



Federal Ministry
for the Environment, Nature Conservation,
Nuclear Safety and Consumer Protection



giz Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH



Guidance Documents on Quality Assurance of Climate Information and Services (CIS)



The cover photo shows a recently cleared sky revealing a perfect semi-circle rainbow over a bountiful rice field. The Philippines is a largely agricultural land, and Climate Information affect this sector of society the most.



Table of Contents

1. Foreword	4
2. Executive Summary	5
3. Purpose and Scope of the Guidance documents	9
4. Concepts and Terminologies	12
5. Principles and Frameworks of Quality Assurance	15
4.1 Climate information	15
4.2 Quality of climate information	15
4.3 Existing CS Frameworks	17
4.4 The need for a “new” framework – Theory of change	17
4.5 Selection of methodologies for quality assurance	18
4.6 Co-production of climate services with intermediate users	19
4.7 Community of Practice on CIS	23
6. Status of CIS in the Philippines	23
5.1 Data provider	23
5.2 ClimDatPh -acquiring data from an online platform	24
5.3 Climate information services in Agriculture Sector	25
5.4 Climate information services in the Health Sector	27
5.5 CIS at the Local Government Units	29
5.6 Role of Community of Practice (CoP)in Quality Assurance of CIS	30
7. Quality Assurance Guidance	31
A. CIS Data Quality	31
B. CIS Knowledge Products	33
C. CIS Utilization	36
8. Cross-cutting issues	38
7.1 Communicating uncertainties	38
7.2 Quality assessment and reporting	38
7.3 Implementation Roadmap	42
9. Conclusion and ways forward	42
10. References	48
11. Annexes:	48
Annex 1 - Weather and climate data, information products and services to selected economic sectors (Source: WMO, 2016)	48
Annex 2 – Needs Assessment Survey Questionnaire	55
Annex 3 – CIS Checklists	56

Foreword

Climate change is an intergenerational crisis, driving shifts in weather patterns, rising sea levels, and increasing the frequency and severity of extreme weather events. These changes have profound implications for ecosystems, economies, and human well-being, particularly in vulnerable regions.

The Philippines exemplifies the severe impacts of climate change, having endured over 500 extreme weather-related events since 1990. The losses and damages, particularly in health and agriculture, threaten to erode hard won milestones in wealth creation, social protection and financial inclusion.

Addressing these escalating risks requires Climate Information and Services (CIS) that are derived from accurate, accessible, and understandable climate data for precise planning and resource-effective decision-making. CIS provides the scientific foundation for understanding climate trends, assessing risks, and informing decisions across key sectors such as agriculture, water management, disaster risk reduction, and public health. By offering accurate, accessible, and tailored climate data, CIS empowers governments, communities, and businesses to anticipate climate impacts, strengthen



Photo courtesy of Climate Change Commission

“The guidebook is intended to assist scientists, researchers, practitioners and decision-makers in effectively utilizing climate data, information and services.”

resilience, support long-term planning, and mobilize climate finance—especially as climate variability continues to intensify.

This guidance document on Quality Assurance for CIS, based on World Meteorological Organization (WMO) standards, was prepared through close collaboration with climate experts and enriched by diverse stakeholder inputs from multiple disciplines. It aims to establish standardized CIS protocols that enhance reliability and usability across sectors.

The guidebook is intended to assist scientists, researchers, practitioners and decision-makers in effectively utilizing climate data, information and services. The Climate Change Commission encourages the use of this guidance document for knowledge sharing, capacity building, and user engagement. The Philippines’ experience in developing climate information services offers valuable resources worth sharing to elevate resilience across the Global South. Ultimately, addressing the climate crisis demands precise information that is user-friendly, uncomplicated and fit for purpose.

ROBERT E.A. BORJE

Vice Chairperson and Executive Director
Climate Change Commission



Executive Summary

The “South-South Collaboration on Climate Information Services (SSCIS)” project is a partnership led by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the Philippines Climate Change Commission (CCC), with funding from Germany’s International Climate Initiative (BMWK). The primary aim of the project is to enhance Climate Information Services (CIS) in the Philippines and support informed decision-making for climate change adaptation and mitigation at national and local levels.

CIS are vital for informing government policy and enabling precise planning and responses to climate-related risks. The Manila Declaration, resulting from an August 2023 conference on the SSCIS Project, emphasizes the role of CIS in sustainable development. Increasing the quality, accessibility, and management of climate data is critical for effective adaptation and disaster readiness, addressing vulnerable communities, and safeguarding ecological health.

Development of Guidance Documents

To streamline the implementation of effective CIS, guidance documents are developed focusing on: (1) quality assessment of climate data used to develop CIS, (2) evaluation of climate information products derived from data, (3) ensuring the availability and accessibility of CIS for decision-makers. These comprehensive guides aim to establish standards and protocols to enhance reliability and usability across various sectors.

Current Landscape and Sectoral Analysis

The project highlights the urgent need for high-quality climate data as risks associated with climate change are amplified by interconnected global economic activities. The Philippines’ National Meteorological and Hydrological Service (PAGASA) is pivotal in delivering climate data, yet current practices in data processing and dissemination need enhancement. The agricultural sector has been identified as a significant user of CIS, benefiting from climate



data to improve farmer decision-making. However, despite some advancement, the health sector faces notable gaps in utilizing climate data for public health initiatives, leading to an emphasis on the need for better data accessibility.

Role of Quality Assurance in CIS

Quality assurance is paramount for the effectiveness of CIS. Several principles and methodologies are indicated for quality assessment, including (1) validating data sources for credibility, (2) regular accuracy checks and reliability metrics, (3) establishing a culture of co-production where stakeholders engage directly with data to refine quality and applicability.

Community of Practice (CoP) and Stakeholder Engagement

The establishment of a Community of Practice (CoP) is proposed to facilitate knowledge sharing, capacity building, and user engagement. By creating a feedback loop from users to data providers, the CoP can ensure the development of climate information that resonates with user needs, improving its relevance and reach.

Quality Assurance Guidance

The guidance in Chapter 6 can be a useful normative framework for climate information producers intended to inform decision-making on coping or adapting to a changing climate. The guidebook is expected to be used by scientists, researchers, practitioners and decision-makers interested in using climate data, information and its services. The quality of Climate Information Services (CIS) is crucial for informed decision-making, risk reduction, and community resilience. This guidance provides a comprehensive framework for assessing the quality of CIS, focusing on three key areas: CIS Data Quality, CIS Knowledge Products, and CIS Utilization.

Key Principles

1. Data Quality: Ensure data source credibility, accuracy, precision, timeliness, completeness, consistency, and reliability.
2. Knowledge Products: Assess relevance, accuracy, timeliness, accessibility, usability, and impact of climate information and services.
3. Utilization: Evaluate relevance, accuracy, timeliness, accessibility, and usability of CIS, as well as user engagement, feedback, and satisfaction.

Assessment Methods

1. Data quality frameworks (e.g., ISO 8000)
2. Technical validation (e.g., statistical analysis, benchmarking)
3. Peer review and expert consultation
4. Field verification (e.g., ground truthing, pilot studies)
5. Performance indicators (e.g., accuracy scores, user satisfaction scores)
6. Comparative analysis (e.g., benchmarking, case studies)
7. User surveys and interviews
8. Performance metrics (e.g., timeliness, error rates)

Best Practices

1. Engage with stakeholders to understand their needs and provide customized services.
2. Ensure transparency and accessibility of data and information.
3. Implement quality control measures and validation processes.
4. Provide regular updates and feedback mechanisms.
5. Evaluate and improve services based on user feedback and performance metrics.

By following this guidance, CIS providers can ensure the quality and effectiveness of their services, supporting

informed decision-making and contributing to a more resilient and prepared society.

Checklists

Three checklists were prepared, which are simplified versions of the Guidance. These checklists will allow CIS providers to assess the quality of the data, knowledge products and utilisation of CIS. A decision flowchart to guide who are may use the checklists is shown in the diagram below.

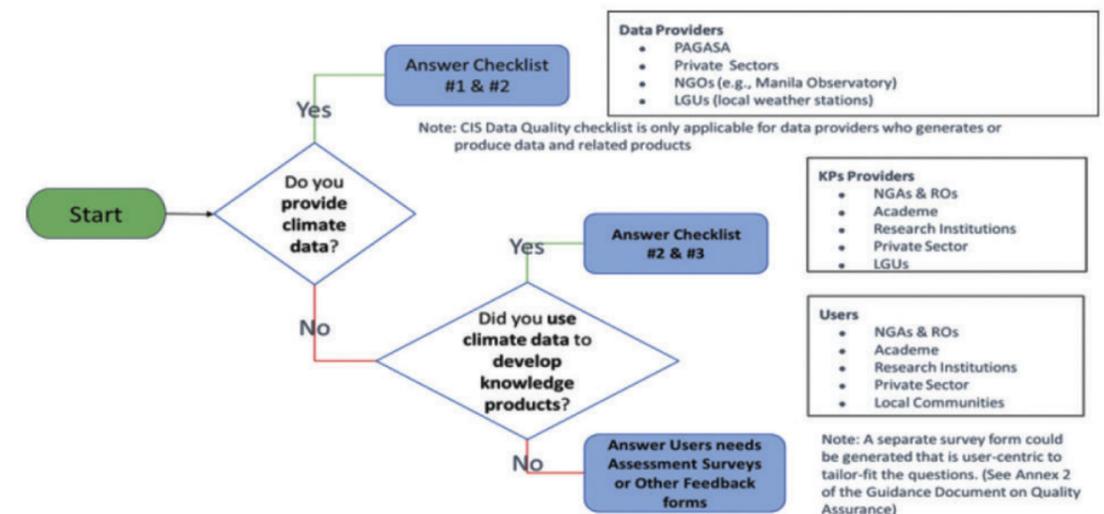
Recommendations for a Way Forward

Key recommendations include:

1. Strengthening institutional frameworks for CIS governance through community engagement and inclusive decision-making.
2. Enhancing digital and ICT infrastructure, especially in rural areas, to ensure equitable access to climate data and insights.
3. Promoting interdisciplinary collaboration among climate experts, data providers, and local stakeholders for the co-design of CIS.
4. Establishing consistent review mechanisms to assess the effectiveness of CIS and ensuring that they meet evolving user needs.

Conclusion

As the demand for accessible, accurate, and relevant Climate Information Services continues to grow, especially amid increasing climate risks, the SSCIS Project aims to refine these services for effective decision-making. By improving processes, fostering collaboration, and integrating various knowledge systems, the Philippines stands to enhance its climate resilience and support sustainable development for future generations.



1. Introduction

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) in cooperation with the Philippines Climate Change Commission (CCC) implemented the project “South-South Collaboration on Climate Information Services (SSCIS): Building a Knowledge Exchange and Learning Platform for the Philippines and the Climate Vulnerable Forum,” funded under the International Climate Initiative (IKI) of the German Federal Ministry for the Environment and Consumer Protection (BMUV). It is a joint undertaking by GIZ, the CCC (implementing agency) and other actors at the national and local level with the objective of using Climate Information Services (CIS) developed jointly to contribute to an expanded knowledge base for understanding climate change and its impacts, and to making informed decisions in planning and implementing adaptation and mitigation measures.

Among the indicators of Component 1 of the Project (Climate data and information for risk assessments), and as basis for the planning and implementation of adaptation and mitigation measures are quality-assessed, available, accessible, well-organized and managed CIS.

The Signed Manila Declaration from the August 2023 Conference in this current SSCIS Project conducted by the Project Team (GIZ, 2023) recognized that CIS play a crucial role in government policy in achieving sustainable development in harmony with nature. It supported the vision of the Philippines Medium Term Development Plan 2023-2028 for institutions within the country to be collaborative, responsive, reliable, and efficient in utilizing natural resources without compromising ecological health and development. To realize this vision, there is a need to strengthen, enhance, and maximize CIS as they provide valuable data, analysis, and forecasts on weather patterns, climatic trends, and their impacts on various sectors such as agriculture, water resources, disaster management, and public health. The data and information include identifying vulnerable areas, developing early warning systems, promoting climate-resilient agriculture practices, and facilitating informed decision-making at all levels of government and society.

The Declaration also indicated forward steps to include research to develop CIS and standardization of all data related to CIS development. However, aside from joint agreement on data generation and sharing protocol, quality assurance of the CIS was not explicitly mentioned. It is critical that by improving and assuring the quality, accessibility, and timeliness of climate information service, the Philippines can effectively plan



and implement strategies to adapt to and mitigate the causes of climate change. Furthermore, by integrating CIS into government policies, programs, and projects, the Philippines can enhance its preparedness and response mechanisms to climate-related challenges. This will enable the country to better address the impacts of climate change, safeguard the well-being of its population, and ensure sustainable development for generations to come.

2. Purpose and Scope of the Guidance documents

2.1 Why develop the guidance documents?

The Earth’s climate and its fluctuations have specific and uneven risks on our lives and well-being, and on various sectors and assets of the economy. These risks depend on the climate hazards, exposure, vulnerabilities, and sensitivities of each sector and asset. Effectively addressing the risks and opportunities stemming from climate changes in the coming months, years, and decades are critical societal challenges. Additionally, the risks associated with climate change have implications that extend throughout sector value chains and across the lifecycles of assets.

This means that climate change risks can affect multiple stages, from the initial planning and design of a project to the pricing and trading of commodities. With today’s global economic activity being interconnected and geographically dispersed, climate risks can quickly spread through global value chains. This transmission can transform physical risks in one location into other risks, such as financial, legal, and operational risks, in other locations. The interconnected and dispersed nature of the global economy enables climate risks to rapidly propagate through value chains, affecting various sectors and assets. This highlights the need for comprehensive and collaborative action to address and reduce the risks posed by climate change.

CIS play a central role in managing the challenges brought about by climate change, inspiring further efforts in reducing risks and realizing benefits, especially as the world seeks a green recovery post-COVID-19 and moves towards achieving net-zero emissions. Quality assurance is seen as an important element in the evolving CIS community, which, until now had received only little attention. This element will require guidance for priority setting in quality assurance (for CIS providers) and quality demands (for CIS users).

These guidance documents will serve as a multi-sectoral guide for quality control and management and provide



standards and protocols for CIS. It will also define the clearing house for climate data and serve as a manual of instructions for the review of data and information to be uploaded to the web-based resource center (CIS portal).

As part of Component 1 of the Project, the work initially entails the development of three guidance/framework documents on quality assurance of CIS with the objectives of assessing quality of:

- i. data provided or used to develop a climate service [CIS Data Quality];
- ii. climate information and services derived from data [CIS Knowledge Products]; and
- iii. CIS availability and accessibility [CIS Utilization].

On a hindsight, it was agreed then that all the guidance documents will be contained in one manuscript, since there are commonalities among the three documents, which needlessly be repeated if written as stand-alone guidance.

2.2 Why are Climate Information Services significant?

CIS is growing in importance in light of the increasingly devastating impacts of climate variability and climate change. Climate services are developed, delivered and used in many ways, based on differing needs and capabilities. There is a huge wealth of data and information on key climate variables and indicators (including temperature, precipitation, wind, soil moisture, ocean conditions, etc.) available from national and international sources, as well as maps, risk and vulnerability analyses, assessments, and long-term projections and scenarios.

All sectors are concerned about climate, its variability and change, but many are unclear about the nature of likely impacts and cannot access the information they need to develop adaptation measures. Climate information and services that can inform decisions at timescales of less than 20–30 years is currently extremely limited and is an area where research is required to exploit any potential predictability. Climate change mitigation measures, such as renewable energy development and afforestation/reforestation, are also driving demand for climate information.

The Intergovernmental Panel on Climate Change (IPCC) Assessment Reports are an authoritative source of climate change information but are not sufficient alone, nor are they updated frequently enough to meet the specific requirements of sectors for their detailed and routine information needs, highlighting the important role that climate services can play. Partnerships spanning sector expertise and climate science are central to developing effective sector-specific applications of climate information. The decision maker is not the expert, and the expert is not the decision maker, but together they can create effective systems and make well-informed decisions.

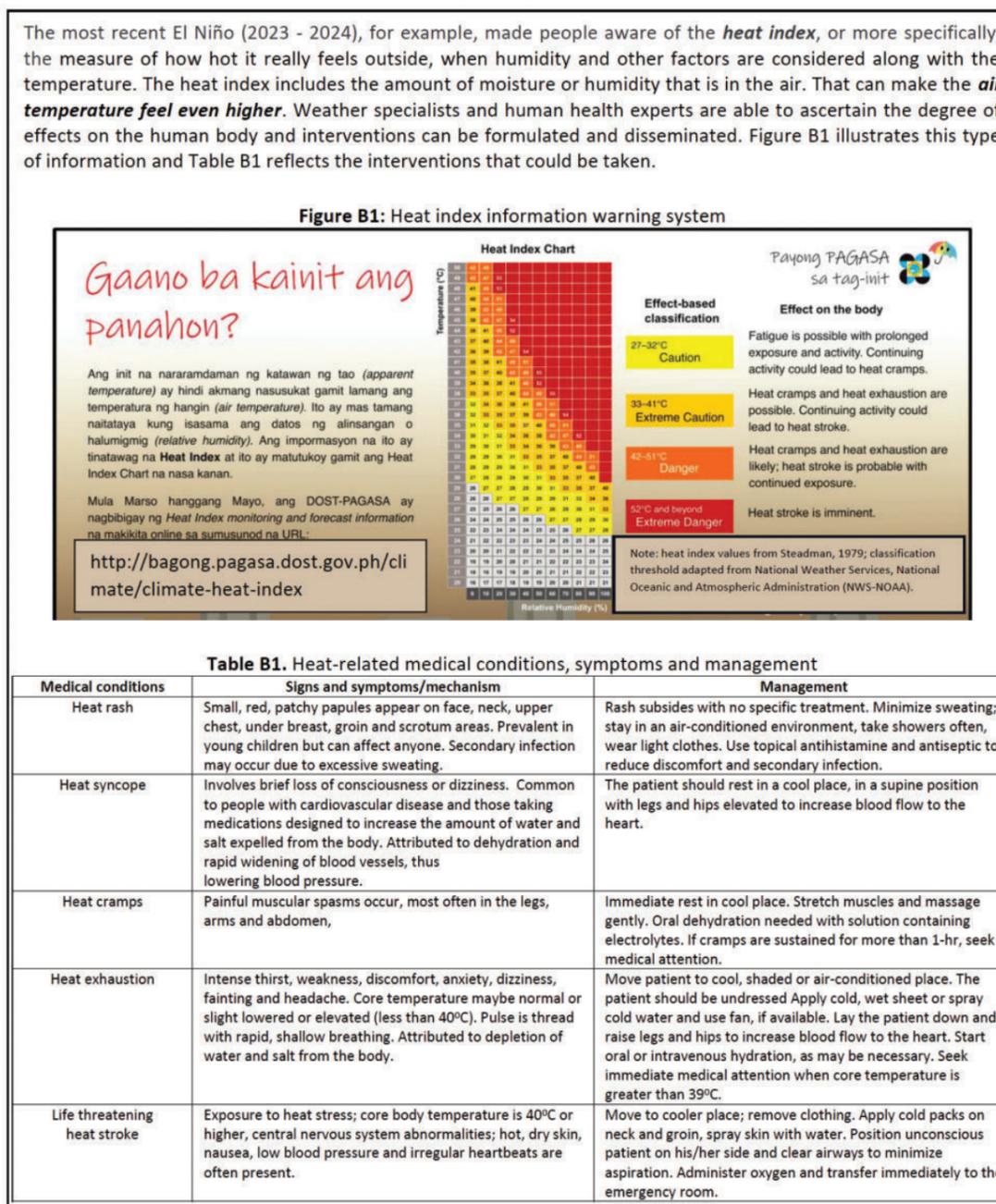
Socioeconomic variables and non-meteorological data (e.g., agricultural production, health trends, water and air quality, human settlement in high-risk areas, road and infrastructure maps) may be integrated, depending on the needs of the decision-makers and the availability of such data. Often the data and information are transformed into customized products for different user communities and use cases. Climate services equip

decision makers in climate-sensitive sectors with better information to help society understand and respond to or manage climate variability and change. Other specific data and information needs of major socio-economic groups are listed in the Annex 1 to this Report.

The guidebook is intended to be used by scientists, researchers, practitioners and decision-makers interested in using such information. For example, a decision-maker may use the guidebook to realize that diversity in types of evidence is needed for the information to satisfy completeness. When exploring a climate service portal, the decision-maker can assess the extent to which

this dimension is satisfied by reading a nontechnical summary that explains the methods used by the climate service provider. The nontechnical summary, however, also needs to satisfy the transparency dimension. It needs to reveal the assumptions and limitations of the information, and to do so to a satisfactory degree it needs to be mediated by a diverse range of experts. The framework can also therefore be a useful normative framework for scientists who produce climate information that is intended to inform decision-making on coping or adapting to a changing climate (see Box 1).

Box 1. Illustrative example of how climate information is intended to inform decision-making on extreme heat episodes.





3. Concepts and Terminologies

3.1 Glossary

Climate Information Services also called **Climate Services (CS)**, was defined by the World Meteorological Organization (WMO) in 2011 as “climate information prepared and delivered to meet users’ needs” (WMO, 2011). This has evolved ever since and now has expanded to “the provision and use of climate data, information and knowledge to assist decision-making by individuals and organizations” (WMO, 2018). Climate services require appropriate engagement between the recipient/user of the service and its provider, along with an effective access mechanism to enable timely action. CIS supports their users to anticipate and

manage the risks of a changing and variable climate. It involves a knowledge cycle of access to, interpretation, communication and use of relevant, accurate and reliable climate information by targeted user communities and their feedback on how the information is used (WMO website).

Climate data: Historical and real-time climate observations along with direct model outputs covering historical and future periods. Information about how these observations and model outputs were generated (metadata) should accompany all climate data.

Climate data providers are organizations or entities that play a crucial role in the dissemination and management

of climate-related information. They collect, generate, analyze, and distribute climate data, making it available for a variety of applications, from scientific research to practical decision-making in sectors such as agriculture, health, and urban planning. Climate data providers are integral to the ecosystem of climate information services, bridging the gap between raw data and practical application. Their contributions can empower stakeholders at all levels to make informed decisions

that enhance resilience to climate impacts and foster sustainable development. Climate data providers can offer their data free of charge (e.g., as open data) or at a price. In the latter case, these data providers are also known as ‘data vendors’, ‘data sellers’ and ‘data-as-a-service (DaaS) companies’ (Data Commerce Cloud website). Table 1 describes the general typology of climate data providers.

Types of Climate Data Providers	Role	Examples
Government Agencies	These agencies are often responsible for collecting and disseminating weather and climate data, issuing forecasts and warnings, and conducting climate research. They serve both the public and private sectors and often have legal mandates to provide accurate and timely information.	National Meteorological and Hydrological Services (NMHS in general; PAGASA in the Philippines case), Environmental Protection Agencies, and other governmental bodies.
Research Institutions and Universities	These organizations conduct fundamental research on climate processes, contribute to climate modelling, and often share their findings through open-access publications, databases, and public outreach.	Academic departments focused on environmental science, climate research institutes, and universities with dedicated climate monitoring program
International Organization	These organizations collect and synthesize global climate data, promote international cooperation on climate issues, and produce guidelines and assessments that inform policymakers and stakeholders worldwide.	The World Meteorological Organization (WMO), the United Nations Environment Programme (UNEP), and the Intergovernmental Panel on Climate Change (IPCC).
Non-Governmental Organizations (NGOs)	NGOs may collect climate data relevant to specific causes or communities and often work to raise awareness, advocate for policy change, and provide support for adaptation and mitigation efforts.	Organizations focused on environmental advocacy, climate action, and community resilience, such as the World Wildlife Fund (WWF) or Oxfam.
Private Sector Entities	The private sector increasingly plays a role in developing climate data services, creating tools for climate risk assessment, and providing consulting service	Companies specializing in climate data analytics, technology firms that provide climate-related services, or businesses in the agriculture, insurance, or energy sectors that generate their own data.
Community-Based Organizations	They may gather local climate data, conduct assessments important for community adaptation efforts, and disseminate information to vulnerable populations.	Local non-profits, grassroots organizations, or cooperatives that focus on specific geographic areas or populations
Data Aggregators and Platforms	These platforms aggregate climate data from various sources, making it accessible to users worldwide through digital interfaces or APIs.	Platforms like NOAA Climate Data Online, NASA’s Earth Data, or the European Space Agency’s Climate Change Initiative
Satellite and Remote Sensing Agencies:	These agencies collect vast amounts of climate data through satellite observations, providing critical information on atmospheric conditions, land use, and changes in ecosystems.	NASA, European Space Agency (ESA), and other space agencies that monitor the Earth’s climate from space

Table 1. General Typology of Climate Data Providers

Climate Information (CI) refers to the collection and interpretation of observations of the actual weather and climate, as well as simulations of climate in both past and future periods. These include climate data, climate products and/ or climate knowledge (WMO, 2011). Climate data and information for risk assessments and as basis for the planning and implementation are quality-assessed. For them to be credible, the CI must be available, accessible and usable, organized and well managed (CARE website).

Climate product: A derived synthesis of climate data that combines climate data with climate knowledge to add value.

Climate Service Information System (CSIS) is the principal mechanism through which information about climate – past, present and future – is routinely produced, archived, analyzed, modelled, exchanged and processed (WMO website [2]). The CSIS is the “operational core” to support the production and delivery of authoritative climate information products through appropriate operational mechanisms, technical standards, communication and authentication.

Early warning system (EWS): the set of capacities needed to generate and disseminate timely, meaningful and actionable information to enable individuals, communities and organizations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss.

Information system means a discrete set of information resources organized for the collection, processing,

maintenance, use, sharing, dissemination, or disposition of information.

Metadata - Often referred to as data that describes other data, metadata is structured reference data that helps to sort and identify attributes of the information it describes. (TechTarget website).

National Framework for Climate Services (NFCS) is a national mechanism to bridge the gap between the climate information being developed by scientists and service providers on the one hand, and the practical application of that information on the other. **Quality** is the extent to which a product or service meets the specifications of the customers, and by extension the specifications within the production process needed to attain the quality levels of final products as required by customers (Larosa, F. and Perrels, A., 2017). Quality control and quality assurance are often mistaken as the same and one. Box 2 explains the difference.

Quality Assurance includes the processes and protocols by means of which an organization assesses the apparent quality of its products and its constituent elements and communicates the aspired and observed quality levels within the organization as well to providers and customers (Larosa, F. and Perrels, A., 2017).

Quality Control (QC) is a procedure or set of procedures intended to ensure that a product or performed service adheres to a defined set of quality criteria or meets the requirements of the client or customer (TechTarget website [2]).

Box 2. The difference between quality assurance and quality control

Quality Assurance (QA) is a passive function that leads to the active function of **Quality Control (QC)**. QA is defined as "part of quality management focused on providing confidence that quality requirements will be fulfilled," and the QC is defined as "part of quality management focused on fulfilling quality requirements" (ISO, 2015).

QA is done by reviewing incoming data to ensure that it meets, and is consistent with, the needs of the users, i.e., no suspicious data are part of the data flow. Standards dictate the level of quality assurance review needed to ensure that data are consistent with goals and objectives of the organization. QA inspection is a continuous process. For example, the QA reviews include the checking of monthly forms, charts and tapes for errors and inconsistencies and ensure the forms correspond to standards established by the National Weather Service (and WMO). A QA inspection not only precedes QC but also identifies what areas require attention to improve data quality. This leads to QC.

QC applies to observations over which national hydro-meteorological agencies (such as PAGASA) personnel have some level of control. Its functions include the improvement of form quality and observational procedures. Both of these areas are a function of the training provided to the data provider. For example, the most effective QC technique to improve data quality is to provide training to observers on all aspects of taking, recording, and reporting of their observations.

4. Principles and Frameworks of Quality Assurance

4.1 Climate information

Knutti (2019) had expressed that “Scientific understanding of climate change has accelerated in recent decades, but climate action has not kept pace.” As the impacts of climate change become increasingly evident and public concern gains momentum, it is a pivotal time to consider the role of science in closing the

gap between knowledge and action. The kind of long-term regional climate information that is increasingly important for decision-makers in various sectors ranges in temporal (from hours to multiple decades)—and spatial (from meters to hundreds of kilometers) scales (see Figure 1).

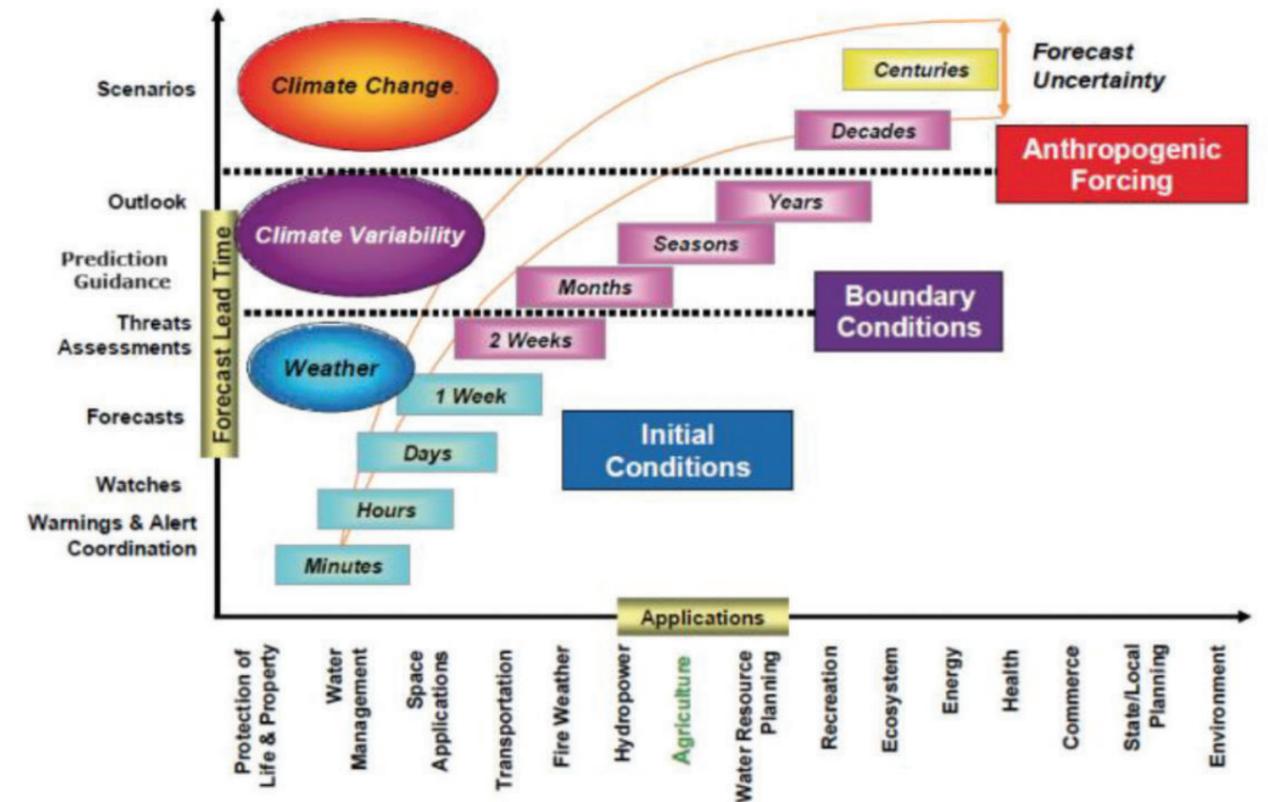


Figure 1. Climate Prediction Framework (Source: WMO, 2016)

Global climate models (GCMs) and Earth system models (ESMs) are the dominant source of regional climate information, but increasingly downscaling, both statistical and dynamical, has been used to achieve higher-resolution information (e.g., Pielke and Wilby 2012; Giorgi 2020). However, it is difficult to evaluate long-term information at the regional scale because of the presence of deep uncertainty and because the usual empirical

tests are not applicable due to the non-stationarity of the climate system (e.g., Stainforth, et al. 2007). Typology of evidence that can be used to present knowledge about our climate system may be given through observations, paleoclimate data, models, theory or expert judgement, while knowledge claims about the future can be supported through story lines, model outputs and probability distribution functions.

Definition: Paleoclimate data are proxies extending weather and climate information archive by hundreds to millions of years. These are derived from natural sources such as tree rings, ice cores, corals, stalagmites, and ocean and lake sediments. The data include geophysical or biological measurement time series and some reconstructed climate variables such as temperature and precipitation. Scientists use paleoclimate data and information to understand natural climate variability and future climate change.

4.2 Quality of climate information

Climate services consist of the collection of climate data; generation and provision of a wide range of information on past, present and future climate; development of products that help improve the understanding of climate and its impacts on natural and human systems; and the application of these data, information and products for decision-making in all walks of life and at all levels in the society. Depending on the user's needs, these data and information products may be combined with non-meteorological data, such as agricultural production, health trends, population distributions in high-risk areas, road and infrastructure maps for the delivery of goods, and other socio-economic variables. International cooperation in seamless research on hydro-meteorological and climate services has led to advances in predictive accuracy and increased lead time facilitating applications in a wide range of user sectors.

The routine provision of climate services is very dependent on intermediaries who make links between expertise and effective application, such as applied scientists, agricultural extension officers, teachers, industry consultants, engineers, policy analysts, trainers and media personnel. The key dimensions to assess climate information quality are diversity, completeness, theory, adequacy for purpose, and transparency (Pachetti, et al., 2021).

One specific aspect of climate services which has not yet received much attention is quality assurance and standards (Hewitt and Stones, 2021) for the services. Standards and quality assurance processes already exist for meteorological data and systems through the WMO (e.g., WMO, 2021; WMO, 2018; Hubbard, et al., 2012; Abbott, 1986) but not for the climate services value chain. Quality assurance and standards are needed at the provider-user interface to ensure that the services meet agreed levels and convey suitable and respectable importance, credibility and authoritativeness, but ideally also for the use of the services to avoid inappropriate or unintended misuse, as well as to build two-way trust between the providers and recipients. Standards are also important at the two links in the value chain upstream from the provider-user interface (i.e. downscaling/ tailoring/impacts and specialized services/translation), following Porter's value chain in the schematics in Figure 2 below.

For example, even if the underpinning climate data meets WMO standards, if this high-quality data is fed into downstream systems that are flawed then this could potentially lead to poor quality information or advice for the decision-maker. The issue of quality is complicated because some use cases might not need as high-quality climate information or services as others. The users of the services therefore have an important role in assessing quality (Vedeld, et al., 2020).

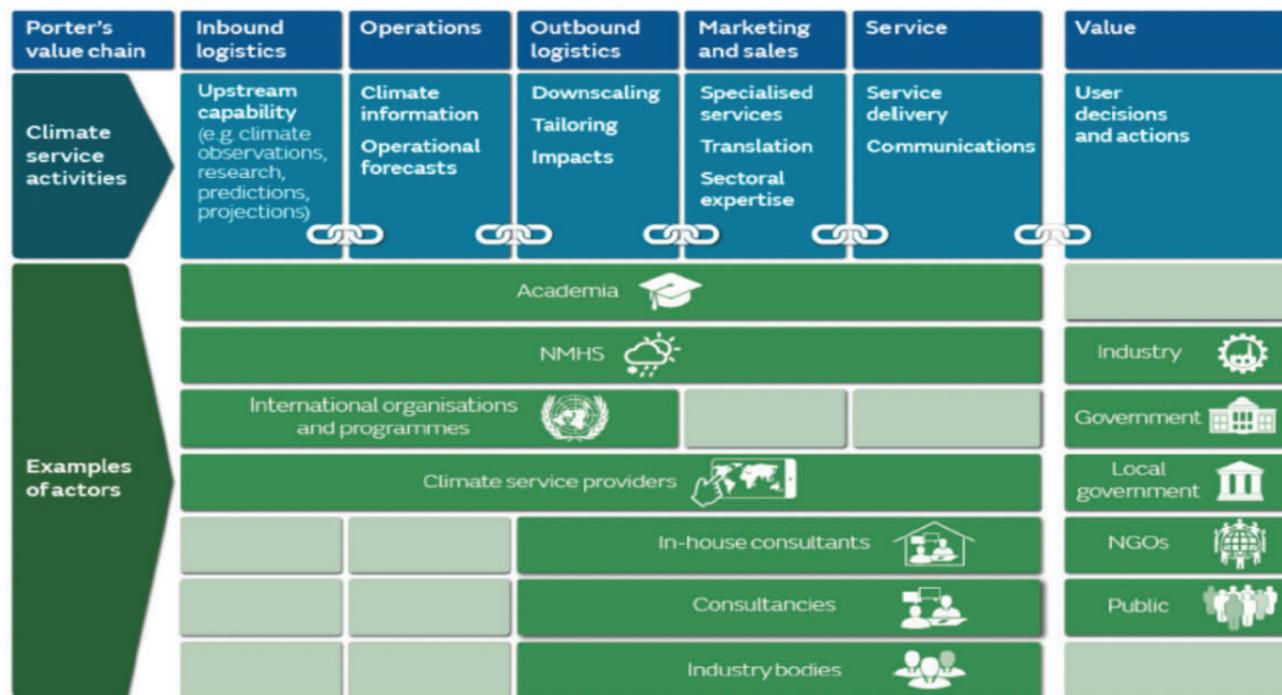


Figure 2. Schematic of the climate services value chain structured around Porter's value chain (Porter, 1985; as cited in Hewitt and Stones, 2021). The schematic shows some of the key activities, and examples of the types of actors typically, but not exclusively, involved in different parts of the value chain.

WMO recommends the use of a process approach as adopted from within the ISO 9000 family of Quality Management Systems (QMS) standards- "...a management strategy that can assist providers of climate products and services to do so in a manner that ensures quality and consistency. It is a powerful way of organizing and managing how work activities can be developed to create value, as it organizes and manages work horizontally so

that work activities create customer value" (WMO, 2018; ISO, 2015). The strategy requires allocation of resources such as people and materials. Inputs to a process are generally outputs of other processes (see Figure 3). A more traditional structure organizes and manages work activities vertically by function, with quality problems frequently occurring at the boundaries of functional departments.

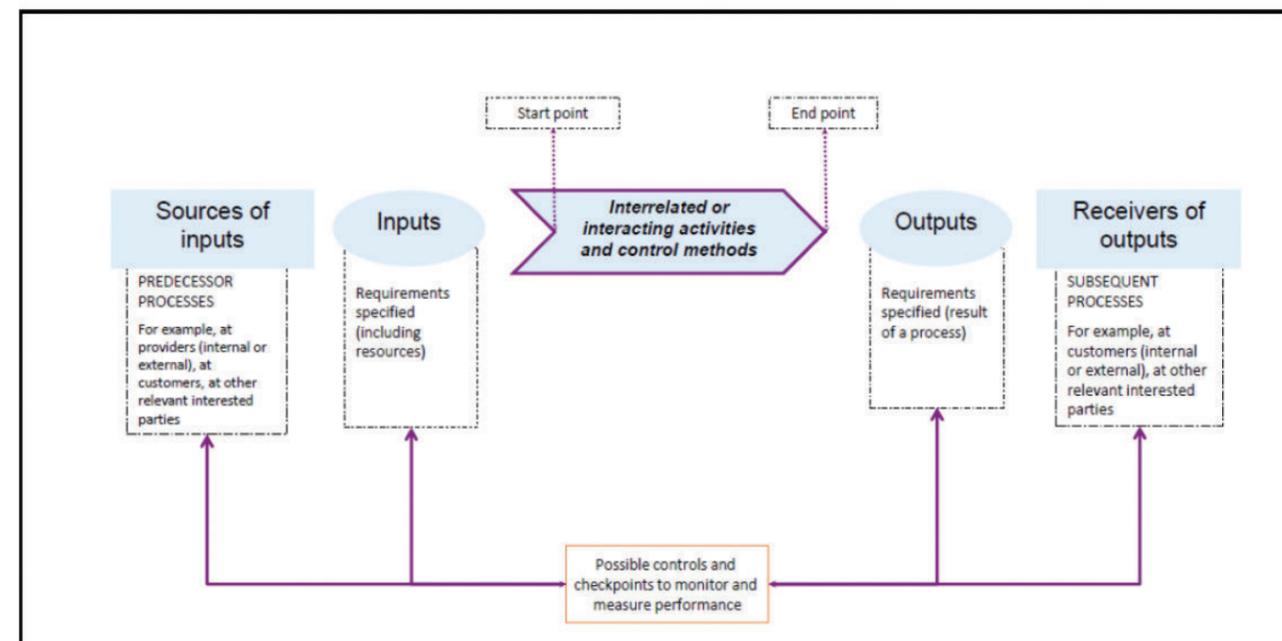


Figure 3. Schematic representation of a process (Source: WMO, 2018)

4.3 Existing CS Frameworks

The demand for climate information is high across all climate-sensitive sectors and it is being routinely used for diverse uses in planning and management, through a mix of established methods and new technological capabilities.

Sector needs and modes of operation vary widely. For example, in some sectors, such as energy and transportation, decision processes are very concentrated, while in others, like agriculture, they involve millions of small users. Many existing climate services are not well focused on user needs and the level of interaction between providers and users of climate services is inadequate.

4.4 The need for a "new" framework - Theory of change

A more mature governance system for the development and use of climate services is urgently needed. Despite the increasing scientific evidence and demand for climate services, widely acknowledged standards, guidelines and

good practices are lagging, resulting in climate services of uneven quality and usability.

But the task is more complex than maturing a set of technical standards or improving research. The utility of climate services is determined by the level of user engagement, co-design, and co-production employed during their development; in fact, state-of-the-art research shows that co-production of these services together with user is necessary to provide efficient and effective services that bring together supply and demand. That is, the governance of climate services requires a broad consensus across a wide variety of stakeholders, representing a mix of technical, socio-economic, and domain knowledge within all relevant sectors. Thus, from the value chain theory of change sees the evolution of the once rather linear data flow a highly interactive process in which users are much more involved in contributing data and sharing in the development and implementation of the solutions (see Figure 4 below).

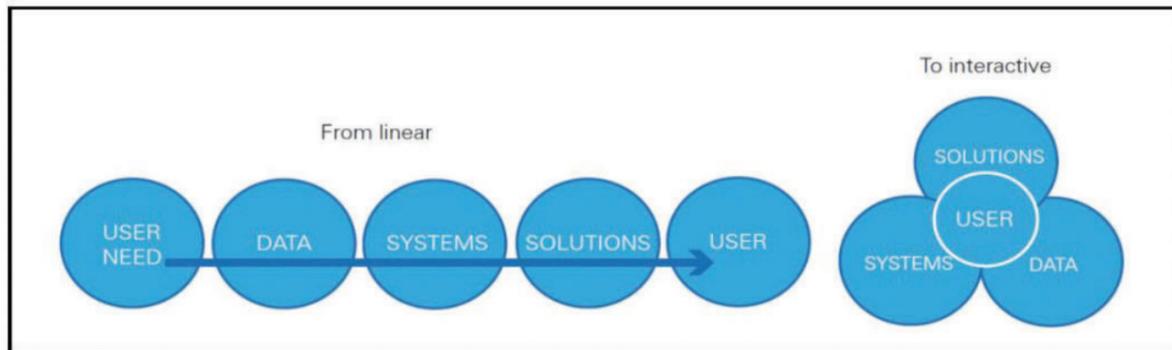


Figure 4. Theory of Change: Co-production of Climate Services (Source: Barrell, 2019)

4.5 Selection of methodologies for quality assurance

The selection of methodologies for quality assurance will depend on the specific context and goals of the climate services being offered. Some principles or frameworks that can be used for quality assurance of climate services are enumerated below. The selection and application of these methodologies may vary depending on the specific context, scope, and goals of the climate services being provided (Bremer, et al., 2021; Englund, et al., 2022).

i. Facilitate interdisciplinary collaboration among climate scientists, statisticians, meteorologists, and other relevant experts. Involve expert reviewers from the relevant field to assess the accuracy, validity, and reliability of the climate services. Peer review helps identify any potential biases, errors, or inconsistencies in the information provided. This fosters cross-disciplinary discussions, peer reviews, and ensures a comprehensive and rigorous approach to quality assurance.

ii. Perform rigorous testing and validation of the climate services before their release to the public. This can involve conducting sensitivity analyses, comparing outputs against known data, and using statistical methods to assess the reliability of predictions.

- Data validation and rigorous checks on data inputs to ensure accuracy, completeness, and consistency. This can involve verifying data sources, conducting quality checks, and addressing any data gaps or errors.
- Verification and validation of models used in the development of climate services through rigorous testing against observed data and known climate patterns. This helps ensure that the models accurately represent real-world climate behavior.
- Definition and tracking of performance metrics to evaluate the reliability, accuracy, and skill of climate predictions and projections. This can include metrics like mean absolute error, root mean square error, and correlation coefficients.

- Usage of ensemble methodologies that integrate multiple models or techniques to generate more robust and reliable climate predictions. This can help in addressing uncertainties and providing a range of possible outcomes.
- Conduct of scenario-based testing to evaluate the sensitivity of climate services to different assumptions and scenarios. This includes assessing the impact of changes in variables like greenhouse gas emissions, land use, or socio-economic factors on the provided services.

iii. Establishment and implement systems to continuously monitor and evaluate the performance of climate services over time such as tracking the accuracy of predictions and the reliability of data sources. This allows for the identification of potential issues or emerging trends, ensuring the services remain up-to-date and reliable. This could involve regular audits, data validation, and comparison with ground truth measurements.

iv. Ensure that climate services are well-documented, including detailed descriptions of methodologies, data sources, and assumptions. This helps maintain transparency and allows others to replicate findings or verify the accuracy of provided information.

v. Establish clear and consistent standards and guidelines for the development and maintenance of climate services. This can include protocols for data collection, analysis, and reporting, ensuring a consistent and reliable approach across different service providers.

vi. Continuous Improvement: Implement a feedback loop to continuously improve the quality of climate services. Regularly evaluate user needs, engage with stakeholders, and use feedback to update and enhance the services over time. Seek input from users, stakeholders, and clients on their satisfaction with the climate services. Feedback from those directly affected by the services can



Whenever it is recommended that a practice should be followed, it is said to be a best practice. When this practice becomes a part of life, it becomes a good practice. The generally accepted definition of best practice is "a method or technique that has consistently shown results superior to those achieved with other means, and that is used as a benchmark". Key into best practice definition is the use of benchmark. (Project Management website)

help identify areas for improvement or address specific needs that may not have been considered.

vii. Best practices sharing by engaging with other climate service providers, users and organizations to lessons learned, and methodologies for quality assurance. This collaboration can help enhance the overall quality and effectiveness of climate services.

- Engage in the co-production of the services, through which both providers and recipients of the system contribute to the knowledge product, to create credible, salient, and legitimate knowledge (Cash et al., 2003) should be seen as a good practice approach wherever possible.
- Emphasizing the significance of dialogue and collaboration in the climate service value chain, a climate service holds value only if it influences outcomes. The concept of co-production is a valuable approach for fostering dialogue and collaboration; ensuring services are based on credible, salient, and legitimate knowledge. More on the co-production is presented in the next section.
- Provide a driving force and mechanism for the pull-through and implementation of new data, knowledge and practices, aligned with national adaptation and resilience priorities.

- Enable knowledge exchange by building a community to link up different actors, promoting common language and understanding.
- Establish and promote good practice, quality standards, and ethical practices within the climate services community through partnership and collaboration.

4.6 Co-production of climate services with intermediate users

Co-production is intended to transform climate data into information and then into client-tailored climate services, including relevant forecast-based advisory services and decision-making tools that the client can make use of (Englund, et al., 202; Daniels, 2020; WMO, 2018). This necessitates a process of partnership-building, iterative dialogue and feedback among providers and intermediate users of climate services. Effective interdisciplinary and cross-sector collaboration is also an important prerequisite for the transformation of climate data and information into climate services, blending climate knowledge with sector-specific knowledge. At its



core, this approach postulates that climate information is not a climate service. To create a climate service – which, by definition, must respond to a climate need – user engagement, iterative dialogue to understand and address client needs, and testing and refinement of the product based on client feedback, are compulsory.

Ownership and sustainability of a climate service will be dependent on ensuring the inclusion of all relevant actors (Figure 5). Particularly important is enabling opportunities for those directly impacted by a climate-related risk to inform the prioritization, shaping and development of the climate service. Without effective engagement, climate services may not be relevant to, or may even heighten inequalities for, marginalized groups. To ensure the climate service can be continued in the long term, initiatives need to be informed by the decision-making context. The frameworks, partnerships and networks required to support the co-production process may need to be strengthened or extended in some way, and political buy-in secured across relevant decision-making levels of the government.

Two examples of how climate information can be tailored into intermediate user-driven products:

(a) When an agricultural expert within the Department of Agriculture (DA), or researcher at the DA's research institute, receives a rainfall forecast bulletin for the next 3 months (climate information), they will be able to overlay this piece of information with their knowledge base on the state of the growing season for farmers in a given region of the country, including stages of plant phenology and multiple other agricultural parameters (sector-specific knowledge),

to produce a tailored rural advisory based on the received climate information – an “agromet advisory” (climate service).

(b) Similarly, when a public health planner at the Department of Health receives information on expected amounts of rainfall forecast and associated temperatures for the season (climate information), they will overlay this information with national health datasets on disease epidemiology per locality for that particular season (sector-specific knowledge). This will help to determine whether the season is likely to be prone to an epidemic breakout of a vector-borne disease (e.g., dengue, malaria, meningitis, or typhoid fever) and produce a climate and “health advisory” (the climate service) for distribution through public communication channels.

The effective delivery of user-tailored climate services can only be realized through strong partnerships among the National Hydro-meteorological Service locally known as the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) and intermediate user groups, including sector experts, national government agencies, local government units, private sector, community of practice and academia. This will help in the interpreting, tailoring, processing and applying of climate information and advisory services for decision-making, for sustainable development, and also for the improvement of climate information products, predictions and outlooks. The processing of received climate, weather and water forecast information to jointly produce, among providers and users, a relevant climate service is defined as **co-production**.

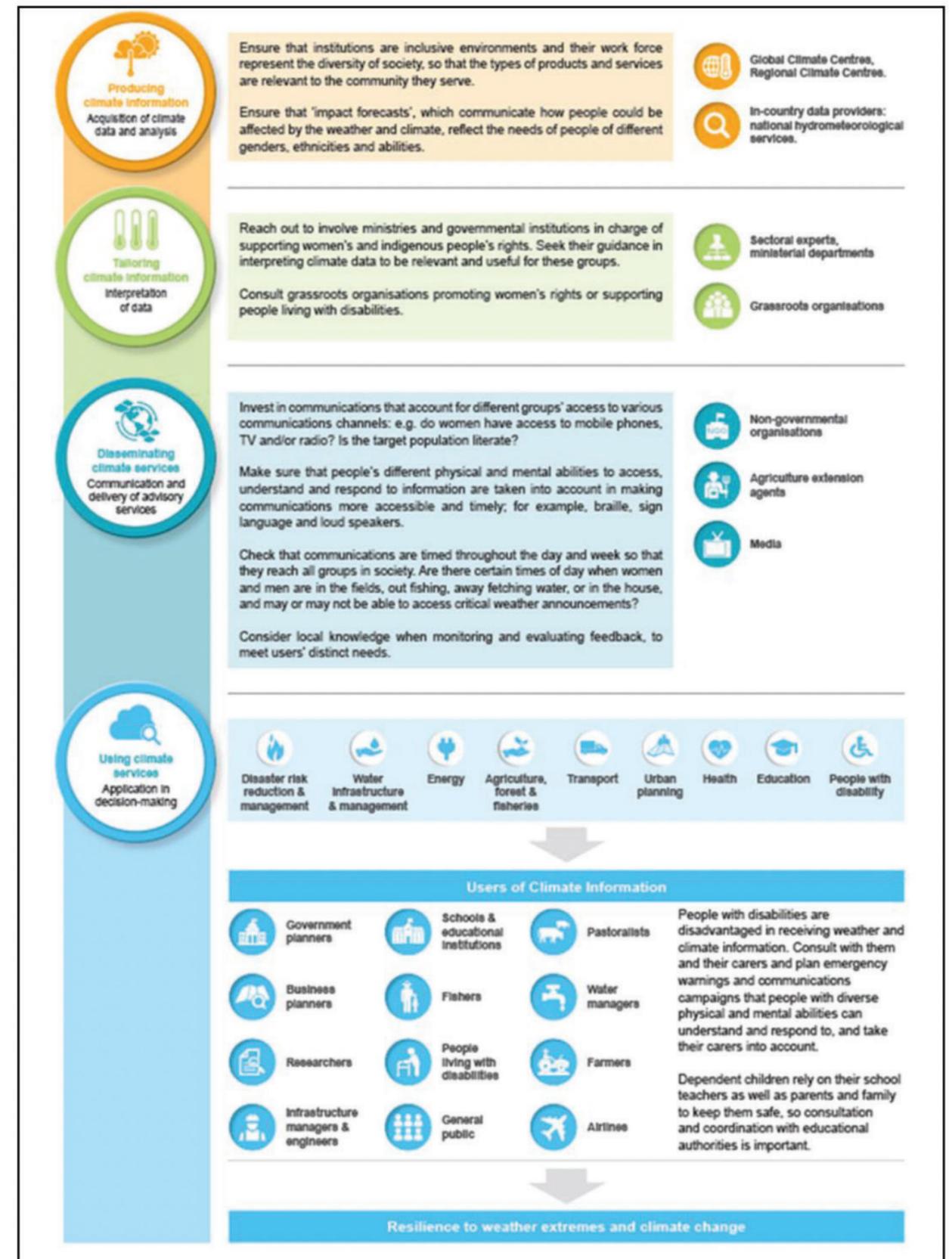


Figure 5. Major actors/stakeholders in an inclusive Climate Service framework (Source: Adapted from https://cdkn.org/sites/default/files/files/Implement-an-Inclusive-National-Framework-for-Climate-Services_Posters-for-Met-Agencies.pdf)



Transforming stakeholders from passive data users to active data generators and platform holders represents a fundamental shift towards a more participatory approach in the development and management of climate information services. This empowerment fosters ownership, enhances the applicability of data, and builds capacity within communities to address climate challenges. While challenges exist, the long-term benefits of increased engagement, sustainability, and local relevance are substantial, ultimately leading to better-informed decision-making and more resilient communities.

4.7 Community of Practice on CIS

A community of practice (CoP) on CIS is a collaborative platform where individuals and organizations share knowledge, expertise, and experiences to improve the effectiveness of climate information provision and utilization. A CoP on CIS provides a space for members to share their knowledge, expertise, and best practices in climate information management, data analysis, and decision-making. Members can connect with peers from diverse backgrounds, including academia, research institutions, national government agencies,

local government units, NGOs, and private sector organizations, to build relationships and collaborations. The CoP can facilitate the identification of common challenges and the development of collective solutions to address them, such as improving data quality, integrating climate information into decision-making processes, or developing new climate-resilient products. Other activities that CoP can do may include the following:

1. **Access to resources** -The CoP can provide access to relevant resources, including research papers, datasets, software tools, and training materials, to support the development of CIS.
2. **Capacity building** - The CoP can offer training and capacity-building opportunities for members to enhance their skills in climate information analysis, communication, and decision-making.
3. **Innovative ideas** - The CoP can foster an environment that encourages the exchange of innovative ideas and approaches to improve the effectiveness of CIS.
4. **Policy influence** - The CoP can provide a platform

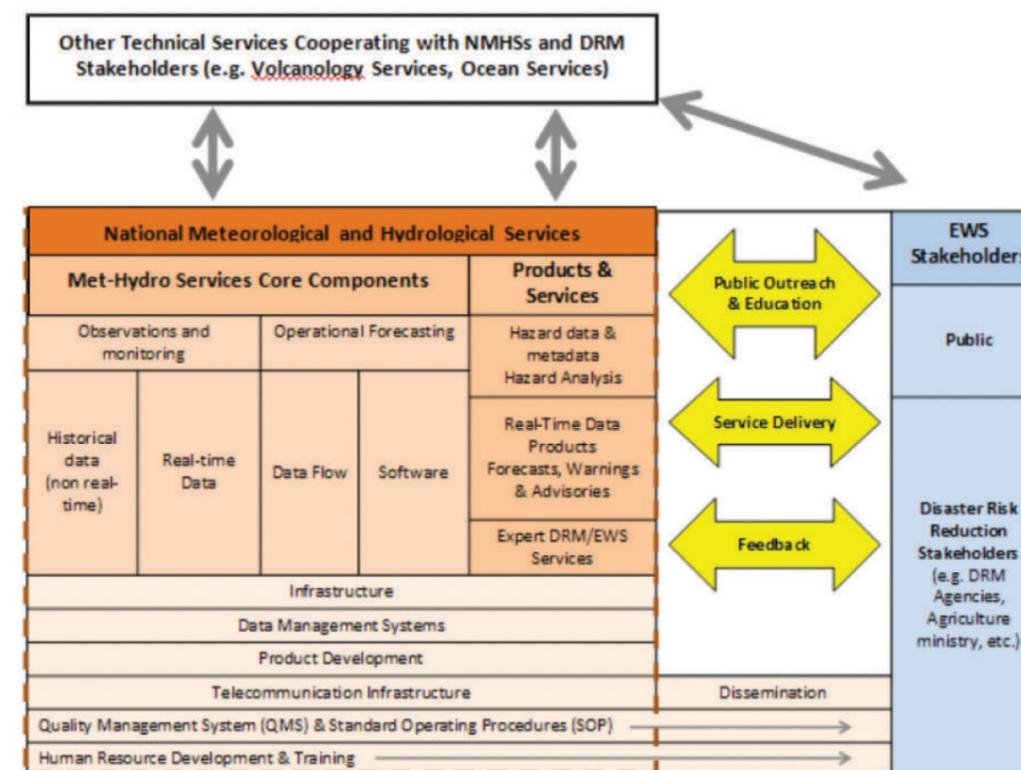


Figure 6. Schematic of linkages of Meteorological Services with EWS stakeholders (Source: Golnarghi, (mgolawww.unisdr.org/files/33988_countryassessmentreportphilippines%5B1%5D.pdf))

for members to engage with policymakers and stakeholders to inform climate policy and decision-making processes at local, national, and international levels.

5. Improved communication - The CoP can facilitate effective communication among stakeholders, including scientists, policymakers, practitioners, and end-users of climate information.

6. Interdisciplinary approaches - The CoP can bring together experts from various disciplines (e.g., meteorology, hydrology, ecology, sociology, economics) to develop a more comprehensive understanding of climate-related issues and their implications for decision-making.

7. Adaptation and resilience - The CoP can support the development of climate-resilient practices and strategies by sharing experiences from various regions and sectors (e.g., agriculture, water management, urban planning).

8. Monitoring, evaluation and learning (MEL) - The CoP can facilitate the MEL of CIS projects and programs to identify best practices, areas for improvement, and lessons learned. The envisioned MEL include accountability for systematic processes and tools to guarantee ownership such as tracking,

reporting and well-defined roles and responsibilities. The integration of community practice into the quality assurance of Climate Information Services through effective MEL processes creates a more resilient and informed community capable of responding to climate change. By fostering local ownership and accountability, communities are empowered to use climate information effectively, ensuring that services remain relevant, reliable, and responsive to their evolving needs. This collaborative approach not only enhances the scientific rigor of climate information but also strengthens community resilience and adaptive capacity in the face of climate challenges.

9. Standardization and harmonization - The CoP can promote standardization and harmonization of climate information formats, protocols, and methodologies to ensure consistency across different regions and sectors.

5. Status of CIS in the Philippines

5.1 Data provider

As the impacts of climate change continue to accelerate due to global anthropogenic climate change, the National Meteorological and Hydrological Services

(NMHSs) will be faced with the increasing challenges and demands of providing more accurate, timely and useful forecasts, products and information. For example, NMHSs provide core support to the public at large, and to disaster risk reduction (DRR) agencies and early warning system (EWS) stakeholders, as shown in Figure 6.

Currently, the major weather and climate information provider in the Philippines is its NMHS or locally known as PAGASA. The data and information flow from collection to downstream is shown in Figure 7.

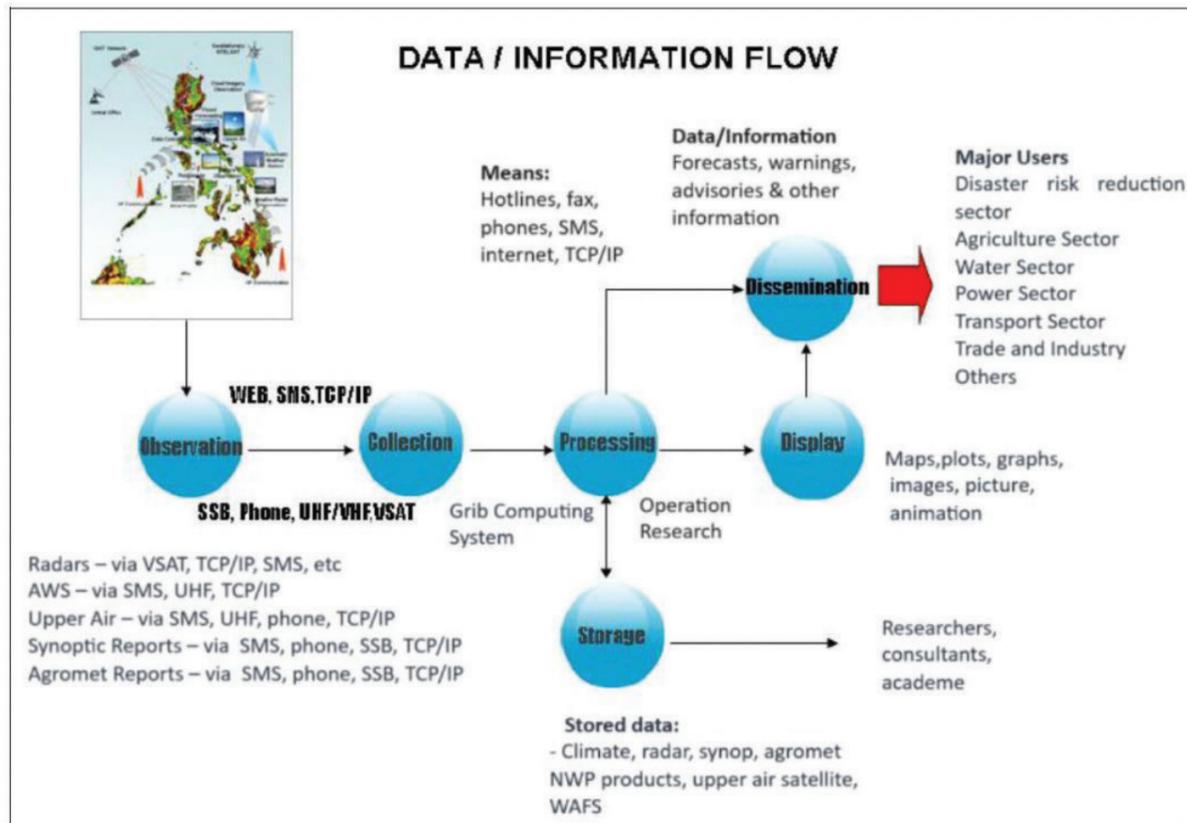


Figure 7. PAGASA data/information flow diagram (Source: Adopted from Engineering Technical Services Division, PAGASA, as cited in https://www.unisdr.org/files/33988_countryassessmentreportphilippines%5B1%5D.pdf)

Hydrometeorology Division, which is responsible for the final quality control and analysis of the observed data. Aside from a leading role in hydro-meteorological early warning services as mandated by law to save lives and lessen damages to properties, PAGASA has been cited as the major provider in the highly developed, documented and assessed downstream CIS in the agriculture sector (Santos, 2023; Balanza, 2023; ACIAR, 2021; Elazegui, et al, 2017; Lapitan, et al, 2017).

5.1.1 Quality control of collected data

The Meteorological Guides and Standards Section of PAGASA conduct quality control of meteorological data manually. It has yet to develop a real-time quality control system for data from Automatic Weather Stations (AWS) as well as manned stations.

For hydrological data, the River Forecast Centers of major river basins in PAGASA conduct the initial quality control of data. The telemetered hydrological data from the River Forecast Centers are forwarded to the Hydro-meteorological Data Application Section (HMDAS) of the

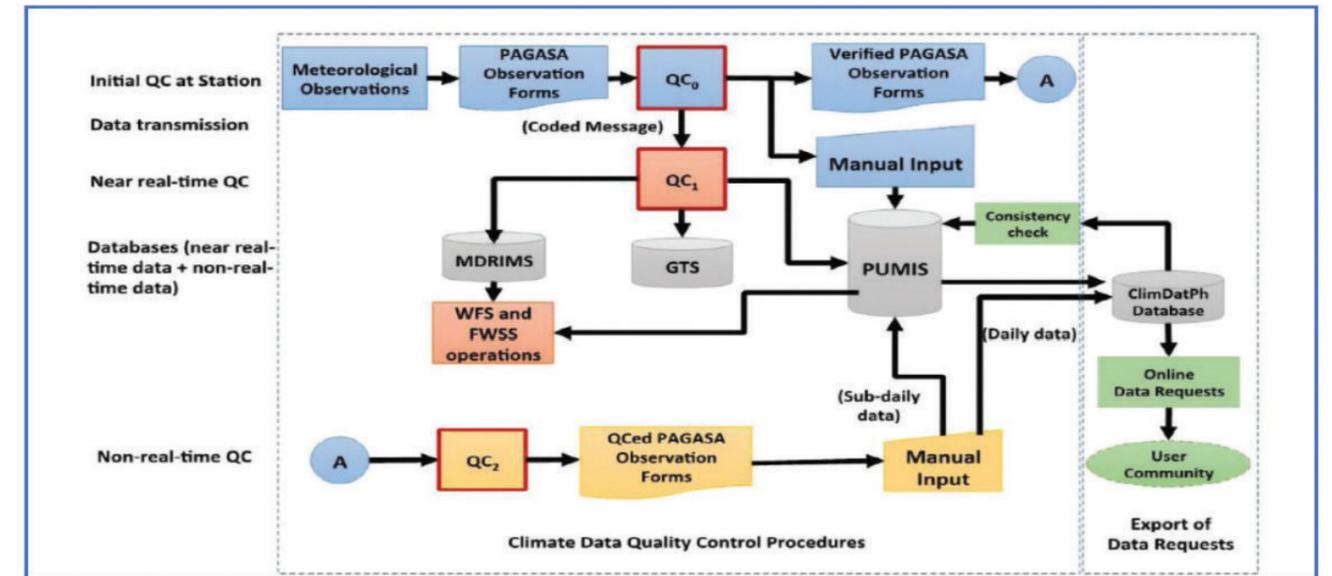


Figure 8. Schematic diagram of data transmission and QC procedures undergone by the climate data prior to making available in ClimDatPh. (Source: Villafuerte, M., et al. 2021)

5.3 Climate information services in Agriculture Sector

Climate data generation and climate information dissemination for use by the agriculture sector in the Philippines are key interventions to aid farmers in their adaptation and mitigation decision making amidst increasing climate variability. At the national level, the Department of Agriculture (DA) leads the use of climate data, outlook and projections as inputs to many of its activities such as, (i) Vulnerability and suitability assessment (VSA); (ii) Activation of the DA disaster risk reduction and management operations center (DA disaster risk reduction and management (DRRM) operation center); (iv) Risk assessment; and (v) Farm and Fishery Operations (Farm Weather Forecast), among others.

At farm level-decision making, a research study by Lapitan et.al (2017) stressed the importance of developing local seasonal climate forecast and extension

delivery that can be initiated by both the national and local governments. Despite availability of local observation instruments (such as AWS), local extension workers continue to rely on generalized advisories reported through PAGASA bulletins as well as televisions and radios. The study indicated that access of local extension agents to location specific climate data requires technical assistance on the processing of climate data into easily understood information for farmers' use in decision making. As noted by other researchers, the decision of farmers depends on how they understand the weather forecasts, climate predictions and other climate services as well as the impacts of climate change and weather-related hazards (Tarchiani et al., 2018; Stigter et al., 2016). Other gaps that were identified by a recent PAGASA workshop¹ with local government units and recommended solutions are presented in Table 3. Despite these gaps, there are success stories in the CIS in Agriculture, as detailed in Box 3.

¹GIZ-SSCIS, 2024. "Integrating Climate Insights for a Resilient Agriculture and Health", Regional Climate Information Workshop Report, 54 pp.

Gaps	Opportunities	Solutions
<ul style="list-style-type: none"> Lack of awareness of the DOST-PAGASA Products Unavailability/inaccessibility of PAGASA digital information to integrate with available digital agriculture tools (i.e. ACAP, PRISM, RCMAS, etc.) Language barrier Limited resources (i.e., no or limited devices, no internet access, etc.) 	<ul style="list-style-type: none"> Use of social media to explain/simplify PAGASA forecasts/warnings Develop thresholds that could trigger flood events Develop threshold that could trigger flood events. Policy recommendation for the establishment of DRR and communication protocol Retooling of provincial and municipal level agriculturists on cascading PAGASA's warnings at farmer level. 	<ul style="list-style-type: none"> Use of FITS Center for awareness Awareness campaigns (i.e. IEC materials, social media, SMS advisories, training, etc.) Simplify and localize Cascade the CIS info to the LGUs, then from LGUs to the farmers State the direct impact of the forecast to the farmers (passive to active) Calibrated action-based forecast be readily available to the farm-level decision

Table 3. Identified gaps in rice production CIS

A. Climate-resiliency Field Schools (CrFSs)

One success story of CIS in the Agriculture sector is the CrFS approach (Christian Aid, 2016). CrFS is more than just a vehicle to provide weather forecasts and climate information to farmers – it seeks to support the transition from low sustainability, high external input dependence, ‘conventional’ agriculture to high sustainability, resilient agro-ecological methods that include enhanced anticipation of climate shocks and stresses. Implementation is premised on a close civil society-public partnership between Rice Watch Action Network (R1, a non-governmental organization partner), PAGASA and the Local Government Unit (LGU), especially the Municipal Agriculture Office. The four main objectives of the CrFS approach are to:

- Enhance farmers’ knowledge on climate variability and ability to anticipate extreme climate events and modify farming decisions;
- Assist farmers in interpreting climate information from PAGASA and facilitate adoption of contingency crop plans;
- Assist farmers in observing climate parameters to support farming practices (e.g., land preparation, pest management);
- Provide the forecast information generation community with farmers’ experiences to assess the relevance and the need to re-design/refine climate information

The AMIA Villages of the Department of Agriculture

The Adaptation and Mitigation Initiative in Agriculture (AMIA) is the flagship program of the Department of Agriculture (DA) dedicated to addressing the dual challenges of climate change: adaptation and mitigation. The overarching vision of the AMIA Program is a climate-resilient Philippine agriculture with empowered and prosperous farmers and fisherfolk. This vision is in harmony with the DA’s mantra “Para sa Masaganang Bagong Pilipinas.” The realization of the vision involves building communities, livelihoods, and enterprises that are resilient to climate and economic shocks. This will be achieved through the promotion of climate resilient agriculture (CRA) and provision of highly responsive agriculture and fisheries support services that empower local communities to manage climate risks while pursuing sustainable livelihoods.

The AMIA Village Approach. This innovative approach enables vulnerable agriculture and fishery communities to test available, mature, and scalable CRA technologies and practices relevant to their identified climate risks. It considers location-specific climate hazards, tailoring support services to match the needs of farmers with the interventions provided. Resilience is built with the adoption of climate adaptation measures and the delivery of integrated support services that are tailor-fitted to the needs of the community. Farmers are taught appropriate CRA strategies and farming techniques, including the use of climate- and weather-informed farming and fishing advisories under climate information services. They are also introduced to other forms of livelihood options applicable to their farms to diversify their farming and income, supported by various agricultural livelihood interventions, from inputs, poultry, livestock, farming tools, machineries and equipment, to infrastructure support (DA website).

Beneficiaries also receive various support services, including skills training along the value chain (from production to marketing) and social preparation and values formation. Assistance is provided for accessing credit and insurance, along with marketing support.

Box 3. Success stories in CIS in Agriculture

5.4 Climate information services in the Health Sector

Water, vector and food-borne diseases are increasing in the Philippines due to climate change and degrading environmental condition including dengue, diarrhea, cholera, and leptospirosis. CIS can focus on developing science-based and simplified knowledge products cases that are bespoke and “close to home” for Local Government Units (LGUs) against the condition of local leadership, e.g., short-term (next election) or long-term priority (future generation impact). However, it was noted that in the Philippines (GIZ, 2023), CIS in the Health Sector is still developing. Although CIS is important, the main challenge is lacking standard data available to health practitioners /agencies to conduct studies, assessments and policy recommendations. Even if data are available, some of these were not accessible as these were not openly shared by owners to users / researchers/ practitioners.

5.4.1 Major gaps in the use of CIS for the health sector² were identified as follows:

- Low technical capacity to interpret data from the PAGASA;
- Limited partnership between PAGASA and the Department of Health (DOH);
- Perceived lack of information on long-term and downscaled climate projections from PAGASA;
- Limited and not standardized information from LGUs;
- Limited coverage of weather monitoring network;
- Post-disaster incorporation of “climate angle”, but no proactive use of climate data to predict disease outbreaks;
- Use of historical climate data, as opposed to long-term projections;
- Lack of studies linking climate change to health and climate-linked disease models.

Out of these gaps, several opportunities and solutions were put forward by the UPNIH in a recent knowledge sharing activity³ with the CIS Technical Working Group.

Gaps	Opportunities	Solutions
<ul style="list-style-type: none"> Translation of CIS to impacts in health sector (historical data and projections) Dissemination of climate advisories down to DOH Regional Offices 	<ul style="list-style-type: none"> Provide alternative/ traditional platforms; integrate with EWS Impact-based infographics, other materials related to weather hazards Evidence-based health outcomes Cascading and info dissemination activities, dialogues and consultation Localized version CIS 	<ul style="list-style-type: none"> Platform for feedback mechanisms (social media applications) Tailor fit access based on resource mapping Formulation of R&D agenda for CIS-Health Enhanced capacities of national and regional SUCs or key players on CIS Strengthening inter-local health zones Augmentation of NHWSS in the local communities Development of advance modeling methods: CIS - diseases outbreak/prevention Developmental partners (CSO, private sector, INGO, NGO, etc.)

Table 4. Identified Gaps and Opportunities in Health CIS

²Result excerpts from Key Informant Interview with Department of Health (DoH), 21 September 2023, 1000 hr (from the National Nutrition Council (NNC) and Epidemiology Bureau (EB))



5.4.2 Available tools and datasets used in the Health Sector

The National Nutrition Council has established a local nutrition EWS in several areas in each of the regions, providing information on total rainfall, vulnerability and food security. However, only 59 LGUs are currently using the system and only historical climate data (from PAGASA) are used.

Historical climate data are accessed from the PAGASA website.

The Epidemiology Bureau manages a health information system and disseminates an event-based bulletin for LGUs to interpret for their local-level health advisories. The information system is available on a server, where LGUs can input case data at the hospital level that is immediately available at all levels of government. However, ~20% of LGUs still use the old system with the local servers. The system is still being refined, with modelling functionalities to be added soon, and there is scope for the inclusion of climate data.

5.5 CIS at the Local Government Units

Climate governance refers to the systems, structures, and processes that enable governments, organizations, and individuals to make decisions and take actions to mitigate the impacts of climate change. It involves the management of natural resources, policies, and regulations to reduce greenhouse gas emissions, adapt to the effects of climate change, and promote sustainable development. Good climate governance is essential for achieving significant reductions in greenhouse gas emissions, adapting to the impacts of climate change, and promoting sustainable development. LGUs as users of CIS in local development plans (LCCAP, CLUP, etc.) can further promote science-based local policy development. As such, it is important that the elected officials are capacitated on this kind of undertaking. For example, SSCIS had been invited to provide inputs on the value of CIS to the DILG Newly-Elected Officials Training (NEO) post elections.

Effective climate governance involves : (i) Inclusive decision-making processes involving diverse stakeholders, including civil society, businesses, and local communities; (ii) Transparency and accountability by ensuring that climate policies and actions are transparent, accountable, and subject to review and evaluation; (iii) Integrating climate considerations into other policy areas, such as energy, transportation, agriculture, and urban planning; (iv) Building capacity

among governments, businesses, and civil society to develop and implement effective climate policies; and (v) Providing adequate funding and finance for climate-related activities, including research, development, and implementation.

Climate governance encompasses a broad range of activities, including: (i) Development and implementation of laws, regulations, and policies to address climate change; (ii) Implementation of climate policies and programs, including the creation of institutions and organizations responsible for climate-related tasks; (iii) Tracking progress towards climate goals, assessing the effectiveness of climate policies, and identifying areas for improvement; and (iv) Building adaptive capacity and resilience to the impacts of climate change, such as extreme weather events, sea-level rise, and droughts.

5.5.1 Importance to the decision-making process

The basic category of climate services that are important to LGUs are those that provide information based on the current and past climate (see Table 5) to serve as a baseline for decision-makers to assess how the climatic conditions affect their constituencies. This is to assess how susceptible and resilient their communities are to climatic events presently, or to provide a record of observed events, or to provide the context for predicted future events. Without understanding this baseline, it is difficult to consider how harmful or beneficial future climatic events may be. Once the decision-maker understands their exposure to the current and past climatic conditions then their needs may well require information about future climatic conditions to assess their future exposure and risks or opportunities that may arise.

Climate services can be categorized into three broad timescales, each with its own unique characteristics and applications.

The first timescale focuses on short-term climate variability, typically ranging from months to a year. This involves using climate data and forecasts to inform decisions such as operational planning, resource management, and financial decisions. For example, seasonal forecasts can help with crop planning, disaster risk reduction, and reinsurance products (Soares et al., 2018; Vaughan et al., 2018; Buontempo et al., 2014). This timescale is well-established and widely used, with many existing services and use cases.

³ See footnote 1

The second timescale looks at longer-term climate change, typically spanning multiple decades. This involves using climate projections to inform science-based mitigation policies and adaptation choices, long-term planning for infrastructure, and assessment of impacts of climate change on various sectors, exploiting opportunities from favorable conditions, as well as specific LGU needs, socio-economic value, technological potential, and deficient supply and demand (Harjanne, 2017). Climate services in this timescale are crucial for assessing the impacts of climate change on various sectors and industries (IPCC, 2021; Bowyer et al., 2015; Asrar et al., 2012;). This area has a wealth of use cases and literature, and is becoming increasingly important within the UNFCCC, IPCC, and other global initiatives.

The third timescale is a relatively new area of focus, combining natural climate variability with longer-term climate change. This timescale is characterized by a combination of emerging scientific understanding and forecasting capability. While there are few established use cases yet, this area has significant potential for development, particularly in areas such as investment strategies, resource planning, assessment of mitigation policies, and near-term climate change adaptation. As research advances and user interest grows, this timescale is likely to become an exciting new frontier for climate service development (Verfaillie et al., 2020; Smith et al., 2019; Solaraju-Murali et al., 2019).

Time scale		Forecast lead time		
		Day Week Month	Season Year Decade	Multi-decade Century
Data	Historical and Current Observations, Climate monitoring	Weather forecasts; extended use forecasts	Monthly to multi-annual climate predictions	Monthly to multi-decadal climate projections
Example Services and use cases	Susceptibility analysis, scenario planning, baseline	Routine and hazardous weather conditions for the public; operations and maintenance planning; emergency responders; disaster risks reduction; market trading	Contingency planning; humanitarian response; development and investment plans (e.g., Local Climate Change Action Plans (LCCAPs), Comprehensive Land Use Planning (CLUPs), Annual Investment Plans, etc.)	Mitigation and other climate change-related policies (e.g., just transition, green jobs); Infrastructure planning; adaptation choices; Long-term impacts on water resources, crops, infrastructure, health
		Resource management planning (e.g., for agriculture, water and energy applications); development planning; infrastructure and (re)insurance schemes		
				Adaptation Strategies Investment strategies

Table 5. Illustrative examples of services across a range of timescales, that are useful for decision-making at the Local Government Level.

5.5.2 Raising awareness on risks and opportunities

In some cases, the decision-maker's interest or need is not determined by any specific timescale and is more about raised awareness of risks and opportunities arising from proper assessment and management of climate-related events, often served by activities to build their capabilities and capacities. Some recipients of climate services may be interested in a wider range of timescales. A particular interest and need is for a seamless link from climate timescales to weather timescales, with the climate timescales providing advance warning of risks or opportunities linked to a possible impending climate event on the decision-maker's timescale of interest (e.g., El Nino and La Nina episodes), and as the time of their interest approaches then seamlessly linking from the seasonal to the

monthly climate service to the weekly (sub-seasonal) timescale, and then in turn to a daily weather service. However, while the pursuit of seamless weather and climate forecasts have been a hugely active area of research and development (Shukla et al., 2009), seamless weather and climate services are yet undeveloped.

5.6 Role of Community of Practice (CoP) in Quality Assurance of CIS

A CoP plays a crucial role in the quality assurance of CIS by disseminating standards, guidelines, and best practices for climate data collection, analysis, and dissemination, ensuring consistency and quality across the community. Members of the CoP can review and validate each other's work, providing constructive feedback and suggestions for improvement to ensure



that climate information products meet the required quality standards.

The CoP on CIS can significantly improve the quality assurance of CIS, enhancing their credibility, reliability, and usefulness for decision-making by addressing gaps and biases in existing CIS and collaborate to address them, ensuring that the community's collective knowledge is comprehensive and unbiased.

Furthermore, the CoP can facilitate knowledge sharing among members with diverse expertise, ensuring that CIS are developed with a deep understanding of the needs and requirements of different sectors and regions. Through an established monitoring, evaluation and learning (MEL) mechanism, the CoP can identify areas for improvement and providing feedback to members to enhance the quality assurance guidance and subsequently, the quality of the members' work. The CoP can disseminate good practices and lessons learned from successful CIS to other members, promoting replication and scaling up of effective approaches.

The CoP can level up by establishing a certification or accreditation process for climate information providers, recognizing those who meet certain standards of quality, reliability, and accuracy following the quality assurance guidance, improving and strengthening the quality control procedures, to ensure that CIS are reliable,

accurate, and timely, including checks on data validation, interpolation, and visualization.

6. Quality Assurance Guidance

A. CIS Data Quality

6.1 Assessing Quality of Data provided or used to develop CIS

Assessing the quality of data used to develop CIS is crucial to ensure that the information provided is accurate, reliable, and useful for decision-making. This is also to ensure the data used to develop CIS is of high quality, thereby enhancing the reliability and effectiveness of the services provided. The key factors and methods to assess the quality of such data include the following:

6.1.1. Data Source Credibility

- Reputation of Source - Verify that the data comes from reputable sources such as national meteorological services (e.g., PAGASA), international organizations such as WMO, National Oceanic and Atmospheric Administration (NOAA), IPCC, or peer-reviewed scientific studies.
- Certification and Standards - Check if the data sources comply with recognized standards and certifications (e.g., ISO standards for data quality).

6.1.2 Accuracy and Precision

- Validation against ground truth - Compare data with ground observations and measurements to validate its accuracy.
- Error margins and uncertainty - Assess the reported error margins and levels of uncertainty associated with the data. High-quality data should include these metrics and transparently communicate them.

6.1.3 Timeliness

- Update Frequency - Evaluate how frequently the data is updated and if the update frequency is sufficient for the intended use (e.g., daily for weather forecasts, monthly for climate trends).
- Latency - Measure the time lag between data collection and its availability to users. Timely data is critical for effective decision-making.

6.1.4 Completeness

- Spatial Coverage - Ensure the data covers the necessary geographic area comprehensively. Partial data can lead to inaccurate CIS.
- Temporal Coverage - Check that the data spans an adequate period to detect trends and patterns (e.g., multiple decades for climate change analysis, see Figure 1 above).

6.1.5 Consistency and Reliability

- Historical Consistency - Data should be consistent over time, with methodologies and instruments remaining stable or changes documented clearly.
- Cross-Verification - Compare data from different sources to check for consistency and reliability. Consistent results across sources increase confidence in data quality.

6.1.6 Accessibility and Transparency (see additional details in Figure 8)

- Data Availability - Ensure that the data is readily accessible to users, preferably in multiple formats (e.g., raw data, processed information, visualizations).
- Documentation and Metadata - High-quality data should come with comprehensive metadata, including information on data collection methods, processing steps, and any limitations.

6.1.7. Relevance and Usability

- Fit for Purpose - Assess whether the data meets the specific needs of the CIS and its users. Data should be relevant to the questions being asked and the decisions being supported.

- User Feedback - Collect feedback from end-users regarding the usability and relevance of the data provided.

6.1.8 Methods for Data Quality Assessment

- Data Quality Frameworks
 - ◆ ISO 8000 - Follow the guidelines provided by ISO 8000, which offers standards for data quality management (see Box 2).
 - ◆ Data Quality Dimensions - Use frameworks that consider multiple dimensions of data quality such as accuracy, completeness, consistency, timeliness, and reliability.
- Technical Validation
 - ◆ Statistical Analysis - Perform statistical analyses to detect anomalies, outliers, and patterns that might indicate data quality issues.
 - ◆ Benchmarking - Compare data with benchmark datasets from established sources.
- Peer Review and Expert Consultation
 - ◆ Peer Review - Subject the data and methodologies to peer review by experts in the field to ensure validity and reliability.
 - ◆ Expert Panels - Consult expert panels for their assessment of the data quality, especially for complex and specialized datasets.
- Field Verification
 - ◆ Ground Truthing - Conduct field verification studies where possible to directly compare data with on-the-ground conditions.
 - ◆ Pilot Studies - Implement pilot studies to test the data in real-world scenarios before full-scale deployment.
- Performance Indicators
 - ◆ Data Accuracy Scores - Quantitative scores derived from validation processes.
 - ◆ User Satisfaction Scores - Feedback from users regarding their trust in the data.
- Timeliness Metrics - Measures of how current the data is.
- Error Rates - Frequency and types of errors identified in the data.



B. CIS Knowledge Products

6.2 Assessing Quality of Climate Information and Services Derived from data

Assessing the quality of climate information and services derived from data involves evaluating several dimensions to ensure the information is reliable, relevant, and useful for decision-making. By systematically evaluating these factors, the quality of climate information and services can be assessed comprehensively, ensuring they are reliable, relevant, and effectively meet the needs of their users.

6.2.1. Relevance and User Needs

- Stakeholder Engagement - Continuously engage with users (e.g., farmers, policymakers, businesses) to understand their needs and ensure the information provided meets those needs. Box 4 shows how a climate Forum is organized by PAGASA in order to engage with multi-stakeholders.
- Customization - Assess whether the services are tailored to different user groups and their specific requirements.

6.2.2. Accuracy and Reliability

- Verification and Validation - Regularly compare the climate information against observed data and independent data sources to validate its accuracy.
- Error Analysis - Analyze and communicate the error margins and uncertainties associated with the climate information.

6.2.3 Timeliness

- Update Frequency - Ensure the climate information is updated regularly and promptly to reflect the most recent data and analyses.
- Real-time Data - Assess the availability of real-time or near-real-time information, which is critical for timely decision-making in scenarios like disaster management.

6.2.4. Accessibility

- Digital Platforms - Evaluate the ease of access to climate information through websites, mobile apps, and other digital platforms. Check for user-friendly interfaces and ease of navigation.
- Offline Access - Ensure the information is also accessible via non-digital means (e.g., printed reports, radio broadcasts) for users without reliable internet access.

6.2.5 Usability

- Clarity and Understandability - Assess whether the climate information is presented in a clear, understandable format, using visual aids like charts, maps, and graphs.
- Training and Support - Evaluate the availability of training programs, tutorials, and user support to help users understand and effectively use the climate information.



6.2.6 Communication and Dissemination

- **Communication Channels** - Assess the effectiveness and variety of communication channels used to disseminate climate information (e.g., social media, SMS alerts, community meetings).
- **Feedback Mechanism** - Ensure there are mechanisms for users to provide feedback on the information and services and evaluate how this feedback is used to improve the services.

6.2.7 Impact and Utility

- **Case Studies and Testimonials** - Collect and analyze case studies or testimonials that demonstrate the impact of the climate information on decision-making processes.
- **Usage Statistics** - Track usage statistics to see how often and in what ways the climate information is being utilized by different user groups.

6.2.8 Sustainability and Continuity

- **Long-term Planning** - Evaluate the long-term sustainability of the CIS, including funding sources and institutional support.
- **Scalability** - Assess the ability of the services to scale up or adapt to changing user needs and increasing demand.
- **User Surveys and Interviews**
 - ◆ **Surveys** - Conduct regular surveys to gather quantitative data on user satisfaction, usability, and the perceived accuracy of the climate information.
 - ◆ **Interviews** - Conduct in-depth interviews with key stakeholders to gather qualitative insights into the strengths and weaknesses of the services.

- **Performance Metrics**
 - ◆ **Accuracy Metrics** - Use metrics like Mean Absolute Error (MAE), Root Mean Square Error (RMSE), and bias to quantify the accuracy of the climate information.
 - ◆ **Timeliness Metrics** - Track the time taken to update and disseminate climate information after data collection.
- **Comparative Analysis**
 - ◆ **Benchmarking** - Compare the CIS against other similar services at regional, national, or international levels to identify best practices and areas for improvement.
- **Field Observations and Ground Truthing**
 - ◆ **Observations** - Conduct field observations to directly compare the climate information with real-world conditions.
 - ◆ **Pilot Projects** - Implement pilot projects to test new information products and services in real-world settings before full-scale deployment.
- **Performance Indicators**
 - ◆ **User Satisfaction Scores** - Quantitative scores derived from user feedback surveys.
 - ◆ **Adoption Rates** - The rate at which different user groups are adopting and regularly using the CIS.
 - ◆ **Impact Assessment** - Qualitative and quantitative measures of the impact of the services on decision-making and outcomes.
 - ◆ **Error Rates** - The frequency and types of errors identified in the climate information.

Box 4. PAGASA Climate Forum

The PAGASA holds regular Climate Forums as part of its efforts to provide accurate and timely climate information to various stakeholders. These forums play a crucial role in disseminating climate outlooks, forecasts, and other relevant information, which are essential for planning and decision-making across different sectors. PAGASA's Climate Forums are a vital platform for the dissemination of climate information and the engagement of stakeholders. They play a key role in enhancing the capacity of various sectors to understand and respond to climate variability and change, thereby supporting efforts to build a more resilient and prepared society.

<p>Objectives:</p> <ul style="list-style-type: none"> • Disseminate Climate Information and provide stakeholders with the latest climate outlooks, forecasts, and advisories. • Engage its multi-stakeholders from various sectors, such as agriculture, water resources, disaster risk reduction, and local government units, to understand their needs and feedback. • Enhance the understanding and capacity of stakeholders in interpreting and using climate information for planning and decision-making. • Raise awareness about potential climate-related hazards and promote preparedness and mitigation measures. 	<p>Key Features:</p> <ul style="list-style-type: none"> • Regular Schedule - The Climate Forum is typically held monthly, providing regular updates on climate conditions and forecasts. • Comprehensive Content that includes the following: <ul style="list-style-type: none"> ○ Presentations of the climate outlook for the upcoming months, including temperature and rainfall predictions. ○ A review of recent climate conditions and significant weather events. ○ Discussions on special topics such as El Niño/La Niña conditions, typhoon outlooks, and seasonal forecasts. • Expert Presentations from PAGASA and other relevant organizations on various technical information and analyses. • Interactive Sessions where participants can ask questions and provide feedback. • Sectoral Focus - The forum addresses the specific needs and concerns of various sectors, ensuring the information provided is relevant and actionable.
<p>Accessibility and Participation:</p> <ul style="list-style-type: none"> • Online and In-Person - The forums are often conducted both in-person and online, making them accessible to a wider audience. • Recorded Sessions - Recordings of the forums are sometimes made available for those who cannot attend live sessions. • Materials and Reports - PAGASA provides materials, presentations, and reports from the forums, which can be accessed by stakeholders for reference. 	<p>Impact and Importance:</p> <ul style="list-style-type: none"> • Informed Decision-Making - The climate forums help stakeholders make informed decisions by providing accurate and timely climate information. • Risk Reduction - By understanding climate forecasts and potential hazards, stakeholders can implement measures to reduce risks and enhance preparedness. • Policy Development - The information shared in the forums supports the development and implementation of policies related to climate adaptation and mitigation. • Community Resilience - By raising awareness and building capacity, the forums contribute to the overall resilience of communities against climate-related impacts.
<p>Audience and Stakeholders:</p> <ul style="list-style-type: none"> • Government Agencies - National and local government units involved in disaster risk reduction, agriculture, water resources, and environmental management. • Private Sector - Businesses and industries affected by climate conditions, such as agriculture, energy, and tourism. • Universities and research organizations involved in climate science and related fields. • Non-Governmental Organizations (NGOs) working on climate change adaptation, disaster risk reduction, and community resilience. • General Public - Community leaders, media representatives, and other interested parties. 	

C. CIS Utilization

6.3 Assessing Quality of CIS Availability and Accessibility

Assessing the quality of CIS availability and accessibility involves evaluating several key factors. These include the relevance, accuracy, timeliness, accessibility, usability, and the degree to which the information meets the needs of its users.

6.3.1 Relevance and User Needs

- Stakeholder Engagement - Engage with various stakeholders, including farmers, policymakers, researchers, and the general public, to understand their specific needs for climate information.
- Needs Assessment Surveys - Conduct surveys or focus groups to gather information on the types of climate data needed, preferred formats, and the frequency of updates. A sample is presented in

6.3.2 Accuracy and Reliability

- Source Verification - Ensure that the climate information is sourced from reputable and scientifically credible institutions like national meteorological services (e.g., PAGASA) or international organizations such as the WMO.
- Quality Control - Implement and review quality control measures and validation processes for data collection and processing.

6.3.3 Timeliness

- Update Frequency - Evaluate how often the information is updated and whether this frequency meets the needs of users (e.g., real-time data for disaster management vs. seasonal forecasts for agriculture).
- Delivery Time - Assess the time taken for data to be disseminated after it is generated.

6.3.4 Accessibility

- Digital Platforms - Assess the availability of CIS on various digital platforms such as websites, mobile apps, and social media. Check for user-friendliness, ease of navigation, and download options.
- Offline Access - Evaluate the availability of CIS through offline means such as radio broadcasts, printed bulletins, and community meetings, especially in remote areas.

6.3.5 Usability

- User Training and Support - Determine the availability of training programs and user support to help stakeholders understand and utilize the climate

information.

- Language and Localization - Assess whether the information is available in local languages and tailored to local contexts and cultural practices.

6.3.6 Communication and Dissemination

- Channels Used - Evaluate the variety and effectiveness of communication channels used to disseminate the information (e.g., SMS alerts, community workshops).
- Feedback Mechanisms - Check if there are feedback mechanisms in place for users to provide input on the services, and how this feedback is used to improve the services

6.3.7 Impact and Usage

- Case Studies and Testimonials - Collect case studies or user testimonials to understand how CIS has been used and its impact on decision-making.
- Adoption Rate - Measure the adoption rate of CIS among the target audience and identify any barriers to usage.

6.3.8 Sustainability and Funding

- Financial Support - Review the financial sustainability of the CIS, including funding sources and long-term financial plans.
- Institutional Support - Assess the level of institutional support and the involvement of governmental and non-governmental organizations in maintaining and promoting CIS.

6.3.9 Methods for Data Collection

- Surveys and Questionnaires - Distribute structured surveys to users and providers of CIS to collect quantitative and qualitative data.
- Interviews and Focus Groups - Conduct in-depth interviews and focus group discussions with key stakeholders to gather detailed insights.
- Field Observations - Visit communities and organizations that use CIS to observe their interaction with the information services directly.
- Document Analysis - Review existing reports, usage logs, and feedback forms related to the CIS.

6.3.10 Performance Indicators

- User Satisfaction Levels - Measure through surveys or feedback forms.
- Accuracy Metrics - Compare CIS data with independent data sources to check for discrepancies.



- Accessibility Metrics - Track the number of users accessing CIS via different platforms.
- Impact Assessment - Evaluate the extent to which CIS has informed and improved decision-making processes.

7. Cross-cutting issues

From the above Guidance in Section 6, three issues can be deduced to cut across CIS. These are (i) communicating uncertainties, (ii) quality assessments and reporting, and (iii) obtaining feedback from users.

7.1 Communicating uncertainties

CIS communicate uncertainties in various ways to ensure that users understand the limitations and potential inaccuracies in the information provided. By employing these communication strategies, CIS can enhance transparency, credibility, and usability of the information despite uncertainties inherent in climate data and predictions. Below are some common methods:

- Probability and Confidence Intervals - One way to communicate uncertainty is by using probabilities or confidence intervals. This can help users understand the range of possible outcomes and the level of confidence associated with each.
- Visualization - Visual aids such as charts, graphs, and maps can effectively communicate uncertainties in climate information. For instance, shaded areas representing uncertainty ranges or error bars on graphs can convey the level of uncertainty.
- Narrative Descriptions - Providing narrative descriptions alongside data can help explain the uncertainties in simpler terms. Descriptive language can clarify what uncertainties mean and how they impact the interpretation of the information.
- Metadata and Documentation - Including metadata and detailed documentation about data sources, methods, and assumptions can help users understand the uncertainties associated with the climate information.
- Risk Communication - Expressing uncertainties in terms of potential risks or impacts can make the information more relatable and actionable for users. This approach emphasizes the consequences of uncertainty in decision-making.
- Feedback Mechanisms - Encouraging feedback from users can help CIS understand how uncertainties are perceived and whether additional clarification is needed. This can lead to improved communication strategies over time.

7.2 Quality assessment and reporting

7.2.1 Measuring product and process quality using quality indicators, quality targets and process variables and descriptions.

CIS measure product and process quality through various methods to ensure and maintain high standards of accuracy, reliability, usefulness and relevance in their products and processes. Continuous monitoring and improvement are essential to ensure that users can trust and benefit from the information provided. Here are some common approaches:

- Verification and Validation - CIS often use verification and validation techniques to check the accuracy of their products and processes. This involves comparing observed data or outcomes with predicted or expected results to assess quality.
- Peer Review - Peer review by experts in the field is a standard practice for evaluating the quality of climate information products. Independent experts review the methods, data sources, and conclusions to ensure credibility and accuracy.
- Quality Control Checks - Regular quality control checks are conducted to monitor and improve the quality of data, models, and processes used by CIS. This may involve data validation, consistency checks, and error detection.
- Feedback and User Engagement - Soliciting feedback from users and stakeholders helps CIS understand how their products are being used and where improvements are needed. User engagement can provide valuable insights into product quality.
- Performance Metrics - Establishing performance metrics and key performance indicators (KPIs) allows CIS to quantitatively assess the quality of their products and processes. Metrics may include accuracy, reliability, timeliness, and user satisfaction.
- Compliance with Standards - Adhering to established standards and best practices in climate science and data management ensures that products and processes meet industry norms for quality. This can involve following protocols for data collection, analysis, and reporting.

7.2.2 Communicating about quality - quality reports

Quality assurance in CIS tackles issues related to communicating about quality, including quality reports, through various strategies to ensure transparency, reliability, and accountability. Here are some approaches:

- Clear Documentation - Quality assurance efforts emphasize clear and comprehensive documentation of processes, methods, and data sources used in generating climate information. Quality reports should



provide detailed explanations of how quality is assured throughout the information lifecycle.

- Standardized Reporting - Establishing standardized formats and structures for quality reports helps ensure consistency and comparability across different products and services. This allows users to easily understand and evaluate the quality information provided.
- Transparent Metrics - Quality reports should include transparent metrics and indicators that measure the quality of climate information products. These metrics should be clearly defined, easily understandable, and relevant to users' needs.
- User-Focused Communication - Quality reports should be tailored to the needs and preferences of different user groups. Communicating about quality in a user-friendly and accessible manner enhances understanding and engagement with the information provided.
- Feedback Mechanisms - Quality assurance processes should incorporate feedback mechanisms that allow users to provide input on the quality of information and the effectiveness of communication efforts. This feedback can inform continuous improvement of quality reporting practices.
- External Reviews - Conducting external reviews or

audits by independent experts or organizations can provide valuable validation of the quality assurance processes and the information products. External reviews add credibility and transparency to quality reporting efforts.

- Training and Awareness - Quality assurance efforts may include training sessions or awareness campaigns to educate users and stakeholders about the importance of quality in CIS. Building awareness can foster trust and confidence in the information provided.

7.2.3 Obtaining feedback from users Obtaining feedback from users of CIS is crucial for improving their effectiveness and relevance. Here are several strategies to gather valuable feedback:

- Surveys and Questionnaires
 - ◆ Online Surveys - Use tools like Google Forms, SurveyMonkey, or Typeform to create and distribute surveys.
 - ◆ Embedded Surveys - Integrate short surveys within the CIS platform, prompting users to provide feedback after using the service.
- Focus Groups
 - ◆ User Panels - Organize panels consisting of a

diverse group of users to discuss their experiences and suggestions.

- ◆ Workshops - Conduct interactive workshops to gather in-depth feedback and engage users in discussions about service improvements.
- User Interviews
 - ◆ Structured Interviews - Prepare a set of questions to ask users about their experiences.
- User Interviews
 - ◆ Unstructured Interviews - Allow users to speak freely about their experiences, which can reveal insights that structured questions might miss.
- Feedback Forms
 - ◆ On-Site Forms - Place feedback forms on the CIS website or app.
 - ◆ Email Forms - Send feedback forms via email to registered users after they have used the service
- Usability Testing
 - ◆ Observational Studies - Watch users interact with the service to identify problem points and areas for improvement.
 - ◆ A/B Testing - Test different versions of the service to see which one performs better according to user feedback.
- Social Media and Online Communities
 - ◆ Social Media Polls - Use platforms like X, Facebook, or LinkedIn to conduct polls and gather feedback.
 - ◆ Community of Practice Forums - Create forums or join existing online communities where users discuss CIS.
- Analytics and Usage Data
 - ◆ Website Analytics - Use tools like Google Analytics to track user behavior on the platform and infer feedback based on usage patterns.
 - ◆ App Analytics - For mobile apps, use in-app analytics tools to monitor how users interact with the service.
- User Reviews and Ratings
 - ◆ App Stores - Encourage users to leave reviews and ratings on app stores for mobile services.
 - ◆ Review Platforms - Monitor reviews on third-party platforms that feature CIS.
- Feedback Widgets or In-App Widgets - Implement feedback widgets within the app or website that allow users to provide immediate feedback while using the service.
- Customer Support Interactions

- ◆ Support Tickets - Analyze support tickets and inquiries to identify common issues and areas for improvement.

- ◆ Live Chat - Use live chat interactions to gather real-time feedback from users.

7.2.4 Assuring continuous quality improvement

In collecting comprehensive feedback from users of CIS, it is good to have clear objectives leading to better-informed decisions and enhanced service quality. By implementing these strategies, comprehensive feedback from users of CIS can be collected, leading to better-informed decisions and enhanced service quality. Some best practices include the following:

- Defining clearly what is wanted from the feedback to create focused questions and methods.
- Employing a “user-centric approach” by ensuring that the feedback process is convenient and respects users’ time.
- Using a combination of methods to get a comprehensive understanding of users’ feedback.
- Focus on actionable insights by gathering feedback that can be translated into improvements or actions.
- Make feedback collection an ongoing process to continuously improve the service.

Assuring data users of continuous quality improvement in CIS requires a systematic and transparent approach. Here are several strategies to ensure users that the quality of CIS is consistently improving

- Establish and Communicate Clear Quality Standards
 - ◆ Quality Framework - Develop a comprehensive quality framework outlining data accuracy, timeliness, reliability, and relevance.
 - ◆ Documentation - Provide detailed documentation about data sources, methodologies, and quality assurance processes
- Implement Robust Quality Assurance Processes
 - ◆ Regular Audits - Conduct periodic audits of data and methodologies to ensure compliance with quality standards
 - ◆ Validation and Verification - Use independent verification and validation procedures to cross-check data accuracy and reliability.
- User Feedback Integration
 - ◆ Feedback Loops - Establish a structured process for incorporating user feedback into the quality improvement cycle.
 - ◆ Responsive Adjustments - Quickly address any



identified issues or suggestions from users to demonstrate a commitment to improvement.

- **Transparent Reporting**
 - ◆ **Quality Reports** - Regularly publish quality assurance reports that highlight key performance metrics, improvements made, and any ongoing issues being addressed.
 - ◆ **Error Logs and Corrections** - Maintain a publicly accessible log of detected errors and their corrections.
- **Stakeholder Engagement**
 - ◆ **Advisory Boards** - Form advisory boards consisting of key stakeholders, including users, to provide insights and guidance on quality improvements.
 - ◆ **User Forums** - Host regular forums or workshops where users can discuss their needs and provide feedback on service quality
- **Continuous Monitoring and Analytics**
 - ◆ **Real-Time Monitoring** - Implement real-time monitoring systems to detect and address issues as they arise.
 - ◆ **Usage Analytics** - Analyze usage data to identify trends, potential issues, and areas for improvement
- **Professional Development and Training**
 - ◆ **Staff Training** - Provide ongoing training for staff on the latest best practices in data management and quality assurance.
 - ◆ **User Education** - Offer training and resources to help users understand the data and its limitations, fostering a collaborative approach to quality improvement
- **Technology and Infrastructure Upgrades**
 - ◆ **Modern Tools** - Invest in the latest tools and technologies for data collection, analysis, and dissemination to ensure high-quality outputs.
 - ◆ **Infrastructure Maintenance** - Regularly update and maintain infrastructure to prevent data quality degradation due to technical issues.
- **Benchmarking and Best Practices**
 - ◆ **Benchmarking** - Compare your services against industry standards and best practices to identify areas for improvement.
 - ◆ **Best Practices** - Adopt and adapt best practices from leading CIS and data management fields.
- **Certification and Standards Compliance**
 - ◆ **Certification** - Obtain relevant certifications (e.g., ISO 9001 for quality management systems) to

demonstrate a commitment to quality.

- ◆ **Standards Compliance** - Ensure compliance with international standards for climate data, such as those set by the WMO.
- **Communication and Transparency**
 - ◆ **Regular Updates** - Keep users informed about ongoing improvements and updates through newsletters, blogs, and social media.
 - ◆ **Open Communication Channels** - Maintain open lines of communication where users can easily report issues and receive updates on their resolution.

7.3 Implementation Roadmap

CIS can build and maintain trust with their users, assuring them of continuous quality improvement and the reliability of the data provided through the following iterative steps:

- **Initial assessment** - Conduct an initial quality assessment to establish a baseline.
- **Develop Quality Improvement Plan** - Create a detailed plan outlining the steps, timeline, and resources needed for continuous quality improvement.
- **Engage stakeholders; involve users; and other stakeholders**, in the planning and implementation phases.
- **Implement Quality Assurance Processes** - Establish and execute quality assurance processes, including regular monitoring and audits.
- **Monitor and Review** - Continuously monitor quality metrics and review processes to ensure ongoing improvement.
- **Communicate progress** - Regularly communicate progress and updates to users. To facilitate the operationalization of the guidance on the quality assurance of CIS, all of the above points are translated into checklists. These are presented and discussed in Annex 3.

8. Conclusion and ways forward

The influence of climate on the formulation of policies and adaptation actions means that the demand for accessible, locally customized, and accurate CIS is expected to rise. As we work toward achieving a climate resilient and low carbon development, improving CIS will enable users to make climate-smart decisions and ensure information is disseminated effectively for practical actions. One key approach to enhancing these services is by integrating the knowledge systems that underpin climate information. Here, we draw conclusions and make recommendations to enhance CIS and support climate adaptation action targets.



- Establish and support institutions dedicated to critical CIS research and advisory, providing tailored products for government, private, and public sector players. Investments need to prioritize those actions to build technical and scientific capabilities such as observation networks, training research personnel, and establishing effective early warning systems. This will ensure the availability and accessibility of high-quality weather and climate information tailored to meet the decision-making needs of various users.
- Informing decision-making for climate adaptation actions requires innovative thinking. For CIS, this means actively integrating diverse knowledge systems to bridge the gap between climate information production and its use. Inclusive, non-hierarchical feedback and engagement mechanisms that enable providers and users, especially socially excluded and marginalized groups, to co-design and co-generate climate information products and dissemination channels must be developed and promoted. Different framings, representations, and legal implications of climate information and dissemination channels from various knowledge systems have to be developed and promoted.

- Access to CIS using a combination of methods commonly employed by different knowledge systems, such as information and communication technologies (e.g., call services, SMS, voice recordings, rural radio), boundary organizations working in communities (e.g., NGOs, community-based organizations, and agricultural extension services), and face-to-face dialogs between climate information providers and users, such as the regular Climate Forum of the PAGASA. Those who are into CIS should engage in inclusive, iterative, interactive, and flexible knowledge exchange mechanisms between stakeholders from different knowledge systems, including climate scientists, resource users, and practitioners. This will help build mutual respect, trust, and create climate information products and dissemination channels that are recognized, accepted, accessible, and used across knowledge boundaries. Climate data providers should promote new information products and dissemination channels developed from these multi-scale and interdisciplinary forums on diverse platforms.
- More efforts are needed to understand climate information user needs and decision-making processes in different contexts towards coming



up with high quality, accessible and accurate CIS which will adequately support the climate actions in different major economic sectors in the Philippines. As of now, agriculture is ahead in the field. Other sectoral agencies have to engage on in-depth use of participatory methodologies aimed at exploring different climate information user needs and decision-making processes in different contexts have to be promoted and supported. Thus, coordination between sectoral agencies, academic institutions, climate research centers and major data providers such as PAGASA and other research centers/institutions towards the production of demand-led climate knowledge, information and products need to be facilitated widely and efficiently.

- Demand-driven research that seeks to explore the kinds of climate information that are useful in different contexts and for different groups (especially the excluded and disadvantaged) needs to be undertaken and examined as to how that information should be constructed, translated, and communicated.
- Strengthening the evidence base of the actual value of produced CIS can be done through rigorous monitoring and evaluation of the services in different contexts using a combination of context-appropriate qualitative and quantitative approaches and based on a theory of change that appropriately captures the input-output-outcome-impact chain of the services.

A significant emphasis to improving ICT infrastructure in rural service areas can expand the CIS to grassroots extensively, given the challenges in accessing and addressing intermittent online connectivity and infrastructure, and limitations in equipment for data storage. Reliable and accessible ICT can significantly enhance the capacity of rural stakeholders to engage meaningfully with climate data, leading to better decision-making, greater community resilience, and overall improved outcomes in addressing climate vulnerabilities. Investments in ICT infrastructure must prioritize inclusivity and alignment with community needs to ensure that they effectively support the objectives of quality assurance in climate information.

However, investing and improving ICT infrastructure in rural service areas while navigating the complexities of multiple agencies, institutions, and sectors can be fraught with challenges, such as: coordination and collaboration; financial limitations; unequal capacity and resource distribution; sustainability and maintenance issues; technological matters (e.g. interoperability); and policy regulatory frameworks, among others. While these are not insurmountable, the situation requires careful planning, robust coordination, and an understanding of local dynamics and require a more thorough and careful consideration in the future.

References

- Abbott, P.F., 1986. Guidelines on the quality control of surface climatological data, WMO/TD-No. 111, WCP – 85
- ACIAR, 2021. "Action ready climate knowledge to improve disaster risk management for small holder farmers in the Philippines", Final Report (FR2021-012) prepared by Peter Hayman and Bronya Alexander, ISBN 978-1-922635-07-5
- Asrar, G.R., Ryabinin, V., Detemmerman, V., 2012. Climate science and services: providing climate information for adaptation, sustainable development and risk management. *Curr. Opin. Environ. Sustain.* 4, 88–100. <https://doi.org/10.1016/j.cosust.2012.01.003>
- Balanza, J.G.C. (2023) An innovative scalable climate information service platform for resilient agriculture is now operational in six provinces in the Philippines. Reporting 2022 evidence, study 4700. Rome (Italy): Biodiversity International; Cali (Colombia): CIAT. 3 p
- Barrell, S., 2019." Data and Systems Perspective on Constituent Body Reform, in WMO for the 21st Century, World Meteorological Organization Bulletin, Volume 68 (1) – 2019, p. 8, ISSN 0042-9767
- Bowyer, P., Brasseur, G.P., Jacob, D., 2015. The role of climate services in adapting adaptation to climate variability and change. In: Leal Filho, W. (Ed.), *Handbook of Climate Change Adaptation*. Springer Berlin Heidelberg, pp. 533–550.
- Bremer, S., Wardekker, A., Jensen, E.S. and van der Sluijs, J. P., 2021. Quality Assessment in Co-developing Climate Services in Norway and the Netherlands, *Frontiers in Climate*, Volume 3, <https://www.frontiersin.org/articles/10.3389/fclim.2021.627665doi:10.3389/fclim.2021.627665>, ISSN=2624-9553
- Buontempo, C., Hewitt, C.D., Doblas-Reyes, F.J., and Dessai, S., 2014. Climate service development, delivery and use in Europe at monthly to inter-annual timescales, *Climate Risk Management*, Vol 6, pp 1-5, ISSN 2212-0963, <https://doi.org/10.1016/j.crm.2014.10.002>. (<https://www.sciencedirect.com/science/article/pii/S2212096314000321>)
- Cash, D., Clark, W., and Alcock, F., 2003. "Knowledge Systems for Sustainable Development", *Proceedings of the National Academy of Sciences of the United States of America*. 100. 8086-91. 10.1073/pnas.1231332100.
- Christian Aid, 2016."Developing Climate Services in the Philippines"
- Daniels, E., Bharwani, S., Gerger Swartling A., Vulturius, G. and Brandon, K., 2020. Refocusing the climate services lens: Introducing a framework for co-designing "transdisciplinary knowledge integration processes" to build climate resilience, *Climate Services*, Volume 19, ISSN 2405-8807
- Elazegui, D.D., Rola, A. C., Luyun, Jr.R. A., Anastacio, J.C., Faderogao, F.J.F., and Alvarez, MC. A., 2017."Policy and Institutional Challenges in Climate Information Services Provisioning in Philippine Agriculture," *Journal of Public Affairs and Development*, Vol. 4: 51-79 (2017), ISSN 2718-9228
- Englund, M., André, K., Gerger, S.A., andlao-Jørgensen, J., 2022. Four Methodological Guidelines to Evaluate the Research Impact of Co-produced Climate Services, *Frontiers in Climate*, Vol4 <https://www.frontiersin.org/articles/10.3389/fclim.2022.909422doi:10.3389/fclim.2022.909422>, ISSN=2624-9553
- Giorgi, F., 2020. Producing actionable climate change information for regions: the distillation paradigm and the 3R framework *The European Physical Journal Plus*; Heidelberg Vol. 135- 5, : 435. doi:10.1140/epjp/s13360-020-00453-1
- GIZ, 2023. South-South Collaboration on Climate Information and Services Conference Proceedings – "Developing Climate Information Services in Health and Agriculture under a One Health Approach: Exploring Areas of Convergence for a Whole of Government Intervention," August 10 -11, 2023, UP BGC Taguig City.
- Harjanne, A., 2017. Servitizing climate science—Institutional analysis of climate services discourse and its implications. *Glob. Environ. Chang.* 46, 1–16. <https://doi.org/10.1016/j.gloenvcha.2017.06.008>.
- Hewitt, C. and Stone, R., 2021. Climate services for managing societal risks and opportunities, *Climate Services*, Volume 23, 100240, ISSN 2405-8807, <https://doi.org/10.1016/j.cliser.2021.100240>
- Hubbard, K., You, J., and Shulski, M., 2012. Toward a Better Quality Control of Weather Data, <http://dx.doi.org/10.5772/51632>
- IPCC, 2021: Summary for Policymakers. In: *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. In Press.
- ISO, 2015. ISO 9000: Quality management systems — Fundamentals and vocabulary <https://www.iso.org/standard/45481.html>

Knutti, Reto. (2019). Closing the Knowledge-Action Gap in Climate Change. *One Earth*. 1. 21-23. 10.1016/j.oneear.2019.09.001. Knutti, R., 2019. "Closing the Knowledge-Action Gap in Climate Change Institute for Atmospheric and Climate Science", <https://doi.org/10.1016/j.oneear.2019.09.001>

Lapitan, A., Rola, A.C., Alvarez, M.C., Cervantes, C., Bayacag, P., Lizada, J., Manzano, J., Espinosa, T., Jimenez, F., Pungtilan, D. and Tabanyag, R., 2017. "State of the Art of Climate Information System (CIS) in the Philippines", UPLB Center for Strategic Planning and Policy Studies Working Paper No. 2017-04

Larosa, F. and Perrels, A., 2017. Assessment of the Existing Resourcing and Quality Assurance of Current Climate Services, EU-MACS Deliverable 1.2

Pacchetti, M. B., Dessai, S., Bradley, S., and Stainforth, D.A., 2021. "Assessing the Quality of Regional Climate Information", <https://doi.org/10.1175/BAMS-D-20-0008.1>

Pielke Sr R A, Wilby R L. 2012. Regional climate downscaling: What's the point?, *Eos Trans AGU*, Vol. 93, No. 5, pp 52–53; doi:10.1029/2012EO050008

Santos, W., 2023. Improving the Use of Weather and Climate Information for Farm Decision Making in Victoria, Oriental Mindoro, Philippines. *European Modern Studies Journal*. 7. 16-30. 10.59573/emsj.7(6).2023.2

Shukla J., Hagedorn, R., Hoskins, B., Kinter, J., Marotzke, J., Miller, M., Palmer, T.N., and Slingo, J., 2009. Revolution in climate prediction is both necessary and possible, *Bulletin of the American Meteorological Society*, Vol. 90 - 2, pp. 175-178.

Smith, D.M., et al., 2019. Robust skill of decadal climate predictions. *npj Clim. Atmos. Sci.* 2, 13. <https://doi.org/10.1038/s41612-019-0071-y>

Soares, M.B., Daly, M., and Dessai, S., 2018. Assessing the value of seasonal climate forecasts for decision-making, *WIREs Clim Change*. 9:e523, doi: 10.1002/wcc.523

Solaraju-Murali, B., Caron, L.P., Gonzalez-Reviriego, N., Doblas-Reyes, F.J., 2019. Multi-year prediction of European summer drought conditions for the agricultural sector. *Environ. Res. Lett.* 14, 124014. <https://doi.org/10.1088/1748-9326/ab5043>

Stainforth, D.A., Downing, T.E., Washington, R., Lopez, A., and New, M., 2007. Issues in the interpretation of climate model ensembles to inform decisions, *Phil. Trans. R. Soc. A*, 365, 2163–2177, doi:10.1098/rsta.2007.2073

Stigter, C. J., Winarto, Y. T., & Wicaksono, M., 2016. Science Field Shops: An innovative agricultural extension approach for adaptation to climate change, applied with farmers in Indonesia. In *Implementing climate change adaptation in cities and communities: integrating strategies and educational approaches* (pp. 391-405). DOI: 10.1007/978-3-319-28591-7_21

Tarchiani, V., Camacho, J., Coulibaly, H., Rossi, F., & Stefanski, R. (2018). Agrometeorological services for smallholder farmers in West Africa. *Advances in Science and Research*, 15, 15-20. DOI: 10.5194/asr-15-15-2018

Vaughan, C., Dessai, S., Hewitt, C., 2018. Surveying climate services: What can we learn from a bird's-eye view? *Weather. Clim. Soc.* 10, 373–395. <https://doi.org/10.1175/WCAS-D-17-0030.1>

Villafuerte, M., Lambrento, J.C.R., Ison, C.M.S., Vicente, A.A.S., de Guzman, R.G., and Juanillo, E.L., 2021. ClimDatPh: an Online Platform for Philippine Climate Data Acquisition. *Philipp J Sci* 150(1): 53–66. <https://doi.org/10.56899/150.01.05>

Wilson, L., Golding, N., Hewitt, C., Lowe, J., Harrison, M., Dunbar, T., 2022. Recommendations for the UK National Framework for Climate Services, UK Climate Resilience Programme

WMO, 2011, *Climate Knowledge for Action: A Global Framework for Climate Services—Empowering the Most Vulnerable*, Report of the High-Level Taskforce for the Global Framework for Climate Services, WMO-No. 1065, Publications Board World Meteorological Organization (WMO) 7 bis, Geneva

WMO, 2016. *Climate Services for Supporting Climate Change Adaptation - Supplement to the Technical Guidelines for The National Adaptation Plan Process*, WMO-No. 1170, ISBN 978-92-63-11170-8

WMO, 2018. *Guidelines on Quality Management in Climate Services*, WMO-No. 1221, ISBN 978-92-63-11221-7

WMO, 2021. *Guidelines on Surface Station Data Quality Control and Quality Assurance for Climate Applications*

Vedeld, T., Hofstad, H., Mathur, M., Büker, P., Stordal, F., 2020. Reaching out? Governing weather and climate services (WCS) for farmers. *Environ. Sci. Policy* 104, 208–216. <https://doi.org/10.1016/j.envsci.2019.11.010>

Verfaillie, D., Doblas-Reyes, F.J., Donat, M.G., Pérez-Zanón, N., Solaraju-Murali, B., Torralba, V., Wild, S., 2020. How reliable are decadal climate predictions of near-surface air temperature? *J. Clim.* 1–57 <https://doi.org/10.1175/JCLI-D-20-0138.1>

Website resources:

CARE website: <https://careclimatechange.org/climate-information-services/>

CDKN website: https://cdkn.org/sites/default/files/files/Implement-an-Inclusive-National-Framework-for-Climate-Services_Poster-for-Met-Agencies.pdf

DA Website: <https://www.amia.da.gov.ph/about-the-amia-program/>

Data Commerce Cloud website: <https://www.datacommercecloud.com/glossary/data-provider>

Project Management Website: https://www.projectmanagement.com/discussion-topic/60517/what-is-difference-between-good-practice-and-best-practice-#_=_

TechTarget website: <https://www.techtarget.com/whatis/definition/metadata>

TechTarget Website [2]: <https://www.techtarget.com/whatis/definition/quality-control-QC>

WMO website: <https://wmo.int/site/global-framework-climate-services-gfcs/what-are-climate-services>

WMO website [2]: <https://wmo.int/activities/climate-services-information-system>

UNISDR website: https://www.unisdr.org/files/33988_countryassessment_report_philippines%5B1%5D.pdf

Annexes

Annex 1 - Weather and climate data, information products and services to selected economic sectors (Source: WMO, 2016)

Annex 1.1: Agriculture and Food Security

Table A1 - Weather and climate data, information products and services to the agricultural community

Area	Variable(s)	Information products and services
Weather	Air temperature	<ul style="list-style-type: none"> • Temperature probabilities • Chilling hours • Degree-days • Hours or days above or below selected temperatures • Inter-diurnal variability • Maximum and minimum temperature statistics • Growing season statistics (dates when threshold temperature values for the growth of various kinds of crops begin and end).
	Precipitation	<ul style="list-style-type: none"> • Probability of a specified amount during a period • Number of days with specified amounts of precipitation • Probabilities of thundershowers • Probability of extreme precipitation amounts
	Wind	<ul style="list-style-type: none"> • Wind rose • Maximum wind, average wind speed • Diurnal variation • Hours of wind less than selected speed
	Sky cover, sunshine and radiation	<ul style="list-style-type: none"> • Per cent possible sunshine • Number of clear, partly cloudy, cloudy days • Amounts of global and net radiation
	Humidity	<ul style="list-style-type: none"> • Probability of a specified relative humidity • Duration of a specified threshold of humidity
	Free water evaporation	<ul style="list-style-type: none"> • Total amount • Diurnal variation of evaporation • Relative dryness of air • Evapotranspiration
	Dew	<ul style="list-style-type: none"> • Duration and amount of dew • Diurnal variation of dew • Association of dew with vegetative wetting • Probability of dew formation based on the season
	Hazards and extreme events	<ul style="list-style-type: none"> • Frost • Cold wave • Hail • Heatwave • Cyclones • Floods • Rare sunshine • Water logging • Gales
	Weather forecasts	<ul style="list-style-type: none"> • Nowcasting • Very short-range forecasts • Short-range forecasts • Medium-range forecasts • Long-range forecasts
	Climate	Recent and historical climate data

Area	Variable(s)	Information products and services
		<ul style="list-style-type: none"> • Long-term means and trends • Diagnostics of climate-variability characteristics • Diagnostics, assessment and attribution of current seasonal/ sub-seasonal rainfall and temperature patterns and their anomalies, including the associated circulation features
	Climate extremes	<ul style="list-style-type: none"> • Drought frequencies • Drought indices • Indices of climate extremes or other, more complex indices that combine several parameters with different thresholds (e.g., temperature with precipitation and humidity) • Information on the distribution, frequency and intensity of climate extremes, such as forest and grassland fires, droughts, floods and heatwaves, including special reports on contemporary and past events
	Climate forecasts	<ul style="list-style-type: none"> • Monthly, seasonal and decadal forecasts on rainfall and temperature, adequately incorporating aspects of uncertainty • Global climate models • Regional climate models • Information on the relevance of major drivers of climate variability (El Niño/La Niña, North Atlantic Oscillation, Indian Ocean Dipole, Madden-Julian Oscillation)
	Climate products	<ul style="list-style-type: none"> • Products (datasets, text, maps, charts, statistics, etc.) that describe the past, present and future climate of different locations and regions in a country • Climate monitoring products such as national state-of-the-climate reports • Climate change projection products, including downscaled national projections based on appropriate IPCC scenarios
Land	Soil temperature	<ul style="list-style-type: none"> • Mean and standard deviation at standard depth • Depth of frost penetration • Probability of occurrence of specified temperatures at standard depths • Dates when threshold values of temperature (germination, vegetation) are reached.
	Soil water	<ul style="list-style-type: none"> • Soil-water balance: moisture assessment and forecasts • Actual evapotranspiration • Irrigation scheduling

Decisions that benefit from the use of information about the weather and climate include:

- Identification of extreme weather and climate hazards that pose risks to agriculture and food security;
- Identification of populations vulnerable to weather and climate hazards;
- Plant and animal pest- and disease-control strategies;
- Regulation and laws;
- Pesticide and herbicide applications, fertilizer management, farm and irrigation management;
- Weather- and climate-sensitive decisions in the agriculture and food-security value chains;
- Decisions on export and import of agricultural inputs and products;
- Decisions related to marketing agriculture and food-security products

Annex 1.2: Human Health

Table A1.2. Types of climate information relevant for health decision-making

Timescale	Examples of climate information products – which may be available and relevant in some regions, seasons	Examples of health-decision applications	Status: Research, Experimental*, Operational**
Historical record of climate observations	Historical time series data, summary statistics and other information products	Epidemiological trend and regression analysis to understand associations of climate and health; develop disease forecasting from current and recent observation data, particularly for infectious diseases with time lags between observed ambient conditions and diseases onset	Operational
Weather Information (hourly, daily, weekly, 30 days)	<ul style="list-style-type: none"> Real-time monitoring of daily weather: temperature, precipitation, humidity, etc. 8–14 probabilistic outlooks Extended range forecasts from 10 to 40 days Tercile forecasts (above normal, normal, below normal) probabilistic prediction of rainfall and temperature Extreme weather probability prediction 	Short-term operational decisions, such as public weather advisories, and thresholds that trigger action plans for staff deployment, delivery of supplies, and public protection.	Operational Experimental
Short-term climate information (1–12 months)	<ul style="list-style-type: none"> Risk indexes of cyclones, floods, dust storms, windstorms, extreme temperature, fire Long-range forecasts of average, maximum and minimum temperature and precipitation conditions 1–9 months ahead (e.g., seasonal forecasts and trends) Tercile forecasts (above normal, normal, below normal) probabilistic prediction of rainfall and temperature 	Short-term operational investment in preparedness, outbreak prevention, resource needs	Experimental and operational
Mid-term climate information (annual to multi-year)	<ul style="list-style-type: none"> Annual to inter-annual forecasts (several years ahead) describing large-scale state of the climate Status of El Niño Southern Oscillation (ENSO) conditions Dynamic and statistical climate models 	1-5 year policy decisions for disease control, research, health systems planning	Limited application of information beyond ENSO

Timescale	Examples of climate information products – which may be available and relevant in some regions, seasons	Examples of health-decision applications	Status: Research, Experimental*, Operational**
Long-range climate information (decades)	<ul style="list-style-type: none"> 10-30 year decadal forecasts of surface temperature, precipitation, sea-surface temperatures, etc. Climate change scenarios, dynamic climate models, global circulation models 	<ul style="list-style-type: none"> Long-term health infrastructure investments, research, demographic and population models, health system planning Increase understanding of disease trends, epidemic behavior on a regional scale 	Research Experimental

* Experimental product defined here as general knowledge available, but products need to be assessed by climate scientists for local decision-making relevance

** Operational product defined here as routinely available and provided by climate practitioners

Annex 1.3. Six priority categories of activities under climate services for disaster risk reduction

(a) **Risk assessment.** Information on weather and climate hazards needs to be complemented with exposure and vulnerability information to develop a complete picture of risk. Climate information is critical for the analysis of hazard patterns and trends.

(b) **Loss data.** Historical and real-time data on loss and damage provide a crucial input for assessing risks of future disasters. Over time, climate services provide information on historical and ongoing extreme climate events and help to identify and build processes for integrating this information into loss- and damage-accounting systems.

(c) **Early warning systems.** Lessons learned from a number of good national practices in multi-hazard early warning systems indicate that these systems enable decisions to protect lives and livelihoods in short- and longer-term timeframes by extending the lead time for contingency planning and preparation. Both short-term weather forecasts and seasonal forecasts can be used to build reliable deterministic or probabilistic risk scenarios and, in turn, to strengthen disaster preparedness.

(d) **Risk reduction in climate-sensitive sectors.** Climate-sensitive sectors include agriculture, health, water, energy, housing, infrastructure, tourism, industry and trade. Multi-sector plans to reduce disaster risk and to adapt to climate change consider historical, current and long-term risk in order to avoid investment that locks in future risk or results in maladaptation, such as infrastructure that cannot withstand shorter return times for heavy rain.

(e) **Planning investment in reducing risk.** Sound financial planning and investment play a crucial role in reducing the risk of disaster. Climate information is an important component of the evidence base required to guide decisions regarding appropriate levels of investment to minimize potential impacts on the economy, ensuring uninterrupted delivery of critical services and infrastructure, investing in the development of early warning systems and contingency planning, reserving contingency funds for emergency use and potentially subsidizing vulnerable or affected sectors to help protect socioeconomic welfare.

(f) **Risk financing and transfer.** Disaster-risk financing and transfer can be broadly defined as structured sharing of the potential financial impacts of disasters caused by natural hazards, often, but not systematically, through insurance mechanisms. Risk financing and transfer require climate services to inform risk assessments and catastrophe risk analysis, ideally based on at least 30 years of hydro-meteorological and other asset and vulnerability information. In the case of innovative risk-transfer tools, such as weather derivatives or index-based insurance, climate information is also needed to determine payout structures, as these are not based on actual losses but are triggered by meteorological parameters, such as wind, rainfall and temperature. Forecasts of these types of parameters have been used for both portfolio risk management and diversification purposes.

Annex 1.4. Water Management

Table A1.4. Weather and climate data, information products and services and their applications in the water sector

Area	Variable(s)	Application areas
Weather	Daily weather: air temperature, precipitation, wind, solar radiation, humidity, atmospheric pressure	<ul style="list-style-type: none"> • Needed for a range of calculations in water budget and energy budget; estimation of stored energy in water; computation of evaporation using different approaches, etc. • Rainfall depth-duration-frequency datasets are provided as tables or sets of curves, having been obtained from a comprehensive probability analysis of rainfall records. They are required as a basis for: <ul style="list-style-type: none"> ○ Drainage design or flood estimation; ○ Irrigation scheduling; ○ Hydropower generation; ○ Potable water, industrial processing; ○ Pollution control; ○ Salinity and sedimentation; ○ Modeling hydrological systems.
	Weather statistics: historical time series, summary statistics	
	Open-pan evaporation	<ul style="list-style-type: none"> • Needed for information on total amount of evaporation and computations of evaporation from drainage basins and evapotranspiration
	Quantitative precipitation forecasting (QPF)	<ul style="list-style-type: none"> • The requirement for more definitive information in flood forecasting and warnings has led weather service providers to move away from qualitative statements on rainfall (e.g., light-moderate-heavy, occasional-persistent and localized-widespread) to defining numerical or proportional ranges to these descriptors. QPF is now provided in well-defined rainfall ranges (e.g., 30 mm–50 mm) over geographically defined areas and with definition of likely start and finish times. • Medium-range forecasts are needed for demand scheduling.
Climate	Recent and historical climate data	<ul style="list-style-type: none"> • Floodplain mapping/zoning • Diagnostics, assessment, and attribution of current seasonal/sub-seasonal rainfall and temperature patterns, and their anomalies, including the associated circulation features • Extreme-value analysis • Long-term means and trends • Diagnostics of climate variability characteristics
	Climate extremes	<ul style="list-style-type: none"> • Drought frequencies and drought indices • Indices of climate extremes or other, more complex indices that combine several parameters with different thresholds (e.g., temperature with precipitation and humidity)
	Climate forecasts	<ul style="list-style-type: none"> • Seasonal and long-range forecasts are required by major water-management undertakings, where knowledge of forthcoming seasonal water conditions is helpful. Forecasts of rainfall and temperature are most commonly needed and are presented as probabilities of conditions falling within different categories, expressed in relation to seasonal norms in 3- or 5-step categories, e.g., very low to very high. • Information on the relevance of major drivers of climate variability (El Niño/La Niña, Pacific Decadal Oscillation, Indian Ocean Dipole, Madden-Julian Oscillation) for mid-term policy decisions on water management.

EO

Annex 2 – Needs Assessment Survey Questionnaire

Table A1.5. Weather and climate data needs for the five focal areas in the energy sector

Focal area	Weather and climate data needs
Identification and resource assessment	<ul style="list-style-type: none"> In situ, and satellite-derived meteorological data for assessment of resources and risks Model-based, high-resolution historical meteorological data Climate change projections
Impact assessments (including infrastructure and environment)	<ul style="list-style-type: none"> High-grade in situ data Detailed site-specific modelling Historical dataset and analyses of extreme events Projections of potential relevant meteorological and climate trends and changes Observations and monitoring of relevant climate-related variables for identification and mitigation of environmental impacts, e.g., on human health and safety and wildlife Air quality and gas emission database (e.g., carbon-based gases from shale gas extractions) Database on weather/climate risks to hydro- electricity facilities, solar panel risks to buildings, energy transport risks to communities, etc.
Site selection and financing	<ul style="list-style-type: none"> Very high grade in situ data, both in terms of quality of instrumentation and temporal resolution Detailed site-specific modelling (e.g., wind-gust estimation, extreme low and high stream flows)
Operations and maintenance	<ul style="list-style-type: none"> Site-specific ground station data Infrastructure-specific meteorological data Database and analyses of historical meteorologically-driven problem (forensic) events for operations and maintenance Forecasts at various lead times Communication methodologies for warning systems
Energy integration	<ul style="list-style-type: none"> Historical datasets of meteorological/climate variables relevant for demand, insurance and energy efficiency Historical datasets of energy demand Model-based data to extend observation records Ancillary datasets such as energy-system response to weather variables Forecasts at various lead times Climate projections Site-specific ground station data for triggering weather index insurance policies

Below is a sample designed to gather insights on the types of climate data and information needed, preferred formats, and the frequency of updates. This questionnaire can be tailored further depending on the specific audience and purpose.

Climate Data and Information Needs Assessment Survey					
Introduction: Thank you for participating in this survey. Your insights will help us understand the types of climate data and information you need, how you prefer to receive it, and how frequently you would like to receive updates. Your responses will remain confidential.					
Section 1: Background Information					
1. Name: _____		3. Role/Position: _____			
2. Organization: _____		4. Location (City/Municipality/Province): _____			
5. Please select your primary area of focus:					
<input type="checkbox"/> Research		<input type="checkbox"/> Education		<input type="checkbox"/> Non-Governmental Organization (NGO)	
<input type="checkbox"/> Policy Making		<input type="checkbox"/> Industry		<input type="checkbox"/> Community-Based Organization	
<input type="checkbox"/> Other (please specify): _____					
Section 2: Types of Climate Data and Information Needed					
6. What types of climate data and information are most relevant to your work?(Select all that apply)					
<input type="checkbox"/> Temperature trends		<input type="checkbox"/> Sea-level rise		<input type="checkbox"/> Socioeconomic impacts	
<input type="checkbox"/> Precipitation patterns		<input type="checkbox"/> Carbon emissions		<input type="checkbox"/> Other (please specify): _____	
<input type="checkbox"/> Extreme weather events		<input type="checkbox"/> Ecosystem impacts			
7. How would you rate the importance of the following types of climate data? 1 = Not important, 5 = Very important					
Temperature trends:					
Precipitation patterns:					
Extreme weather events:					
Sea-level rise:					
Other (please specify):					
Section 3: Preferred Formats for Data and Information					
8. In what format do you prefer to receive climate data and information? (Select all that apply)					
<input type="checkbox"/> Reports (PDF/Word)		<input type="checkbox"/> Webinars or online training			
<input type="checkbox"/> Interactive dashboards		<input type="checkbox"/> Email newsletters			
<input type="checkbox"/> Infographics		<input type="checkbox"/> Other (please specify): _____			
9. How important are the following formats for your access to climate data?					
Reports (PDF/Word)					
Interactive dashboards					
Infographics					
Webinars or online training					
Other (please specify):					
Section 4: Frequency of Updates					
10. How often would you like to receive updates on climate data and information?					
<input type="checkbox"/> Daily		<input type="checkbox"/> Weekly		<input type="checkbox"/> Monthly	
		<input type="checkbox"/> Quarterly		<input type="checkbox"/> Annually	
<input type="checkbox"/> As events occur					
11. Are there specific triggers or events that would prompt you to seek climate data updates? (e.g., emergency situations, disaster events, policy changes)					
Section 5: Additional Comments					
12. Do you have any additional comments or suggestions regarding your needs for climate data and information?					
Thank you for your participation!					

This questionnaire can be distributed via online survey platforms such as Google Forms, Survey Monkey, or as a printed document, depending on the target audience.

Annex 3 – CIS Checklists

These checklists are simplified versions of Chapter 6 (Quality Assurance Guidance). The guidebook is intended to be used by scientists, researchers, practitioners and decision-makers interested in using climate data, information and its services. The guidance can be a useful normative framework for climate information producers that is intended to inform decision-making on coping or adapting to a changing climate.

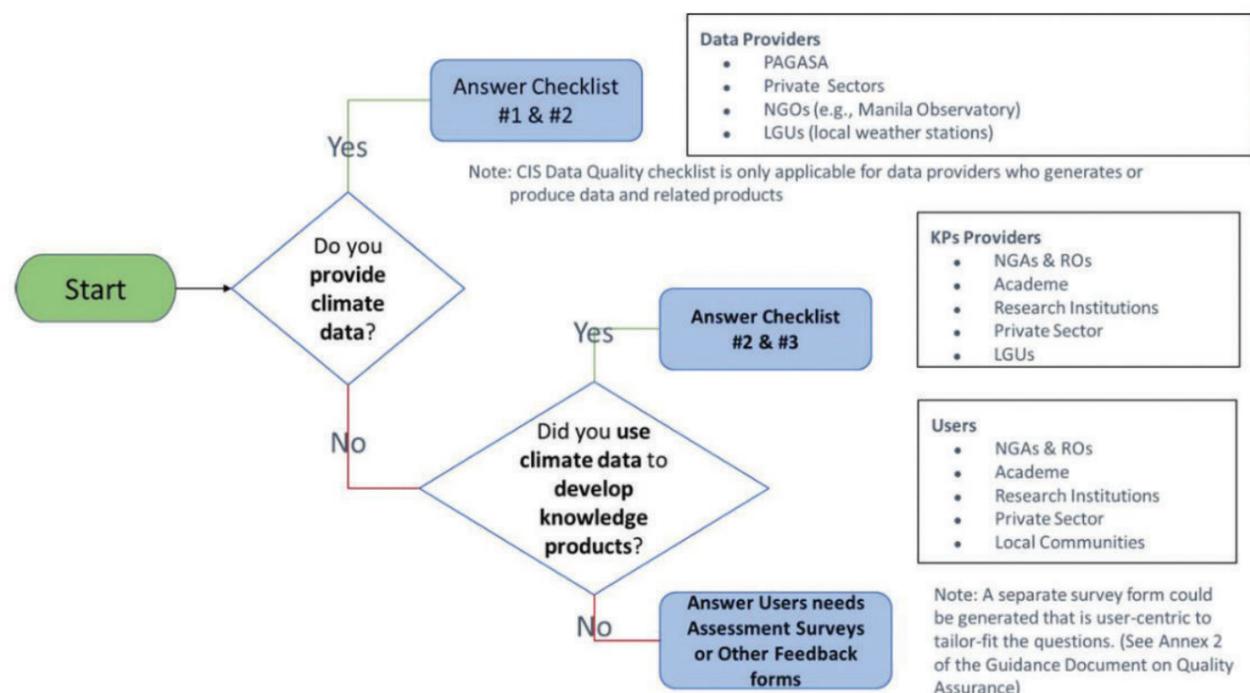
A decision-maker may use the guidebook to recognise that diversity in types of evidence is needed for the information to satisfy completeness.

This checklist will allow CIS providers to assess the quality of the data, knowledge products and utilisation of CIS, through 3 separate checklists. One major point of consideration for data and information providers are to reflect on whether the data source of the climate data/information/services that they are providing are from reputable/reliable sources (and were not from random internet pages).

The 3 checklists were prepared to specifically assess:

1. the quality of data provided or used to develop a climate service [CIS Data Quality];
2. the quality of climate information and services derived from data [CIS Knowledge Products]; and
3. the quality of CIS availability and accessibility [CIS Utilization]

Please use the appropriate checklist as necessary. To guide you which checklist to answer, please refer to the diagram below:



Please provide the following information for monitoring purposes:

Name of Respondent (Optional): _____

Location: _____ (Barangay, City/Municipality, Province)

Sex: Male Female Do not want to disclose. Date accomplished: _____ (DD-MM-YY)

Sector: Agriculture Health Others: _____

Checklist 1: Quality of data provided and/or used for Climate Information and Services [CIS Data Quality]

These are some questions to check if the data used to develop CIS is accurate, reliable, and useful for decision-making. These questions will help ensure that the data used to develop CIS is of high quality, thereby enhancing the reliability and effectiveness of the services provided. Please answer the following questions with a Yes or No.

Data Source Credibility:	Yes	No
Does the data (please refer to attached Annex) come from reputable sources? <i>Examples of reputable sources are national and international meteorological services (PAGASA and World Meteorological Organization [WMO] respectively; National Oceanic and Atmospheric Administration [NOAA], Intergovernmental Panel on Climate Change [IPCC]), peer-reviewed scientific studies, etc.</i> What was the source of the data: _____		
Does the data comply with recognized standards and certifications? <i>i.e., ISO standards</i> What was the standard/certification used? _____		

Accuracy and Precision:	Yes	No
Is the data compared with ground observations/measurements (real-world conditions) to validate its accuracy?		
Is the data reported with error margins and levels of uncertainty? <i>High-quality data should transparently communicate levels of uncertainty.</i>		

Timeliness:	Yes	No
Is the frequency of update of the data sufficient for the intended use? <i>Examples of frequency of updates: daily for weather forecasts, monthly for climate trends</i> If no, what frequency of update do you require/need? _____		
Is the time lag between data collection and availability to users sufficient? If no, how long before the data was available to you? _____		

Completeness:	Yes	No
Does the data comprehensively cover the necessary geographic area? <i>Partial data can lead to inaccurate CIS.</i>		
Does the data span an adequate period to detect trends and patterns? <i>Multiple decades must be analyzed for climate change analysis</i>		

Consistency and Reliability:	Yes	No
Is the data consistent over time with methodologies and instruments remaining stable, and were any changes documented clearly?		
Is the data consistent/the same, even if you checked from different sources? <i>Consistent results across sources (regional/national/international level) increase confidence in data quality.</i>		

Accessibility and Transparency:	Yes	No
Is the data (raw, processed information, visualisations) readily accessible to users in multiple platforms – websites, mobile apps, social media, etc.? If yes, where did you access the data? _____		
Does the data come with comprehensive metadata (information on data collection methods, processing steps, limitations)? If no, what is missing? _____		

Relevance and Usability:	Yes	No
Does the data meet the specific needs of the CIS and its users? <i>Data should be relevant to questions asked and decisions being supported.</i> If no, what is/are your specific need/s of CIS? _____		
Was feedback collected from end-users on the usability and relevance of the data? If yes, how was the feedback collected? _____		
Total Count		

Checklist 2: Quality of Climate Information and Services derived from data [CIS Knowledge Products]

These are some questions to assess the quality of CIS derived from data. These questions will help you comprehensively assess the CIS product to ensure that it effectively meets the needs of users. Please answer the following questions with a Yes or No. Please provide Means of verification as necessary.

Relevance and User Needs:	Yes	No
Is there continuous interaction with users (farmers, policymakers, businesses) to understand their needs and ensure the information provided meets those needs? If yes, how often does the interaction occur? <input type="checkbox"/> weekly <input type="checkbox"/> monthly <input type="checkbox"/> quarterly <input type="checkbox"/> annually <input type="checkbox"/> other: _____		
Are the services tailored to different user groups? <i>Each user group will have specific data/information requirement(s).</i>		
Accuracy and Reliability:	Yes	No
Is the information regularly compared to observed data (real-world conditions) and to other independent data sources, to validate its accuracy? <i>CIS data should be compared to other similar services at regional, national or international levels, to identify best practices and areas for improvement.</i>		
Is the climate information reported with error margins and uncertainties? <i>Error margins/uncertainties can help quantify the accuracy of the information.</i>		
Timeliness:	Yes	No
Is the update of the climate information regular and promptly reflects the most recent data and analyses? <i>Track the time taken to update and disseminate climate information after data collection.</i> If no, what frequency of update do you require/need? _____		
Is real-time or near-real-time information available? <i>This is very critical for timely decision-making in scenarios like disaster management</i>		
Accessibility:	Yes	No
Is it easy to access climate information through websites, mobile apps, and other digital platforms? <i>If yes, is the platform/interface user-friendly and easy to navigate?</i> _____ If yes, where did you access the climate information? _____		
Is the information also accessible on non-digital platforms - printed reports, radio broadcasts? If yes, where did you access the offline climate information? _____		
Usability:	Yes	No
Is the climate information presented in a clear and understandable format (visual aids). If yes, which format/s do you understand the most? <input type="checkbox"/> charts <input type="checkbox"/> maps <input type="checkbox"/> graphs <input type="checkbox"/> others: _____		
Are training programs, tutorials, and user support available to help users understand and effectively use the climate information?		
Communication and Dissemination:	Yes	No
Is climate information effectively disseminated using various communication channels (social media, SMS alerts, community meetings)? If yes, which communication channel did you access the climate information? _____		
Are there feedback mechanisms for users and is the feedback used to improve the information and services? If yes, where did you provide your feedback? _____		
Impact and Utility:	Yes	No
Were case studies or testimonials collected and analyzed to understand the impact of climate information on the decision-making process? <i>Pilot projects help test new information products & services in real-world settings before full-scale deployment.</i>		
Is usage statistics tracked? <i>how often information was used, how it was utilized by different user groups, etc.</i>		
Sustainability and Continuity:	Yes	No
Does the CIS have long-term sustainability (continuous funding sources & institutional support)? If yes, what is funding source, and which institution supports it? _____		
Can the services be scaled up, or can it adapt to increasing demand or any changes in user needs?		
Total Count		

Checklist 3: Quality of CIS Availability and Accessibility [CIS Utilization]

These are some questions to assess the quality of the availability and accessibility of CIS. You will be asked to evaluate based on its relevance, accuracy, timeliness, accessibility, usability and degree to which the information meets the needs of its users.

Relevance and User Needs:	Yes	No
Is there continuous interaction with stakeholders to understand their specific needs for climate information? <i>Stakeholders can be farmers, policymakers, researchers & general public.</i> If yes, how often does the interaction occur? <input type="checkbox"/> weekly <input type="checkbox"/> monthly <input type="checkbox"/> quarterly <input type="checkbox"/> annually <input type="checkbox"/> other: _____		
Are surveys or focus group discussions conducted to gather information on the types of climate data needed, preferred formats, and the frequency of updates? If yes, how often do the surveys/discussions occur? _____		
Accuracy and Reliability:	Yes	No
Is the climate information sourced from reputable and scientifically credible institutions? <i>Examples of credible institutions are national and international meteorological services (PAGASA and World Meteorological Organization [WMO] respectively; National Oceanic and Atmospheric Administration [NOAA], scientific communities such as Intergovernmental Panel on Climate Change [IPCC]), etc.</i> What was the source of the information: _____		
Is data collection and data processing implemented with quality control measures and validation processes? Are these measures and processes reviewed?		
Timeliness:	Yes	No
Is the information updated frequently to meet the needs of users? <i>Examples: real-time data for disaster management vs. seasonal forecasts for agriculture</i> If no, what frequency of update do you require/need? _____		
Is the data disseminated as soon as it is generated? If no, how long does it take before it is disseminated? _____		
Accessibility:	Yes	No
Is the CIS available on various digital platforms - websites, mobile apps, and social media? <i>If yes, is the platform/interface user-friendly & easy to navigate?</i> _____ <i>Can you download the info?</i> _____ If yes, where did you access the climate information? _____		
Is the CIS also available offline (radio broadcasts, printed bulletins, and community meetings), especially in remote areas? If yes, where did you access the offline climate information? _____		
Usability:	Yes	No
Are training programs, tutorials, and user support available to help users/ stakeholders to understand and utilize the climate information?		
Is the climate information available in local languages and tailored to local contexts and cultural practices? If yes, in what dialect or local/cultural context? _____		
Communication and Dissemination:	Yes	No
Is climate information effectively disseminated using various communication channels (social media, SMS alerts, community workshops)? If yes, which communication channel did you access the climate information? _____		
Are there feedback mechanisms for users and is the feedback used to improve the information and services? If yes, where did you provide your feedback? _____		
Impact and Usage:	Yes	No
Were case studies or testimonials collected and analyzed to understand how CIS has been used and its impact on decision making?		
Is there a high adoption rate of CIS among the target audience? If no, identify any barriers to usage. _____		
Sustainability and Funding:	Yes	No
Does the CIS have financial sustainability (continuous funding sources and long-term financial plans)? If yes, what is funding source and for how long is it available? _____		
Is there institutional support and involvement of governmental and non-governmental organisations to maintain and promote CIS? If yes, which institution/s support to maintain and promote CIS? _____		
Total Count		



As a federally owned enterprise, GIZ supports the German Government in achieving its objectives in the field of international cooperation for sustainable development.

Published by:

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH
Registered offices
Bonn and Eschborn, Germany
Registered offices Bonn and Eschborn
Address Friedrich-Ebert-Allee 32
53113 Bonn, Germany
T +49 61 96 79-0
F +49 61 96 79-11 15
E eba@giz.de
I www.giz.de

Project description:

Towards South-South Collaboration for Climate Information and Services (SSCIS)

Authors:

Dr. Rosa Perez

Independent Consultant, commissioned by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Design / layout:

Aaron J.P. Almadro, Tacloban City, Philippines

Suggested citation:

GIZ (2025). Guidance Documents on Quality Assurance of Climate Information and Services (CIS). Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Bonn, Germany.

Photo credits / sources:

Cover © Pexels-binyaminmellish-108941

Inside Cover © Pexels-bastab-tapan-

bordoloi-481991010-15871785

Contents © Pexels-rjmadelomobilephotography-928447

P. 5 © Pexels-zeng-jinwen-679366437-17912390

P. 6 © Pexels-thirdman-7652243

P. 8-9 © Pexels-thirdman-7652039

P. 10 © Pexels-anvit-rainloure-1425442-13350163

P. 12 © Pexels-i-sa-kahraman-272682694-32376555

P. 19 © Pexels-dada-11283650

P. 20 © Pexels-pixabay-247597

P. 22 © Pexels-pixabay-460715

P. 28 © Pexels-iurii-laimin-78973777-14515491

P. 31 © Pexels-elmer0224-31584960

P. 33 © Pexels-ian-panelo-20737466

P. 34 © Pexels-julius-espanol-34482413-16330439

P. 37 © Pexels-abishoka-oleta-3651588-13154001

P. 39 © Pexels-jemsanchez-1108814

P. 41 © Pexels-kyyy-16729885

P. 43 © Pexels-red-tadeo-59231224-11592043

P. 44 © Pexels-itsehsanh-23106805

P. 60-61 © Pexels-maitri-woimae-95406915-9223052

Inside Back © Pexels-ben-traveling-96284025-14963848

Back Cover © Pexels-tomfisk-2015589

URL links:

This publication contains links to external websites.

Responsibility for the content of the listed external sites always lies with their respective publishers.

On behalf of the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV), Berlin and Bonn.

Financed by the

International Climate Initiative (IKI) and the German Federal Ministry for Economic Cooperation and Development (BMZ).

GIZ is responsible for the content of this publication.

Published in Manila, Philippines. 2025





Federal Ministry
for Economic Affairs
and Climate Action



Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

