity

Improved resilience of rural communities in Tajikistan to natural hazards, climate change and climate variability by addressing limited availability of accurate weather forecasts, early warning systems and WWCS in general through a circular value chain for provision and uptake of WWCS.

Implementing organisation: Caritas Switzerland
International partners: MeteoSwiss, World Meteorological Organization (WMO), Swiss WSL Institute for Snow and Avalanche Research (SLF), International Center for Agricultural Research in the Dry Areas (ICARDA)
National partners: Tajik Hydromet, Committee on Emergency Situations and Civil Defense (CoESCD) Tajikistan, Ministry of Agriculture (MoA)
Donors: Swiss Agency for Development and Cooperation (SDC), Leopold Bachmann Foundation, Kanton Zürich Gemeinnütziger Fonds, Ville de Meyrin
Location: Tajikistan

Background

Tajikistan's climatic conditions are challenging. With less than 10% of national territory suitable for intensive irrigated agricultural production, food security is of persistent concern. About 30% of the population live below the national poverty line, inducing work migration that often leaves women and the elderly in charge of rural farms. Exacerbated by land degradation from deforestation and overgrazing, floods and landslides threaten lives and assets, especially in mountain areas. Rural communities are vulnerable to these events and to the impact of changing weather on their agriculture-dependent livelihoods and their general well-being and safety.

Accurate weather forecasts, agronomic decision support and early warnings are weak or absent. This is largely a result of limited capacity (both human and technological) to anticipate and properly manage changes in weather, water resources and climate. The national agency for hydrometeorology, Tajik Hydromet, lacks the resources to provide these services. There is insufficient availability and density of weather observations. Compounded by outdated Soviet-era irrigation practices, agricultural productivity is much below its potential, with negative impacts on food security and nutrition. Lack of early warning systems translates into significant crop losses to annually recurring flash floods, snow avalanches and landslides.

Implementation, approach and stakeholders

The project aims to improve the resilience of rural communities in Tajikistan to natural hazards, climate change and climate variability by addressing the limited availability of accurate weather forecasts, early warning systems and WWCS in general through a circular value chain for the provision and uptake of WWCS.
WWCS that overcome Tajikistan's constraints need to be cost-effective, leverage resources outside of Tajik Hydromet for operation and maintenance of weather stations, and allow for delivery of services with minimal additional effort for Tajik Hydromet. WWCS must rely on a fee-for-service model, based on economic demand from farmers of all sizes, commercial enterprises and government agencies willing to pay based on value generated.

Consultations with stakeholders identified a first set of particularly relevant WWCS. These are to be tested together with options for improving sustainable productivity:

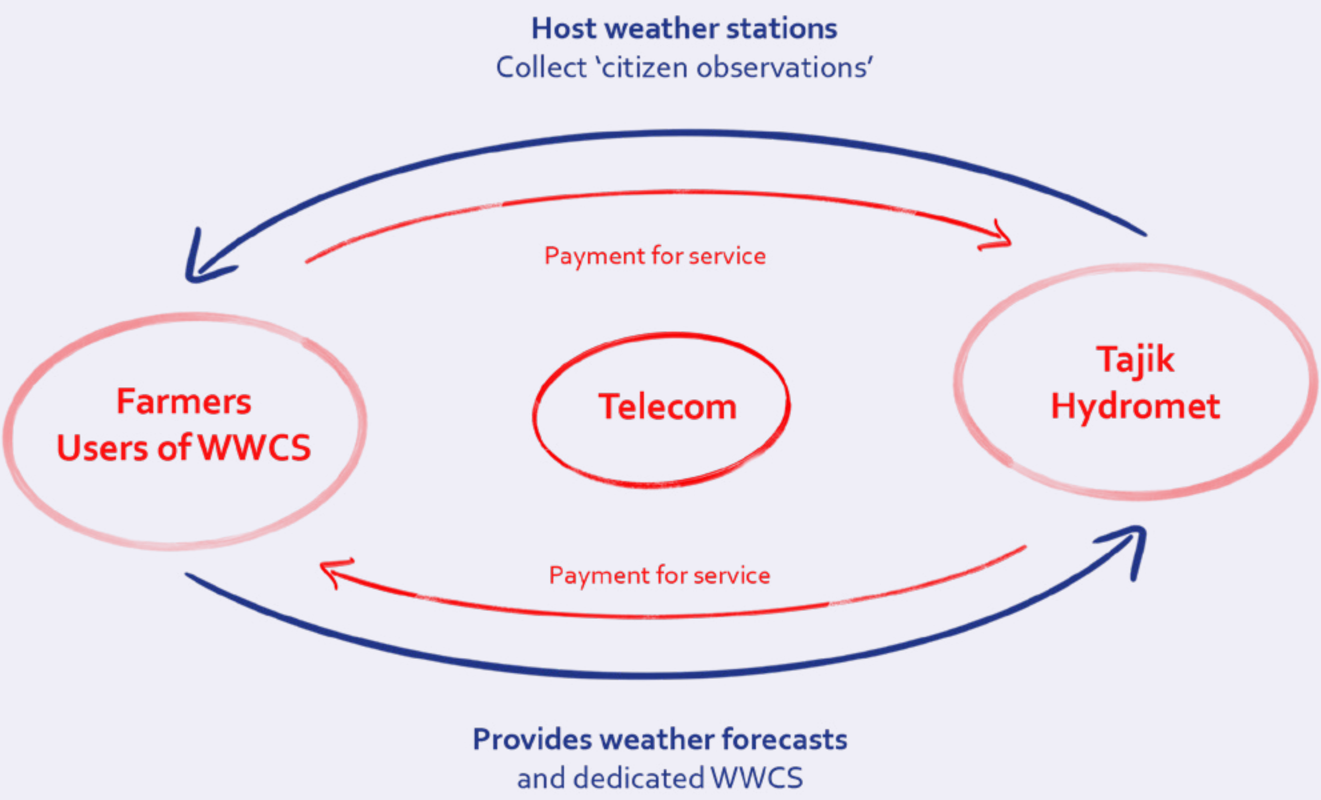


Figure 5: A circular value chain of data and services supports the project.

- Measurement of soil temperature to identify an optimum timing for planting
- Crop-specific and weather-based advice on irrigation (where, when, how much)
- Frost warnings for orchards, including at the time of harvest
- Heatwave/cold weather warnings to protect livestock
- Advice on innovative crops and crop rotations to improve productivity and soil health

The approach that was subsequently developed can be described as a circular value chain (Figure 5). Farmers and other users of WWCS host and (to some extent) maintain low-cost and open-source weather stations, which transmit data automatically through cell-phone networks of national telecom providers to Tajik Hydromet. Manual ('citizen') observations of rainfall, soil temperature and snow complement the data from the weather stations. The farmers send these (e.g. by SMS) according to specified protocols. Tajik Hydromet uses these data to generate more accurate weather forecasts and dedicated WWCS to farmers and other users. This circular dependence contains necessary economic elements: Tajik Hydromet pays farmers for hosting stations and providing citizen observations while also receiving income from farmers that subscribe to relevant WWCS to improve their agricultural productivity.

Having historically worked predominantly at the grassroots level, the necessity to collaborate with many national stakeholders within one project was new to Caritas Switzerland. With Tajik Hydromet alone, the spectrum of stakeholders ranges from the local to national level. Further national-level stakeholders include the Ministry of Agriculture (MoA) and the Committee on Emergency Situations and Civil Defense (CoESCD). Of direct relevance to WWCS in Tajikistan are rural advisory services, overseen by MoA, which support farmers in applying WWCS in the field. As providing and using WWCS includes specific technical and socioeconomic dimensions, Caritas Switzerland looked for international support for backstopping. The consortium now includes the World Meteorological Organization (WMO), the Swiss national hydromet service (MeteoSwiss), the Swiss WSL institute for snow and avalanche research (SLF) and the International Center for Agricultural Research in the Dry Areas (ICARDA). These institutions ensure state-of-the-art approaches to the technically demanding parts of the project.

Results

Early experiences were collected through two pilot WWCS applications:

- Enhanced production of chickpeas through WWCS. The use of a simple decision protocol, based on manual measurements with a low-cost

thermometer, permitted the selected women production groups to plant two weeks earlier than neighbouring farmers and harvest before the summer heat, tripling their crop.
- WWCS-based irrigation. A dedicated trial site was used to investigate the impact on yield and water consumption of potato under traditional and WWCS-informed irrigation. Basing irrigation on WWCS led to significant increases in yield (25–40%) while at the same time reducing water consumption.

Practical considerations and recommendations

- Define your system boundaries. Realising WWCS for one community is different from working towards a national system for WWCS.
- At national level, realising a system for WWCS provision and uptake is a multi-stakeholder and time-intensive undertaking.
- The many aspects of WWCS (from technological to socioeconomic) require a consortium of strong international partners, and a minimum level of technical capacity within the NGO
- Firmly established working relationships and cooperation agreements with governmental partners in a country are essential and must reflect their inherent and contextual diversity.

Outlook

Over the next 18 months, the project will develop and test WWCS to guide the timing of harvest and to warn for hot and cold spells. Rather than adding many more WWCS, the project will focus on effective dissemination processes, involving key governmental partners such as the MoA to encourage national ownership of the system.
In terms of disaster risk management, the project is still in the initiating phase. A first WWCS under development aims to improve monitoring of snow avalanche risk by feeding citizen observations of snow height as well as automatic measurements from low-cost weather stations into a snow model. Another application of early warning addresses weight loss and potential mortality of livestock due to cold spells and inclement weather.

Further information

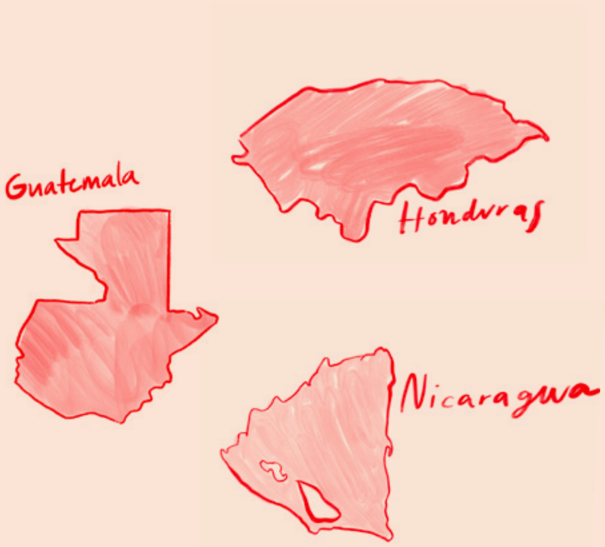
Project factsheet

Photos

A weather station run by Tajik Hydromet © Boris Orlowsky, Caritas Switzerland

Signing of a Memorandum of Understanding between Caritas Switzerland and the Agency for Land Reclamation and Irrigation © Boris Orlowsky, Caritas Switzerland

Caritas Switzerland staff installing a low-cost weather station © Boris Orlowsky, Caritas Switzerland



CASE STUDY

GUATEMALA, HONDURAS AND NICARAGUA:

Community-based weather and climate monitoring

Improved evidence-based natural resource management and food security through better access to local weather data, especially on precipitation, and local climate change trend data such as observed changes in precipitation patterns.

Implementing organisation(s):
Asociación Vivamos Mejor Guatemala (AVMG), Fundación Parque Nacional Pico Bonito (FUPNAPIB), Asociación Centroamericana Centro Humboldt (ACCH)
Partners: Vivamos Mejor
Donors: Vivamos Mejor
Location: Lake Atitlan Region, Volcanic Chain of Guatemala, Pico Bonito National Parc, Northern Honduras, Estuary delta of Rio Estero Real, Gulf von Fonseca, Nicaragua

Background

In Guatemala, Honduras and Nicaragua, the previously very regular rainy seasons have shifted considerably in recent years and are now more irregular. The state meteorological institutions (INSIVUMEH in Guatemala, CENAOS in Honduras) only provide meteorological services at the national or regional level. The local data needed for reliable local forecasts is lacking. However, farmers need precise forecasts to decide when to sow crops, especially as the previously regular seasons have shifted. Longer-term climate scenarios also only exist at a national and regional level. There is therefore a need for local weather forecasts and local climate scenarios. Filling this gap requires the collection of local weather data. Farmers traditionally observe weather patterns very closely. However, they are unable to quantify weather patterns and changes.

Implementation, approach and stakeholders

The project aims to improve natural resource management and food security through better access to local weather data, especially on precipitation, and local climate change trend data such as observed changes in precipitation patterns.
Local partner organisations in Guatemala, Honduras and Nicaragua started community-based climate monitoring as an additional component in three projects in 2019/2020 with the objectives to:

- Raise awareness among the rural population of the importance of meteorology and create knowledge and knowhow on how to quantify rainfall.
- Strengthen awareness among the rural population of the relationship between natural resources, water resources and rainfall.
- Obtain local precipitation data.
- Obtain local climate change trend data such as observed changes in precipitation patterns.

The NGOs identified volunteer weather observers in the communities and installed rain gauges, according to the standards of the World Meteorological Organization (WMO). They trained the weather observers according to Centro Humboldt's proven community climate monitoring method to record the precipitation data daily. The weather observers transmit their collected data to the NGO at the end of each month. In addition, the NGOs set up automated weather stations, which measure temperature, humidity, wind direction and speed and solar radiation as well as precipitation.

A total of 22 rain gauges and 7 weather stations provide reliable weather data collected in accordance with WMO standards. The NGOs analyse the collected data and compare it to official national weather data (Figure 6).

The NGOs compile monthly bulletins from the analysed data. In these, the farmers receive targeted information and graphs on rainfall quantity, distribution, number of rainy days, as well as temperature profile of the previous month, including a comparison of this data with the long-term (regional) average for the month. In Honduras, Fundación Parque Nacional Pico Bonito (FUPNAPIB) also displays the graphs in the offices of the local water supply committees, thus reaching a wider audience.

The bulletins also contain a (regional/national) outlook from the national weather services for the next three months with recommendations from the agricultural authorities.

The bulletins reach around 1,200 farming families. Potentially, a population of 86,000 people could be reached in the three project regions.

Results

The locally involved communities have gained access to local weather information with easily understandable graphics showing precipitation and temperature during the past month, as well as a comparison to the monthly averages of previous years.

With the bulletins, the farmers also receive a (regional/national) outlook from the national weather services for the coming months and recommendations from the agricultural authorities. The NGOs thus also bridge the last mile of weather information from the state services. The farmers have learnt to quantify local weather patterns and to back up observed changes in the rainy seasons with measured data.

Practical considerations and recommendations

In the given context, it was useful to limit the community observations to one key variable (precipitation).

Outlook

Since 2023, in addition to the weather data, the NGOs have systematically and regularly collected data on phenological characteristics and yield figures for maize, coffee, cocoa and rambutan in defined monitoring plots as well as key data on biodiversity in neighbouring natural forests. These data will be correlated with the weather data to develop locally tailored climate adaptation measures. This "Agro-Bio-Climate-Monitoring" is well suited to a long-term monitoring. To create reliable local weather forecasts in the future on the basis of existing regional weather forecasts and own local data, expertise in weather modelling is required. This endeavour will be initiated in 2024 with the support of specialist partners. The reverse approach of enriching official weather forecasts with local data requires the willingness of weather services to integrate this data into their forecasts.

Figure 6: The community-based climate monitoring projects involve farmers and NGOs and draw on data and services from national weather services.

Further information

Cresto Aleina, González-Xiloj, González-García, and Secaira-Ziegler (2022): Towards an integrated agro-climatic monitoring: results and challenges in two central-American protected areas, Journal of UNiversities and international development Cooperation (JUNCO), 1/2022 (69-83), ISSN 2531-8772. https://ojs.unito.it/index.php/junco/issue/view/781/496

González-García (2023, still to be published): Sistematización del desarrollo de un sistema de Monitoreo Agroclimático para cuatro cultivos de prioridad socioeconómica y cultural en dos áreas protegidas de Centroamérica: Hacia un monitoreo agroclimático en el contexto de cambio climático.

Photos

Community weather observer in Guatemala. © AVMG

Installation of an automated weather station in Honduras. © FUPNAPIB

Monthly weather overview as displayed at offices of the local water supply committee in Honduras. © FUPNAPIB

CASE STUDY

NICARAGUA:

Small-scale farmers as local climate masters – Climate resilience of food systems

Farmers strengthen their food systems in the face of climate change by maintaining a system for the generation of timely and accurate climate information, and building on agroecology.

Implementing organisation(s):
SWISSAID Nicaragua
Partners: Organización para el Desarrollo Económico y Social para el Área Urbana y Rural (ODESAR), Fundación Denis Ernesto González (FUDEGL), Programa Campesino a Campesino (PCAC) de la Unión Nacional de Agricultores y Ganaderos (UNAG)
Donors: Swiss Agency for Development and Cooperation (SDC), Roman Catholic Community of Bern, other institutional and individual donors
Location: Six municipalities in Matagalpa, Nicaragua: Esquipulas, San Dionisio, Darío, San Ramón, Terrabona and Jucuapa

Background

Nicaragua is one of the most vulnerable countries to climate change in the world. Storms, droughts, floods and landslides have had devastating effects on an already vulnerable population, and they have increased in frequency and intensity in recent years.

Further, changing weather patterns are affecting food systems through the risk they pose for agriculture. Existing climate and weather services lack localised data for effective prevention and adaptation measures among smallholder farmers in rural areas. The project is located in the so-called Central American Dry Corridor (affecting Nicaragua, Honduras, El Salvador and Guatemala), where the population is poor and depends on small-scale agriculture for food security.

Implementation, approach and stakeholders

The project aims to strengthen food systems in the face of climate change. For over a decade, it has supported small-scale farmers in collecting weather data. The data today clearly shows climatic changes and trends in their specific locations. Coupled with capacity building and exchange among farmers on locally adapted crop varieties and agroecological practices, the project has been helping farmers build a system for the generation of timely and accurate seasonal forecasts and the adaptation of their agriculture (Figure 7).

Over the years, SWISSAID and partners have built a network of 72 so-called local climate promoters. A focus lay on the involvement of young people and women to strengthen their knowledge about weather data and climate change as well as agroecology on the one hand, and assert their role in the communities on the other.

The promoters support 85 farms located in various communities in the collection of daily records on precipitation, relative humidity and temperature. They then upload the data points enriched with data from a few automated stations using the app KoboCollect. Local partner organisations help review and systematise the data. They also collaborate closely with the promoters and the involved farmers to interpret the data, based on the weather data of past years ("años análogos") and the farmers' knowledge about the characteristics of different crop varieties.

The digital platform Power Bi helps in the creation of user-friendly information dashboards: these show whether a given month or season is particularly wet, dry or hot compared to an average value. Based on the stored data and the different crop varieties' qualities, they further allow user-friendly presentations of estimates and recommended actions to be taken during the different phenological stages of a selected crop growth cycle. Therefore, leveraging these actors' combined expertise along with data-based knowledge allows for tailored recommendations that align with local producers' realities and can be disseminated to the rest of the community and neighbouring communities. The information is accessible via mobile phone app.

For the calibration of the methodology, official historical databases dating back as far as 30 years were used. To corroborate the very localised data set, the team relies on statistical correlations with satellite data. The results have proven to be robust.

The information obtained is regularly discussed with farmers in depth, mostly during workshops. These take place at critical moments (beginning of a season, before harvests, closing of a season, etc.). The findings are thus also regularly validated by the farmers: they can verify ex-post whether the information they have received on their mobile phones and the practices they have implemented were beneficial.

Concretely, the application provides the following information to farmers:

- what local varieties are suitable (mostly maize and beans so far)
- their ideal estimated sowing dates
- estimated timing of sensitive phenological stages of the crop growth cycle
- how to optimally manage (rain)water supplies to irrigate the chosen varieties
- early warnings about heat or frost (this information has so far been shared via text message or in-person meetings, as the app may not reach everyone in time due to connectivity issues)
- additional agroecological and farm management advice (e.g. on when to sell produce to likely benefit from better prices).

The information is also distributed per community or territory in the form of seasonal forecasts and trimestrial, semestrial and annual bulletins.

Results

- The combination of agroecology and farm management advice with weather and climate information supports climate change adaptation by farmers.
- Based on their own accounts, farmers were able to increase their harvests thanks to the climate and weather information provided and their own

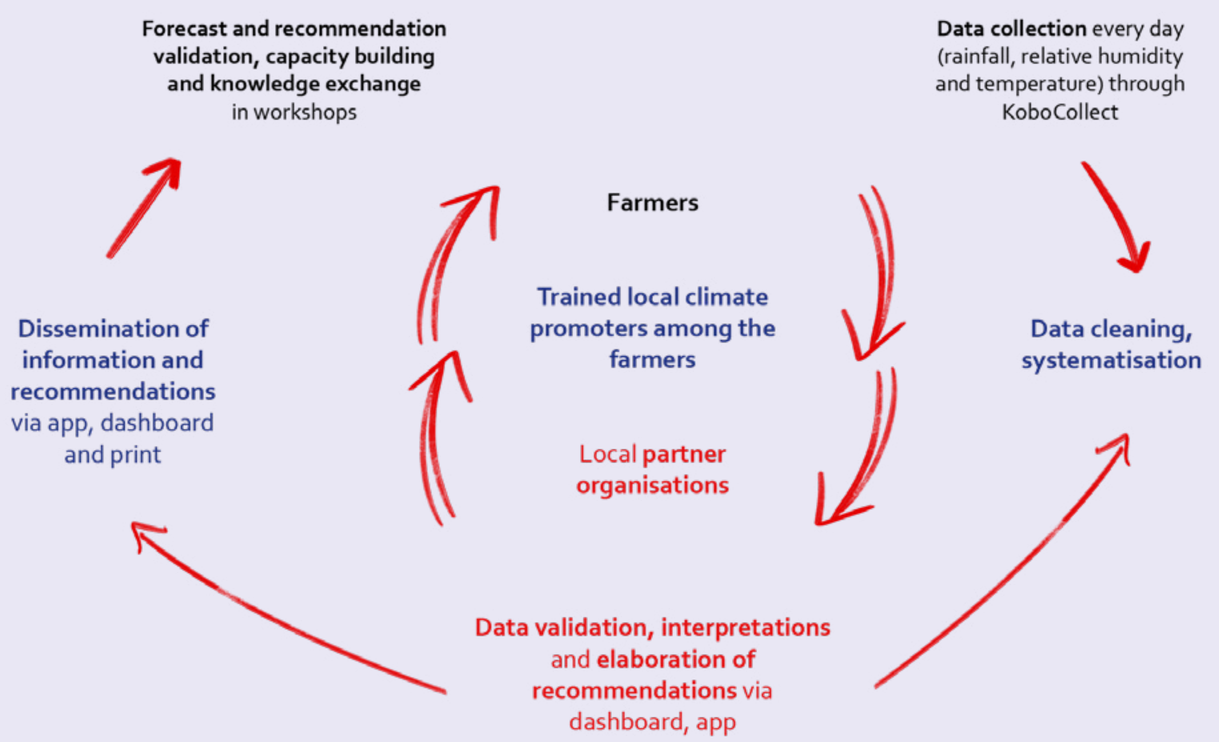


Figure 7: Small-scale farmers supported by local partner organisations are engaged in the entire information value cycle and validate the resulting recommendations.

knowledge of local seed varieties, growth cycles and agroecological farming.
- Through the validation and capacity building/ knowledge exchange workshops, a broader audience from within the communities was reached.

Practical considerations and recommendations

- Rather than financing and installing many automated weather stations, good local data can be obtained by working in selected communities to locate simple, manual stations with highly motivated smallholder families and differentiating their locations based on agroecological conditions and altitude (e.g. to cover wetlands, drylands, highlands and lowlands), as well as spatial coordinates. A few automated stations help triangulate the data and gather information on additional parameters, if needed.
- A large share of available resources should be invested in capacity building for community members so that they can correctly interpret the data.
- It is advisable to share localised data with partners and/or to link up with a private weather service, especially since public services on WWCS are largely absent or currently hard to obtain at the community level in Nicaragua.
- It may prove important to provide a small incentive to the network of climate promoters to sustain their motivation in the coming years and to allow for a professionalisation of the service. Services may consequently cost a small fee in the future.

Outlook

The project will continue working on the capacity of smallholder families to gather weather data and correctly use the provided services. An easily understandable print version of the information available on the app is to be provided to different segments of the population. For the sustainability of the services, it will be key to partner with private and/or public entities who often lack localised data and are typically providing more aggregate weather and climate data. In the meantime, the services will also be provided to other interested actors such as NGOs, researchers and additional farmers' groups and cooperatives.

Further information

[Country information, Climate Change Knowledge Portal]

Photos

Promoters with simple weather stations in San Dionisio and Jucuapa municipalities. © Carlos Daniel Zelaya Orellana

Automated weather station – San Dionisio municipality © Carlos Daniel Zelaya Orellana

Example of crop-specific information provided to farmers via smartphone app.

CASE STUDY

MADAGASCAR:

An integrated system that revitalises early warning systems

Strengthening disaster resilience with enhanced national early warning systems.

Implementing organisations: Medair and consortium partners (Helvetas, Action Against Hunger (AAH), Save the Children, Humanity and Inclusion (HI), Islamic Relief France (SIF), Luxembourg Red Cross
Partners: National Disaster Management Office (BNGRC), Directorate General of Meteorology (DGM), Welthungerhilfe, Private Sector Humanitarian Platform (PHSP), Communication Technology Regulatory Authority (ARTEC), Viamo, MEDIAS (Audiovisual Press), Institute and Geophysical Observatory of Antananarivo (IOGA), Start Network, decentralised territorial collectivities, decentralised territorial services, communities, community associations and social workers, Federation of Scouting of Madagascar (FSM)
Donors: European Civil Protection and Humanitarian Aid Operations (ECHO)
Location: 10 districts across 7 regions of Madagascar (Region of Analamanga, District of Antananarivo; Region of Atsimo Andrefana, Districts of Morombe and Toliary; Region of Boeny, District of Ambatoboeny; Region of Diana, Districts of Ambanja and Ambilobe; Region of Menabe, Districts of Mahabo, Miandrivazo and Morondava; Region of Vatovavy, District of Mananjary)

Background

Because of its geographic location and climatic conditions, Madagascar frequently experiences natural hazards, such as droughts, tropical cyclones, and floods, and is among the most vulnerable country to the effects of climate change worldwide. Hydrometeorological phenomena generate economic damage valued at up to 4% of GDP (about USD 420 million) (Banque Africaine de Développement). Early warning systems use weather, water and climate forecasts to analyse and identify potential climate and weather-related risks and hazards. All early warning systems aim to enable early action to save and protect the lives, livelihoods and property of people at risk.

Implementation, approach and stakeholders

The project was designed to strengthen the national early warning systems (EWS) through more efficient coordination and mobilisation of local actors. It aims to change the paradigm in the management of risks and disasters related to natural hazards, improve decision-making process and emergency response times, and send real-time alerts to the population through a combination of community animators and geospatial intelligence. It is characterised by pre-operational forecasting of hydrometeorological conditions, the use of information and communication technologies (ICTs) to send warnings before the disaster occurs, a predictive approach to crisis management, the rapid mobilisation of response teams, and the improvement of preparedness and response through early actions.

The project comprised three main steps. The first is related to the identification of community needs, and began with the collection of baseline data on knowledge, skills and practices and an awareness campaign on EWS. These exercises were followed by training and revitalisation of governance, risk and compliance committees, staffing of EWS, provision of water, sanitation and hygiene (WASH) kits, and the updating of contingency plans. The second phase, dedicated to operationalisation, relates to strengthening the capacities of institutions responsible for supporting community-led meteorological and hydrological studies, community risk mapping, dissemination of warnings, and strengthening emergency response. The third phase, devoted to the project's sustainability, involved supporting vulnerable groups, strengthening the hydrological monitoring network, and intensifying awareness campaigns on major hazards (e.g. cyclones, floods and fires).

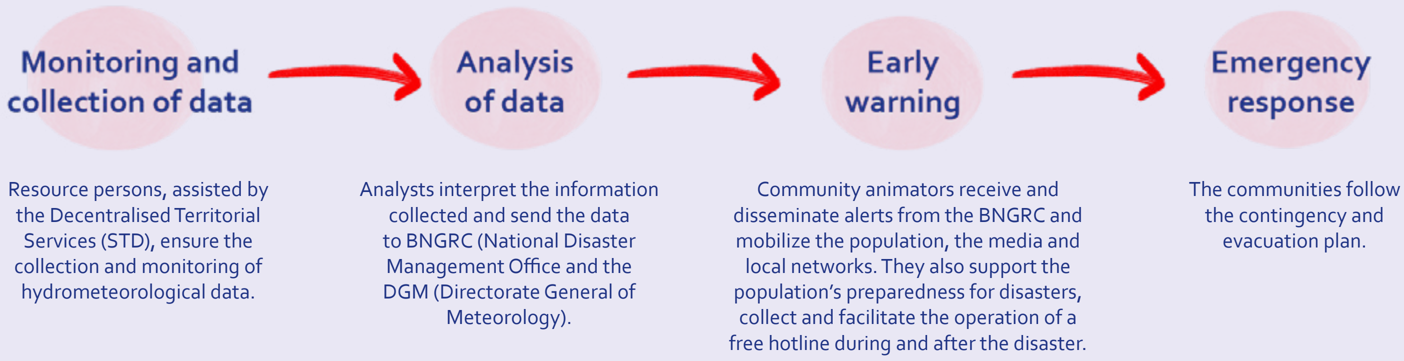


Figure 7: Local actors are engaged from observation to decision-making.

The implementation of the project involved the country's lead organisation for hydrometeorology, the Directorate General of Meteorology (DGM), as well as the National Disaster Management Office (BNGRC) which is responsible for the coordination of risk and disaster management (Figure 7). With the help of a memorandum of understanding, stakeholders were able to standardise approaches, share their expertise, address challenges together, and integrate their work plans. To improve the flow of information, institutions specialised in logistics and digital technology contributed to the development of EWS operating tools. For supervision and outreach work, rural organisations, community associations, and volunteers facilitated the uptake and appropriation of EWS. Local authorities have also been involved in this process. End users are communities, families and individuals, who receive the information directly through social networks, the media, local authorities and leaders, scout volunteers or community workers.

Results

The achievements of the project include hydrological studies that provide information on the geospatial risk-level; the training of government entities to monitor threats by hydrometeorological stations, triggering of warnings by digital technology, and use of a free hotline, which is a free voice response telephone line which provides data and information on threats and allows the population to take appropriate measures to reduce the impact of disasters. The project has also helped to promote community resilience by initiating risk assessment and monitoring, evacuation plans, and the development of local maps and water level markers. To strengthen disaster response, manuals in local dialect have been developed and communities, volunteers and intervention teams familiarised with operational procedures and the identification and triggering of early actions. The preparedness of the population has been strengthened by the provision of information technology, water level markers and WASH kits, the construction of storage warehouses and the pre-positioning of emergency items.

Practical considerations and recommendations

A framework should be developed for collaboration with communities and services, rural organisations and the private sector in a given area. It would be essential to address all major contingencies and to simplify access to the project products. It would be advantageous to use local dialects and pay particular attention to the complementarity of the use of ICT and community tools. It should be emphasized that strengthening anticipatory actions at the community level based on risk knowledge also strengthens the ability to make informed decisions and act after receiving an alert or follow-up.

Outlook

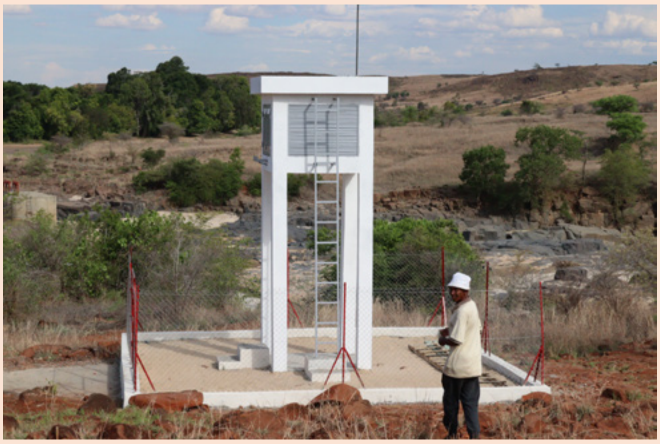
MEDAIR will transfer the project to the BNGRC, which will continue to strengthen EWS in the process of developing national "early warning for all", the implementation of the "Common Alerting Protocol", the enrichment of data in a digital library, and the feeding of the BNGRC dashboard. The management and coordination of the trained volunteers and response teams will be entrusted to the territorial services and collectivities. In addition, the management of assets such as storage warehouses, pre-positioned items and WASH kits will be transferred to local risk management committees which will also be responsible for the operation of water level markers and the dissemination of alerts.

Further information

News article

Photos

Simulation exercise (SIMEX), after the SAT Yellow Alert, following the risk management plan, the inhabitants of Ampasy-Morondava evacuate their homes and head to the community shelter site. © MEDAIR 2022



Installation of a weather station in Migodo, Municipality of Ankilizato, District of Mahabo © MEDAIR 2022

Multi-hazard community mapping training Mahabobe, Urban Municipality of Mahabo © MEDAIR 2022

CASE STUDY

MALI:

Well informed – well adapted

Better access to agrometeorological information services combined with improved farming practices help farming communities to adapt to climate change and increase their resilience.

Implementing organization(s): Helvetas Mali
Partners: National Meteorological Service Mali Météo, local offices of National Agricultural Department, local authorities and companies, local radio station
Donors: Helvetas Switzerland, Swiss Agency for Development and Cooperation (SDC)
Location: Ségou region (Cercles (administrative subdivisions) of San, Bla and Tominian) and Sikasso region (Cercles of Koutiala and Yorosso). The project was implemented in a total of 50 villages.

Background

Mali suffers not only from a fragile and complex political situation. In recent decades the effects of climate change have become increasingly evident and further accentuated the difficult situation of the agricultural sector, where 80% of the population is engaged, leaving about half of all Malians living in extreme poverty. Rainfall has become unpredictable and brings short, heavy deluges that are too much to be absorbed by the dry soil, leading to runoff that can cause local flooding. Droughts, when they occur, are also more severe. Over-exploitation of land makes the situation worse, with soils depleted by conventional farming practices unable to retain water. In rural areas, discouraged families, especially young people, leave in search of better opportunities elsewhere.

In this context, an opportunity to improve the livelihoods of small-scale farmers was identified through the strengthening of cooperation among stakeholders and service providers. Mali Météo provided information and forecasts on several temporal scales but was not yet able to reach small-scale farmers due to lack of resources and its focus on a technical audience. Meanwhile, in rural communities, weather forecasting based on traditional knowledge was becoming unreliable due to the changing climate. Further entry points for cooperation were identified for input providers, seed growers and local authorities eager to participate.

Implementation, approach and stakeholders

The Nyèsigi project, which in Bambara means "Let's build our future," aims to strengthen the adaptation capacity of smallholder farmer communities by combining several components: improving understanding of and access to agrometeorological information, introducing new and adapted farming and water management practices, and fostering innovations and the use of communication technologies and renewable energy sources.

To improve the uptake of agrometeorological information and involve young people, the project set up a local agricultural advisory service based on young volunteer data collectors, selected and supported by their communities and also supported by governmental technical extension services. The data collectors attended several training courses and were provided with equipment and tools such as rain gauges, telephones and data collection sheets. The project provided training and equipment and covered travel and other expenses needed to collect, send and receive data.

The role of the data collector is twofold: to gather weather and agricultural data in their communities and provide it to Mali Météo for further analysis and use; and to disseminate the weather forecasts and agrometeorological information provided by Mali Météo (Figure 8.). This includes sharing forecasts and information in appropriate language in the communities, discussing it during village assemblies, and supporting farmers in their planning. Mali Météo provides for the analysis and interpretation of the weather data in a multidisciplinary committee composed by experts from different technical services, such as agriculture, livestock, fisheries, forestry, and civil protection. Mali Météo is also responsible for ensuring the dissemination of disaster alerts and early warnings.

A smartphone-based communication platform has been set up to facilitate the continuous sharing of information, experiences, and data between the 100 data collectors as well as seed growers and local weather information disseminators covering the project area.

Farmers are also assisted to apply improved techniques in farming, soil conservation and water management. Some of these practices are newly promoted, others are rediscovered traditional practices for the rehabilitatitation of land and the conservation of water. Another important element was the introduction of short-cycle seeds and varieties. These were made available on the local market through a network of farmers. In addition to adaptation practices, young people are trained on the promotion of innovative technologies, such as solar pumps to facilitate irrigation and smoking techniques to preserve fish – an important measure amid increased fish production thanks to better managed water resources. The promotion of improved cookstoves that reduce wood consumption is also part of the activities.

Results

Today, 80% of the family farms in the intervention region use the agrometeorological information service. Most producers receive it by local radio (nearly 90%) and in village assemblies. A total of 100 collectors, including 18 women, are active in 50 villages.
In the past, Mali Météo's seasonal forecast was only available to a technical audience because the scientific nature of the data made it difficult to use for farmers. Now, this information is available to producers, giving an overview on the expected precipitation and temperature trends. Regarding the ten-day weather forecast, agrometeorological information is shared by Mali Météo and its multidisciplinary committee, and disseminated via the collectors supported by the project in every village assembly.

The combination of agrometeorological services, adapted practices and seeds has led to a significant increase in farmers' harvests. According to an evaluation by Mali Météo, producers who use the service and apply good farming practices increased their yields on average by 30%. Together with improved post-harvest management practices, the project has positively contributed to food security in the region.

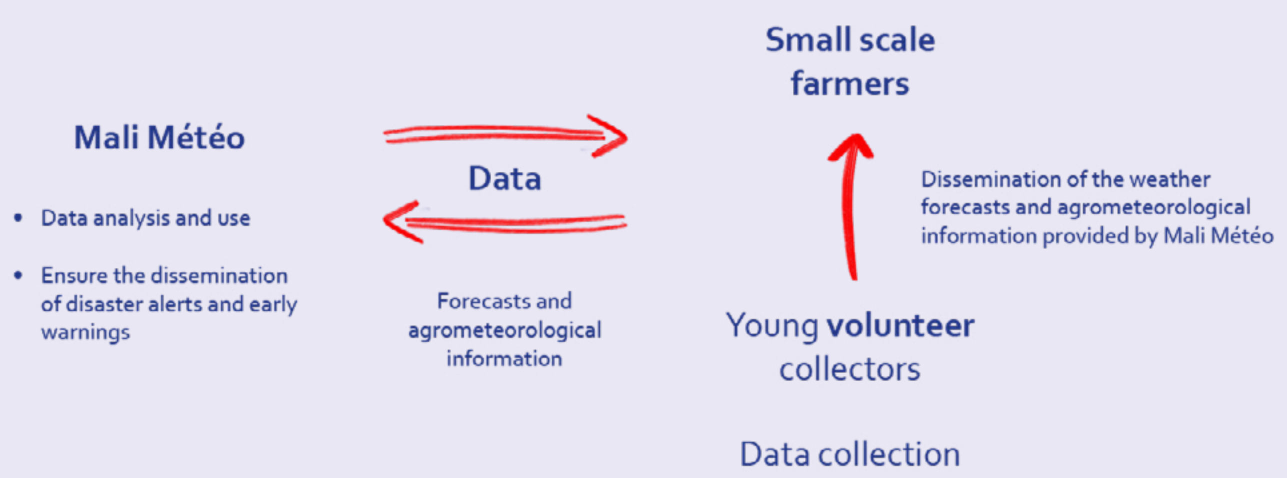


Figure 8: Mali Météo and young volunteer data collectors ensure a functional value cycle of forecasts and agrometeorological information.

Practical considerations and recommendations

To provide reliable agrometeorological information, a broad range of key expertise is necessary, and the time and resources needed to coordinate all key stakeholders should not be underestimated.

The duration of three years to test and implement this approach and the combination of measures has allowed the identification of strengths and weaknesses which will be considered during further upscaling.

Integrating and valuing tradition knowledge and practices for weather forecasting and farming as much as possible increases acceptance and contributes to successful outcomes.

The sustainability of the information service is challenging and the involvement of private sector actors (as input providers) could be a meaningful strategy.

Outlook

The next phase of the project foresees its upscaling to other regions in order to provide a larger group of farmer communities with access to the services. At the beginning of this phase, the analysis of climate and disaster risks for the region will be deepened to allow the development and introduction of further recommended practices in farming, soil and water conservation. With regard to the agrometeorological information service, there is a need to develop a sustainable business model which allows not only the continuation of the service but also a meaningful frequency of further training and the integration of new data collectors and stakeholders.

Further information

Project factsheet

Photos

Data collectors taking readings from a rain gauge © Tatoumata Tioye Coulibaly/fairpicture © Helvetas

A smallholder farmer listening to the radio for a bulletin of agrometeorological information. © Helvetas

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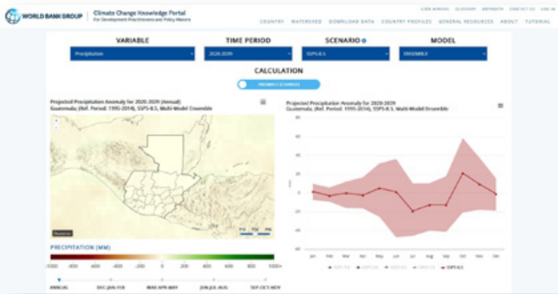
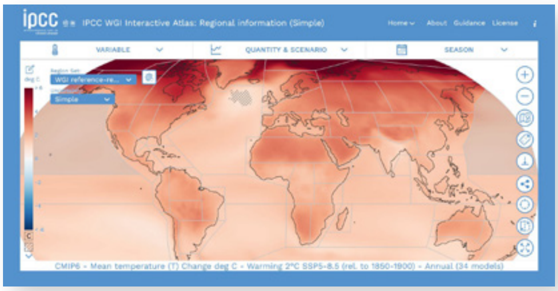
Tools, data portals and further information



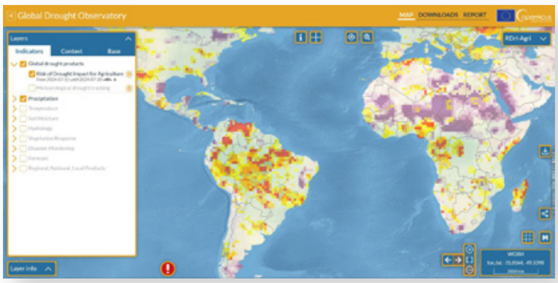
Climate Change Knowledge Portal of the World Bank

The Climate Change Knowledge Portal uses the latest reports and datasets from the Intergovernmental Panel on Climate change (IPCC) to provide information and analysis on historical and future climate data, vulnerability (with a focus on natural hazards), and impacts at the country, region and watershed scales. Information is available, for example, on the number of frost days, or days with precipitation > 20 mm, and on land use and hazard risks. Climate Risk Country Profiles provide deeper insights by country.



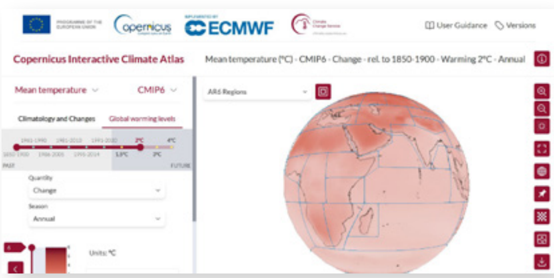
IPCC Interactive Atlas

The IPCC Interactive Atlas allows for regional and temporal exploration of observed and projected climate data used in the IPCC's Sixth Assessment Report. The Regional Information section allows users to generate maps and regionally aggregated products based on key datasets. The Regional Synthesis section provides qualitative information about changes in climatic impact-drivers in categories such as heat and cold.



Global Drought Observatory

The Global Drought Observatory provides drought-relevant information and early-warnings for Europe and globally. The service publishes short analytical reports in anticipation of an imminent drought.



Copernicus Interactive Climate Atlas

The Copernicus Interactive Climate Atlas is set to be an important new resource for policymakers looking to formulate effective climate policy and for other users needing to visualise and analyse climate change information. This new tool, which builds on the Interactive Atlas of the IPCC (see above), provides authoritative information on recent past trends and projected future changes for a wide range of key climate variables.

WMO guidelines

- Multi-hazard Early Warning Systems: A Checklist is a series of practical checklists of actions and initiatives that should be considered when developing or evaluating early warning systems
- Guide to Instruments and Methods of Observation Volume I – Measurement of Meteorological Variables provides guidance on the correct siting of weather stations and the measurement of variables including temperature, precipitation, wind, with a chapter dedicated to each.
- The WMO e-library provides a wide range of resources and is searchable by keyword.

Initiatives hosted by WMO and related to WWCS

Climate Risk Early Warning Systems (CREWS)

Announced in 2015, CREWS is a financing vehicle to increase the availability of and access to EWS in least developed countries (LDCs) and small island developing states (SIDS). The projects funded are implemented by the three Implementing Partners: WMO, World Bank/ Global Facility for Disaster Reduction and Recovery (GFDRR) and the United Nations Office for Disaster Risk Reduction (UNDRR).

Launched in 2023, the Accelerated Support Window (ASW) is a new way to access CREWS funds. Submission to ASW can be done directly by countries. Actions financed through ASW must be related to EWS, achievable within 12 months, and focused and targeted. The maximum support available through ASW is USD 250,000. Implementation is through one of the CREWS Implementing Partners.

Systematic Observation Financing Facility (SOFF)

Operational since the end of 2022, SOFF aims to finance observations in LDCs and SIDS to meet the requirements of the Global Basic Observation Network. SOFF also intends to finance maintenance and operations, provided that observations are exchanged internationally.

Country Hydromet Diagnostics (CHD)

Developed as a tool to assess NMHS along the whole value chain, CHD is carried out by another NMHS in a peer-to-peer approach. Final reports are made publicly available. For NGOs approaching a NMHS, these reports can provide useful information on the strengths and weaknesses of existing services.

The Hydromet Gap Report 2024 presents analysis based on CHD assessments in 20 LDCs and SIDS. It sheds light on the weakest links in the hydrometeorological value chain, which require urgent attention from governments and development partners.

WWCS project examples

Cambodia's Early Warning System 1294

This project successfully established flood early warning systems using low-cost measurement technology and innovative communication channels. Most notable is the national scale achieved thanks to strong institutionalisation and coordination among different actors.

Zurich Climate Resilience Alliance

The Zurich Foundation launched a global initiative to increase the resilience of the most vulnerable communities to floods and other hazards. The initiative has inspired various interventions around the world and developed an innovative methodology to measure resilience in remote communities.

Anticipatory Action initiatives of the International Federation of the Red Cross (IFRC) and other actors

The IFRC, through the Red Cross Climate Center (RCCC), has strongly pushed the WWCS agenda in the humanitarian sector and fostered several anticipatory actions initiatives. These interventions require knowhow on community vulnerability and locally collected data–areas where NGOs can support WWCS.

Further resources:

- The WeatherPod podcasts from the GFDRR.
- Issue brief: "The changing role of NGOs in supporting climate services" (Jones et al. 2016).
- Scientific publication: "The evolving landscape of climate services in sub-Saharan Africa: What roles have NGOs played?" (Harvey et al. 2019).
- Scientific publication: "Commercialization pathways for climate services for small holder farmers in the global South" (Spyridon et al. 2023).
- Report: "The Power of Partnership: Public and Private Engagement in Hydromet Services" (World Bank 2019).

7 Unlocking the potential of NGOs in WWCS – concluding remarks

The involvement of NGOs in WWCS shows great diversity in terms of approaches and roles. NGOs can play an important role in providing and strengthening WWCS in many ways, but there are also limitations, for example regarding the scientific analysis of weather data and the provision of accurate weather forecasts. Therefore, it is essential as an NGO to acquire the necessary understanding and to have the whole interplay in the value cycle clearly in mind before developing a project in this area.

The **role of the NGO/CSO** is usually covering coordination between stakeholders, capacity building of local actors, and bridging the last mile to the end users, usually communities and/or farmers. NGO work closely with communities, which is a huge added value that none of the other stakeholders can deliver. The multitude of stakeholders that need to be part of a functional weather and climate information service often brings huge complexity to the cooperative set-up required. Managing this is demanding in terms of time and (human) resources and should not be underestimated. In some cases, NGOs have been able to go beyond the traditional roles of intermediary/broker, trainer and convener, where the required expertise and resources were available. Especially in countries where the national hydrometeorological institution is not able to provide the service, the NGO contribution is important in the whole value cycle.

Reliability of and trust in the service and the information provided are key for the end user. For an NGO, it is often difficult to guarantee the quality of the information provided, as data processing is a science and NGOs often lack expertise in this area. Yet NGOs are obliged in their DRR and climate adaptation programming to avoid maladaptation, and carry responsibility for the weather and climate information used and shared with communities. It is therefore important to refer to WMO standards, link up with knowledgeable institutions and organisations, and work in partnerships to fill these gaps.

Synergies with global, multilateral or bilateral institutions (e.g. WMO) need to be better exploited at all steps of the value cycle, ideally across the national government and its entities (including national hydrometeorological service institutions), and in cooperation with academia if locally present. There are often **local or regional intermediaries** such as rural extension or agro-consulting services which also need to be involved. Global-scale cooperation allows also learning from experiences in other regions.

In most cases, the feedback loop between local data and the national/regional system should be strengthened. Usually, the responsible entities are interested in receiving local data, and this can be a **door opener for further dialogue and collaboration**. In some cases, the data can also be integrated into other research projects, such as studies on crop varieties and their adaptability.

The integration of **local knowledge** and observations, including biological indicators such as the behaviour of fauna and flora, is also interesting and important. These observations can provide evidence of gradual change (e.g. plants flowering earlier, birds nesting at different times), as well as current weather conditions (e.g. birds flying low means insects are also flying low due to falling atmospheric pressure, which can point to the arrival of rainy and stormy weather).

NGOs contributing to the development of WWCS should ensure that the share of **resources for hardware and software** is well balanced. There is a risk that too many resources are used for modern equipment and not enough is left for capacity building of the users and for the maintenance and processing of the collected data. The cases studies presented above use different **user outreach models:** In some cases, users receive the information directly (e.g. via phone/SMS or less targeted via radio) or indirectly. In one case, users must themselves call a service number to get the information. Ideally, projects should make the information available without requiring any action to be taken (or cost to be covered) by the user, especially for emergency warnings. Early warning systems should be regarded as an important public service and not be part of paid services.

As in all partnerships and projects, **sustainability and phasing out are key issues**. The foundation for sustainability can be laid if all relevant stakeholders are involved and strengthened in their respective role and task from the beginning. Also, if the reliability and the effectiveness of a weather and climate service is proven, specific end user groups such as farmers are willing to pay contributions to get access to that information, as it helps to increase their productivity and to reduce weather-related losses. On the other hand, weather services need a dense network of weather stations that need maintenance that national institutions are not able to ensure, so this can be performed by the farmers, leading to a win-win-situation. Solutions to these issues are still being explored and new models tested, but there is great potential here for public-private partnerships.