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USAID ADAPTASI PERUBAHAN IKLIM DAN KETANGGUHAN

CLIMATE & WEATHER INFORMATION SERVICES ROADMAP

JANUARY 2017

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Program Title:	**Adaptasi Perubahan Iklim dan Ketangguhan**
Sponsoring USAID Office:	**USAID/Indonesia Office of Environment**
Contract Number:	**AID-497-C-16-00003**
Contractor:	**DAI**
Date of Publication:	**March 2017**
Author:	**DAI**

TABLE OF CONTENTS

LIST OF EXHIBIT

ACRONYMS AND ABBREVIATIONS

APIK	Adaptasi Perubahan Iklim dan Ketangguhan Climate Change Adaptation and Resilience
ARG	Automatic Rain Gauge
AWS	Automatic Weather System
AAWS	Auxiliary Automatic Weather System
AWLR	Automatic Water Level Recorder
AWOS	Automated Weather Observing System
BASARNAS	National Search and Rescue Agency
BBWS/BWS	Watershed Regional Office
BMKG	National Meteorological, Climatological and Geophysics Agency
BNPB	National Disaster Management Agency
BPBD	Local Disaster Management Agency
BPLHD	Local Environmental Management Agency
BPDAS	Watershed Management Agency
BLH	Local Environmental Agency
Dinkes	Local Health Agency
Dishub	Local Transportation Agency
Distamben	Local Mining and Energy Agency
DJF-JJA	December-January-February (Wet Season) and June-July-August (Dry Season)
DPU	Local Public Works Agency
DKP	Local Maritime and Fisheries Agency
CCROM	Centre for Climate Risk and Opportunity Management; Bogor-based NGO for climate change research organization
CWI	Climate and Weather Information
CWIS	Climate and Weather Information Services
ESDM	Ministry of Energy and Natural Resources
IMACS	The Indonesia Marine and Climate Support project
InAWARE	Disaster Management Early Warning and Decision Support Capacity Enhancement Project in Indonesia
ICAO	International Civil Aviation Organization
IUWASH	Indonesia Urban Water, Sanitation, and Hygiene Program
JABODETABEK	Jakarta, Bogor, Depok, Tangerang and Bekasi Area
KATAM	Planting Calendar
KEMENATR	Ministry of Agrarian and Spatial Plan
KEMENHUB	Ministry of Transportation

KEMENKES	Ministry of Health
KEMENTAN	Ministry of Agriculture
Kemenkominfo	Ministry of Communication and Informatics
KKP	Ministry of Marine Affairs and Fisheries
KLHK	Ministry of Environment and Forestry
K/L	Ministry/ National Level Agency
PY1	Project Year 1
PY2	Project Year 2
PIKU	BMKG's Center for Climate and Air Quality
POLRI	Police
RASON	Radiosonde Observation Network
RPJMD	Regional Medium Term Development Plan
RPJMP	Province Medium Term Development Plan
POKWASMAS	Community Group for Monitoring
Pusdalops PB	Center of Control Disaster Management Operation
PUPERA	Ministry of Public Works and Housing
PUSDATIN	Center of Data and Information
PUSLUHDAYA	Counseling Center and the Marine and Coastal Community Empowerment
RAN-API	National Climate Adaptation Action Plan
SAR	Search and Rescue
SIDIK	Vulnerability Inventory Index Information System; a product of National Climate Change Vulnerability Index owned by Ministry of Environment and Forestry
SIMAIL	Change Adaptation and Environmental Information System; a system consist of maritime weather warning for fisher folk or seaman owned by the Ministry of Marine Affairs and Fisheries
TNI	National Army/Military
TNC	Third National Communication
TV	Television
MSME	Micro, Small and Medium Enterprise
UNFCC	United Nation Framework Convention on Climate Change
USAID	United States Agency for International Development
WMO	World Meteorological Organization

DEFINITIONS

Climate (WMO), sometimes understood as the "average weather," is defined as the measurement of the mean and variability of relevant quantities of certain variables (such as temperature, precipitation or wind) over a period of time, ranging from months to thousands or millions of years.

Climate Variability (WMO) is defined as variations in the mean state and other statistics of the climate on all temporal and spatial scales, beyond individual weather events. The term "Climate Variability" is often used to denote deviations of climatic statistics over a given period of time (e.g. a month, season or year) when compared to long-term statistics for the same calendar period. Climate variability is measured by these deviations, which are usually termed anomalies. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external factors (external variability).

Climate Change (WMO) refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external factors such as persistent changes to the atmosphere or changes in land. UNFCC defines Climate Change is a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods

Data is sets of values of qualitative or quantitative variables collected for reference or analysis. Data is input to products and tools, and may be collected locally or remotely from satellites or sensors (e.g., TRMM data, in-situ weather data, crop data, elevation data, rivers data, user preferences, user feedback, and socioeconomic data, etc. Data is obtained from measurement instrumentation or observation process that is owned and managed by an institution. For example, BMKG owns weather and climatology station that spreads across Indonesia. The data can be accessed through their website (http://dataonline.bmkg.go.id/). Another example is at the subnational level: BPBD that owns automatic weather system (AWS) installed at several points in its location.

Dataset is an aggregate of data.

Decision maker is an individual who has authority to utilize (or not) information (tool, product, data, service) in a decision making context. (E.g., individuals responsible for facility operations, resource management, alerts/warnings, or planning, permitting, budgeting, or policy processes).

Derivative Product is a product resulting from benefitting the climate and weather data. For example, PVMBG and BNPB issued an exposure map to volcanic ash from volcanic eruptions. This product resulted from the modelling of volcanic ash spread where the input of that model is wind direction and speed information from BMKG. Meanwhile, BNPB added more information such as population data at each district/city. This product can be categorized as the derivative product of weather information because in the process, it cultivates and adds other information and as a result there is an existing product that has added value.

DJF-JJA-rule or **"wet and dry season rules"** in Indonesia means December-January-February for wet season and June-July-August for dry season.

Information Channel/Mode is a media channel used to deliver climate and weather information to the users. For example, website, text message, facsimile, telephone, bulletin board to name a few.

Information System is an organized system to collect, organize, store, process, automate, and distribute information that utilizes, disseminates or produce climate and weather information or its derivative products.

Method/Methodology is a specific technique/approach falling within the bounds of a set of scientific assumptions.

Model is a graphical, mathematical (symbolic), physical, or verbal representation or simplified version of a concept, phenomenon, relationship, structure, system, or other aspect of the real world created to (1) facilitate understanding by eliminating unnecessary components, (2) aid in decision making by simulating scenarios, or (3) explain, control, and predict events on the basis of past observations.

Product is information that has been processed or analysis results that use a certain dataset and become derived information with more added value. Product also defines as the output of data processing and analysis (or any organized aggregate collection thereof) to fulfill a particular purpose of a user (e.g. land cover maps, land cover change statistics, forecasts, post-disaster imagery). For example, BMKG has daily weather forecast information that is published via website, mobile application or other channels. Another example, CCROM owns information as a result of downscaled climate change projection that is used by SIDIK.

Portal is an online interface through which data, products and tools are hosted and/or disseminated. e.g. MRC Data and Information Services Portal.

Qualitative Data is information that describes attributes, properties, or qualities and are often expressed in words rather than numerically

Quantitative Data is information that can be measured or expressed numerically, typically describing amounts, ranges, or quantities

Tool is a program, model, system or device that gathers, processes and analyzes data and information to fulfill a particular purpose of a user (e.g. CREST viewer, flood mapper, frost monitor, etc.)

In analyzing the value chain of climate and weather information, market segmentation is essential to map consumer needs, producers and those that deliver the information.

In that regard, we categorize those actors into **Producer**, **Communicator**, **User** and **Beneficiary.**

Producer is an institution that produces and publishes climate and weather information data/product available for the public, free or as paid services. For example: BMKG-HO produces and publishes national weather and climate data whereas on the regional base, BMKG owns weather and climate station at each region and publishes regional weather and climate information. Other than BMKG, APIK also identifies other producers such as university, business institution and SKPDs.

Communicator is an institution/individual/group that takes into account/plays an important role in distributing climate and weather information. The delivered information can be the original information obtained from the producer or processed into derived information as an analysis. An example of a communicator is the Agriculture Agency in Batu District. This department has to distribute information to the farmers at the beginning of monsoon season through the local instructor. Furthermore, Kalender Tanam (KATAM) is an example of information that has been processed. It is published by Research and Development (Litbang) Division of Agriculture Ministry and can be accessed via http://katam.litbang.pertanian.go.id/. The information shows rainfall prediction, planting schedules and recommended commodities for planting. Example of other prominent communicator is media, printed or electronic. The media role is very significant because its accessibility can be reached by the whole society.

Users are the person/institution that directly uses the formal CWI product for their own interests (e.g. SKPD staffs, Local Marine and Fisheries Agency, Transporter).

Beneficiaries are the individual who receives the benefits of climate data, products, or tools to fulfill a particular purpose, but does not necessarily use the product directly (e.g. fisher folk, farmers).

One participant/actor can act as a Producer, Communicator or Users or a combination of two of three of them. An example of participant who acts both as a producer and as communicator is BMKG Head Office (BMKG-HO) and BMKG Regional Office (BMKG-RO). Moreover, an example of participant/audience who acts as a communicator and users is an officer/local official in a community. Apart from using the climate and weather information for personal use, this actor is also responsible to pass the information on his or her community. APIK is yet to find an example of an actor who acts as a producer as well as user. An example of the combination of the three actors is BPBD. BPBD can both consume the information from BMKG and have the authority to manage their own AWS so they can produce as well as disseminate the information. In today's crowdsourcing era, there is a growing number of actors who acts as producer, communicator and user at the same time so they can contribute to each other.

EXECUTIVE SUMMARY

Climate and weather information services (CWIS) are used by a wide range of actors in Indonesia—public, private, and civil society—to fulfill specific, placed-based needs, from maximizing crop yields to navigating coastal waters to warning communities of impending flood risk. Recent advances in technology enable meteorologists to capture larger quantities of more precise weather data, while mobile and internet-based communications are steadily (albeit disparately based on location) allowing more and more community leaders, farmers, and fisher folk to access real-time weather updates. Nevertheless, the CWIS "marketplace" remains quite fragmented with varying levels of coordination along the "value chain" of service provision that collects raw data, translates it into information useful for decision-makers, and, ultimately, leads to tangible socioeconomic and security benefits at the community level.

Building from the broad evaluation of climate services described in the **APIK Climate and Weather Information Services Assessment Report**, the following **CWIS Roadmap** sets forth the Adaptasi Perubahan Iklim dan Ketangguhan (APIK) Project's implementation strategy for improving the development and dissemination processes that will help to ensure that climate services are both *used* and *useful*.

More specifically, the Roadmap serves to narrow the Project's focus and home in on key technical assistance entry-points for the coming four years. For each of APIK's priority provinces—East Java, Southeast Sulawesi, and Maluku—the document describes: (1) priority application areas for technical assistance; (2) a preliminary analysis of specific climate services value chains within each application area, including the respective users and beneficiaries ultimately served; and (3) the Project's proposed portfolio of assistance activities to help strengthen each value chain and close critical information gaps at the place-based level. Throughout the Roadmap report—and as part of its broader approach—APIK strives to keep the users and beneficiaries at the fore, such that improvements along the value chain of climate services yield safer, more resilient communities.

The following executive summary is presented in three subsections. First, we review APIK's technical approach to improving climate and weather information services as presented in the aforementioned CWIS Assessment Report accompanied by the principal information gaps identified during the assessment process. Second, we summarize the focal areas and technical assistance strategies in the APIK priority provinces, identifying key stakeholders and partners in each locale. Importantly, the work at the provincial and local level is also then linked with supporting activities with national-level service providers. Finally, we discuss the immediate next steps during Project Year (PY) 2 as the Project transitions from the evaluation of climate services in Indonesia to activity implementation.

Technical Approach to Strengthening CWI Services

Broadly speaking, climate and weather information services consist of the hardware (sensor networks, weather station infrastructure, and IT equipment), software (trained staff, recognized communication and dissemination platforms, local awareness) and the supporting institutional arrangements (codified roles and responsibilities, data sharing policies, dedicated funding) that facilitate the systematic collection, analysis, packaging, communication, and use of meteorological, hydrological, and climate data. Robust CWIS are integral to Indonesia's

National Action Plan on Climate Change Adaptation (RAN-API) in the context of hydro-meteorological disaster risk reduction and development planning. At the international level, the WMO also recognized the critical role of improved climate services, establishing the Global Framework for Climate Services in 2012 as a worldwide mechanism for coordinated actions to enhance the quality, quantity, and application of climate services.[1]

Climate and weather information services are most impactful when an *active* process is put in place to transform raw environmental observations into actionable information communicated to the *right people* at the *right time*. Toward this end, the APIK Project uses the concept of a **climate and weather information value chain** to frame the institutional roles and action steps required in the transformation of data into decisions. These steps are: (1) raw data collection and organization, (2) product development (including data analysis, visualization, and packaging), (3) communication and dissemination, (4) application and use, and (5) benefit realization. The notion of climate and weather information services as a value chain operating in the context of a market allows us to identify and segment the key climate and weather services actors and define the roles that such actors play across all the links of the value chain. Additionally, this approach seeks to connect those that collect and produce CWI services (the "supply side") and those that apply them at the local level (the "demand side") and, ultimately, detect specific gaps or weaknesses in the value chain and target technical assistance efforts accordingly.

Based on research conducted for the Assessment Report, the APIK team previously identified a series of critical gaps along the CWIS value chain in Indonesia. Exhibit 1 below provides a summary of these gaps.

Exhibit 1 CWIS Gaps in Indonesia

Value Chain Phase	Analysis of Key Process and Information Gaps
Data Collection	• While BMKG has (and continues to make) investments in the reliable collection of observational data, significant spatial and temporal gaps persist, especially as man systems remain dependent on manual data collection. • A lack of open data policies continues to inhibit the sharing of climate information, inhibiting warning systems, the improvement of models, and the proliferation of climate research. • Even when data is in the public domain, important gaps often exist in historical datasets and platforms to access those datasets are not always reliable.
Product Development (Analysis and Packaging)	• Like many climate and weather marketplaces around the world, product development in Indonesia is supply-driven, lacking a clear focus on the needs of users and beneficiaries. • One of the main challenges for CWIS across the different landscapes is that each area has its own risk characteristics depending on the local context and issues.
Communication and Dissemination	• Local TV and radio are the primary channels people use to access timely weather information, while digital products are playing an increasing role in many areas, leading to a "digital divide" in climate services availability. • CWI dissemination is not just about posting data and products, but requires targeted marketing and capacity building.

[1] See http://www.wmo.int/gfcs/

Value Chain Phase	Analysis of Key Process and Information Gaps
	• Local staff and volunteers represent a critical link in communicating climate and weather information at the community level.
Use/Application	• While both institutional and individual users expressed moderate satisfaction with formal CWI products, there is still progress to be made on many levels, including the timeliness with which CWI products are delivered to users in order to inform actual decisions. • Many stakeholders continue to rely on personal observations and traditional climate knowledge, especially when more "formal" climate services are not available or the awareness of such services is low.
Benefit Realization	• Existing climate and weather products struggle to reach the "last mile" of beneficiaries, often failing to make it to the communities and households where they are most needed.

Regional CWI Services Strategies

Based on the CWIS Assessment Report, ongoing landscape vulnerability assessments, and associated stakeholder consultations, the APIK team identified specific application areas and associated climate services value chains in each priority province. In accordance with the WMO's Global Framework for Climate Services, we divide the application areas into five sectors: agriculture and food security, disaster risk reduction, energy, health and water. While the sectors emphasized below are likely to evolve as the Project progresses, they nonetheless provide a concrete starting point for APIK's assistance.

East Java

In the Province of East Java, APIK has forged municipal partnerships with seven districts/cities within the Brantas Watershed: Kota Batu, Kota Malang, Malang, Blitar, Mojokerto, Jombang, and Sidoarjo. The seven districts/cities make up a significant port of the Brantas Landscape, starting from the upper most of the watershed in Batu (the source of the Brantas River) until the downstream in Sidoarjo where the Brantas ultimately enters the Madura Strait. The referenced local governments are exposed to a variety of climate and disaster risks, with landslides (in the upstream areas) and flash flooding (in both upstream and downstream communities) topping the list. Drought has also become an increasing threat in the southern reaches of the watershed as the dry season becomes more prolonged and groundwater resources face greater demand and more limited recharge.

Focal CWIS Application Areas and Value Chains. The immediate focal areas for APIK in East Java are Agriculture/Food Security (AFS) as well as Disaster Risk Reduction (DRR).

Concerning the emphasis on the former, agriculture represents the principal source of income for the population of East Java as the province is one of the largest rice and maize producers nationwide. From the upstream rice paddy farmers to the downstream aquaculture farmers, communities rely heavily on ag-based incomes and are therefore highly vulnerable to erratic weather patterns and longer-term shifts in climate. In accordance with the findings of the Assessment Report, APIK will concentrate efforts on the climate services value chains for upland agriculture (including food crops, vegetables, and fruits), lowland horticulture farming, and coastal aquaculture communities (specifically pond farming and sea salt harvesting).

Agriculture extension officers and the farmers themselves require accurate, easily understood forecasts, particularly relating to the timing of planting and harvesting. Based on APIK's preliminary value chain analysis for climate services in the ag sector, key gaps or weaknesses include the following:

- The collection and sharing of rainfall data is poorly coordinated between BMKG Karangploso Station and the East Java Irrigation Agency, constraining both the temporal and spatial resolution of data. Further, many rain gauge stations in East Java are no longer operational or operate only on an intermittent basis (*Data Collection*);
- While BMKG Karangploso produces a monthly rainfall forecast bulletin, some farmers complain that it is too lengthy and difficult to understand (*Product Development)*;
- BMKG Karangploso's seasonal and monthly forecast products often do not reach the heads of communities and farming cooperatives in a timely fashion such that they can inform decision-making (*Communication*); and
- Limited "climate literacy" among ag extension officers and farmers means that they do not readily take advantage of those climate products that are available (*Use and Application*).

Regarding the Disaster Risk Reduction sector, APIK will focus efforts on CWI value chain for flood and landslide early warning systems. Riverbank communities such as Desa Galengdowo in Jombang, for example, are exposed to flash flood risk while others such as Desa Kemiri in Mojokerto are prone to landslides due to steep topography. Notable gaps in the flood/landslide early warning value chain include:

- Local Disaster Management Agencies (BPBD's) do not often have access to timely data from major collectors such as BMKG Karangploso or Perum Jasatirta I. The BPBD's also collect little hydrological data independently (*Data Collection*);
- The existing early warning systems provided by Jasa Tirta I only cover the Bengawan Solo watershed, meaning that many exposed communities do not have any formal systems established (*Product Development* and *Communication*); and
- Few community leaders are trained in the best ways to make use of climate and weather information services for the purposes of issuing disaster alerts (*Use and Application*).

CWIS Entry-Points. Following the verification of the preliminary value chain analyses, APIK will work with local stakeholders such as the BPBD of Kota Malang or BMKG Karangploso to improve how climate and weather data is collected, packaged, communicated, and applied. The following exhibit highlights proposed interventions in the Brantas Landscape.

Exhibit 2 Illustrative Technical Assistance Entry-Points for CWIS in East Java

Value Chain Phase	Activity Description	Key Partners
Data Collection	• Facilitate data sharing agreements between BMKG Karangploso, Perum JasaTirta I, and BPBD • Pilot community-based data collection systems for flood early warning.	BMKG Karangploso, PJT I, BPBDs, local communities and volunteers
Product Development (Analysis and Packaging)	• Support Meteorological Dept. BMKG-HO to develop high-resolution temporal and spatial weather prediction products for East Java	• BMKG Juanda (East Java), BMKG National Office
Communication and Dissemination	• Support BMKG Karangploso to design and produce the user-centered product suitable for multiple delivery channels	• BMKG Karangploso, BMKG National Office, Ag Extension Officers,
Use/Application	• Conduct training/ workshop/ socialization/ product marketing (e.g. Climate Field School for farmers) to improve the farmers knowledge, literacy and utilization of the CWI	• Department of Agriculture, Local Government Agencies, Farmer Cooperatives

Southeast Sulawesi

In the Province of Southeast (SE) Sulawesi, APIK has forged municipal partnerships with two local governments, namely, Kota Kendari and Kabupaten Konawe Selatan. The Province is characterized by an extensive coastal landscape as well as a dense, but rapidly degrading, rain forest in the central regions. Kota Kendari is the economic hub of the Province, with more than 300,000 people living around the edges of Kendari Bay. South Konawe District is situated in the southern part of the province, where the headwaters of the Wanggu River—the biggest river in the province—originate.

Increasingly erratic weather patterns in Southeast Sulawesi are having significant impacts on local economies and livelihoods. Protracted droughts have particularly affected irrigated agriculture, increased the risks of forest fires, and reduced fodder production for livestock. Local fishermen and seaweed producers also are impacted by recent climate trends as warming sea temperatures (and coastal pollution) are pushing fish to deeper waters, reducing the size and quality of annual fish catches, and causing seaweed producers to shift to a hardier variety that brings a lower market price. Southeast Sulawesi is especially prone to climate change and hydrometeorology disasters such as flood, tidal surges, landslide, drought, storm, and extreme waves. It is notable that the region suffered massive flooding in 2013, displacing thousands of people.

Focal CWIS Application Areas and Value Chains. In SE Sulawesi, APIK will work in both watershed and coastal landscapes, focusing our CWIS strengthening activities around the application areas of: Agriculture and Food Security (including fisheries, farming and aquaculture), and Disaster Risk Reduction (specifically for high waves, flooding, and landslides).

Regarding the Agriculture and Food Security Sector, fisher folk surveyed for the Assessment Report identified needs for better information concerning wind, wave height, temperature,

rainfall, currents, seasonal prediction, and fishing grounds. Upland farmers also noted the importance of precise and timely information on optimal planting season, drought early warning to encourage water management, and pest management practices. Based on the preliminary value chain analysis for climate services in the agriculture sector, key gaps or weaknesses include the following:

- There is no existing climatological station in Southeast Sulawesi, as the closest one is in Maros (South Sulawesi). This has greatly hindered the collection of usable, local data accompanied by the issuance of tailored forecasts. That said, BMKG does plan to open a Climatological Station in Kendari City in 2017 (*Data Collection and Product Development*);
- The mobile messaging applications for local forecasts provided by BMKG provide very low resolution which is not useful for understanding localized weather patterns (*Communication and Dissemination*); and
- The limited penetration of programs such as Climate Field Schools hinders the application of those climate products that are available (*Use and Application*).

On the Disaster Risk Reduction side, APIK will initially concentrate on the CWI services value chain for early warning systems in Kendari City. Specifically, the Assessment Report identified 37 villages as highly vulnerable to a combination of flooding and landslides. Pertinent gaps in the local warning systems value chain include:

- There are currently no early warning sensor systems in or near those villages identified as high risk to flooding or landslides (*Data Collection*);
- Only a limited number of the communities have established communication channels to disseminate information related to the threat of landslides and floods. Very few villages were found to have any type of flood warning siren, for example, and not all households were able to receive Short Messaging Service (SMS) alerts (*Communication and Dissemination*); and
- Community disaster management volunteers are not well trained by government officials in disaster response and the capacity of the local BPBD is also low (*Use and Application*).

CWIS Entry-Points. Following the verification of the preliminary value chain analyses, APIK will work with local stakeholders such as the BPBD of Kota Kendari and the forthcoming BMKG station to strengthen the CWIS supply chain. The following exhibit highlights proposed interventions.

Exhibit 3 Illustrative Technical Assistance Entry-Points for CWIS in Southeast Sulawesi

Value Chain Phase	Activity Description	Key Partners
Data Collection	• Support BPBD to set up environmental sensors for early warning systems and/or facilitate data sharing from all local hydro-meteorological instruments • Build capacity of new BMKG Station to collect data independently and from the local irrigation department.	BPBDs, BMKGs, BPDAS, BWS Sulawesi Tenggaratra, Village Officials,
Product Development (Analysis and Packaging)	• Provide technical assistance to the new BMKG Station to develop and package seasonal, monthly, and daily forecast products at a useful scale for the farming and fishing communities.	BMKG Kendari Station, BMKG National Office

Value Chain Phase	Activity Description	Key Partners
Communication and Dissemination	• Support the BPBD to establish lines of communication to community leaders for the purposes of disaster warning	BPBD, Community leaders
Use/Application	• Conduct training/ workshop/ socialization/ product marketing (e.g. Climate Field School) to improve the farmers and fisher folk knowledge, literacy and utilization of the CWI • Facilitate disaster preparedness and management trainings with flood-prone villages	Ministry of Agriculture, BPBD, Community leaders, Farmer Cooperatives

Maluku

In the Province of Maluku, APIK has partnered with two local governments, namely, the City of Ambon and Maluku Tengah District and in addition is currently in the process of expanding to Kepulauan Aru District. The Project will initially focus its work on the islands of Ambon, Saparua, Haruku and Nusalaut (collective referred to as the "*Lease"* Islands). In the Lease Islands, climate change is contributing to livelihood insecurity and producing shifts in labor patterns—from fishing to farming (and back) as well as from rural work to urban employment. In recent years, unpredictable and extreme weather, winds, and tides have run contrary to expected patterns. Traditional fishing grounds have been adversely impacted and fish stocks have declined. Many fisher folk now work at least part time in manual labor, and many return to family-owned land to farm as an alternative livelihood. Sea level rise and coastal erosion also are observable in many locations around Ambon Island and threaten many smaller communities, where precarious housing structures are highly exposed to natural hazards.

Focal CWIS Application Areas and Value Chains. In Maluku APIK will work across the small island landscape, focusing our CWIS strengthening activities around the application areas of: Agriculture and Food Security (fishing) and Disaster Risk Reduction (specifically for marine navigation safety, flooding, and landslides).

Regarding the Agriculture and Food Security sector, many fishing communities in the Lease Island landscape still rely heavily on traditional seasonal patterns and indigenous knowledge (e.g. *Nanaku*). Fisher folk engaged by APIK during the assessment suggested that they need information such as weather and wave height forecasts, extreme weather warnings, and optimal fishing grounds data. Based on the preliminary value chain analysis for climate services in the agriculture sector, key gaps or weaknesses include the following:

- There is very limited hydro-meteorological sensing equipment in Maluku, and those instruments that do exist have often fallen into disrepair (*Data Collection*);
- Local fishing communities in the Lease Islands noted that the format of CWIS products is often difficult to understand, citing the fishing grounds products from BPOL as one example of a product that is challenging to interpret (*Product Development*); and
- The BMKG Pattimura Station often has limited internet access while other fishermen do not regularly carry hand phones or smart phones (*Communication*).

As concerns Disaster Risk Reduction side, marine navigation amongst small island communities is already challenging in Maluku, with passenger ferries prone to accidents. Such

risks are only exacerbated by unexpected weather patterns and increasingly intense storm events. Unfortunately, marine and land-based warning systems in Maluku are underdeveloped, and communities are highly exposed to coastal inundation during high tides as well as flooding during storm events. Notable gaps in the DRR value chain include the following:

- As noted above, there is very low spatial resolution of hydro-met data in Maluku. Further, the data that does exist is not widely shared, including with disaster management agencies (*Data Collection*);
- Early warning products/systems are often not tailored to the village level, making it difficult for community leaders to ascertain the threat level (*Product Development*); and
- Community leaders are not aware of those CWI early warning products that do exist or are not trained by BPBD in their usage (*Use and Application*).

Exhibit 4 Illustrative Technical Assistance Entry-Points for CWIS in Maluku

Value Chain Phase	Activity Description	Key Partners
Data Collection	• Support BPBDs to set up environmental sensors for early warning systems and/or facilitate data sharing from all local hydro-met instruments	BPBDs, BMKGs, BPDAS, Village Officials,
Product Development (Analysis and Packaging)	• Improve CWI product packaging /presentation in accordance with the most widely used communication channels (i.e. television and radio)	BMKG Ambon Station, BMKG National Office
Communication and Dissemination	• Build capacity of local media outlets and radio operators to provide/present climate and weather information to targeted audiences.	Media Organizations
Use/Application	• Socialize the availability of existing CWI products (i.e. community outreach); • Facilitate disaster preparedness and management trainings with flood and coastal-inundation prone villages	BPBD, Community leaders, Farmer Cooperatives

National Level Support

In addition to conducting technical assistance at the regional level, APIK will also support national agencies in improving the packaging, dissemination, and uptake of climate and weather information services. Such efforts will directly tie to assistance the regional level, however, keeping the user and beneficiary at the fore. Key entry-points for assistance include:

- Support BMKG's National Headquarters to improve the spatial and temporal resolution (e.g. down to village level at three hour intervals) of the weather prediction products utilizing the existing radar information and regional forecast;
- Coordinate with the BMKG's Public Relation and Dissemination Division to standardize communication and dissemination processes, techniques, packaging and presentation (including standardization of format, wording and imagery) of climate and weather service; and

- Facilitate the updating and expanded implementation of Climate Field Schools as an important medium for building climate literacy amongst farming communities.

Next Steps

The CWIS Roadmap represents the starting point for strengthening the CWIS value chains identified in each region. In other words, the value chain analysis table for DRR and Agriculture and Food Security illustrate APIK's working knowledge of the context and existing gaps that prevent climate and weather data and information from reaching users and translating into benefits. Following our strengthening strategy, in PY 2 APIK will engage directly with target users and beneficiaries and work from there down the value chain to further detail activities that will lead to improved use and application of CWIS products at the ground level. Given the critical mass of CWIS products that already exist, we anticipate that most initial strengthening activities will focus on the communication phase and the use and application phase of the value chain. Notably, while the Roadmap presented four to five priority interventions in each region, APIK will remain flexible and look for opportunities to expand and scale this important work.

INTRODUCTION

Overview of APIK

USAID's five year "Adaptasi Perubahan Iklim dan Ketangguhan" (APIK) Project supports the Government of Indonesia to strengthen climate and disaster resilience, working in an integrated manner from the national level down to the regional and community levels. In support of this overall objective, APIK seeks to:

- Mainstream climate change adaptation and disaster risk reduction into national and sub-national governance frameworks;
- Build the capacity of local communities and the private sector to address climate change and weather-related natural hazards; and
- Support the use of information for climate and disaster risk management among key stakeholders.

At the national level, APIK provides technical assistance to ministries to strengthen their understanding of climate change and the impact of weather-related natural disasters, and to mainstream tools and approaches that facilitate the systematic consideration of climate change adaptation (CCA) and disaster risk reduction (DRR) in their core planning, budgeting, and operations. Given the cross-cutting nature of CCA/DRR, APIK works with economy-wide agencies—such as the Ministry of Planning (BAPPENAS) and the National Disaster Management Agency (BNPB)—as well as technical ministries such as Environment and Forestry (KLHK), Marine Affairs and Fisheries (KKP), Energy and Mineral Resources (MEMR), Public Works and Public Housing (PUPERA), Agrarian and Spatial Planning, and Agriculture (Kementan).

At the subnational level, APIK seeks to build the capacity of local governments in East Java, Southeast Sulawesi, and Maluku to address CCA and DRR through planning and operations, public outreach, and the institutionalization of resilience-building practices in day-to-day activities. With a regional office located in the respective provinces, the Project works in targeted landscapes with the communities on the front lines of climate change and disaster resilience in the target districts to implement measures and link those measures to the relevant government processes in a holistic systems approach.

Crosscutting the national and subnational levels, APIK further seeks to mainstream CCA/DRR into the private sector as well as improve uptake and utilization of climate and weather information (CWI) services. Private sector engagement is critical to addressing shared economic risks and livelihoods, while improved climate and weather information services empower public and private institutions alike to better prepare for and respond to climate and disaster risk.

The APIK Project applies a technical approach centered on **place-based resilience,** which emphasizes that vulnerability to natural disasters and climate change are directly linked to each locale's unique landscape, socioeconomic, and institutional characteristics.

Climate and Weather Information Services

In an era of increasing meteorological and hydrological uncertainty, climate and weather information systems are fundamental to fostering place-based resilience, saving lives in the near term through disaster preparedness while supporting better planning and investment in the long term through climate change adaptation.

Broadly speaking, **climate and weather information services** consist of the hardware (sensor networks, weather station infrastructure, and IT equipment), software (trained staff, recognized communication and dissemination platforms, local awareness) and the supporting institutional arrangements (codified roles and responsibilities, data sharing policies, dedicated funding) that facilitate the systematic collection, analysis, packaging, communication, and use of meteorological, hydrological, and climate data. Robust CWI services are integral to Indonesia's National Action Plan on Climate Change Adaptation (RAN-API) in the context of hydro-meteorological disaster risk reduction and development planning. The World Meteorological Organization (WMO) also recognized the critical role of improved climate services, establishing the Global Framework for Climate Services in 2012 as a worldwide mechanism for coordinated actions to enhance the quality, quantity, and application of climate services (see http://www.wmo.int/gfcs/).

Improved data and information is not an end in and of itself but must be linked to institutional capacity building, pro-poor programming for sustainable livelihoods, and trans-boundary ecosystem management. Indeed, the availability of reliable climate and weather data is not sufficient; rather, it must also be effectively translated and communicated in a manner that supports informed decision-making and action. Government, businesses, and communities need data and tools to address climate change and climate related natural disasters. Critically, they need that information to be packaged in ways that are usable, clear, collaboratively developed, and provide a basis for action.

A key tenet of the APIK Project's approach, therefore, is that, by strengthening the capacity of stakeholders to develop, disseminate, and apply tailored climate information services that are closely aligned with the information needs of practitioners, the use of climate and weather information services will increase and empower people to better manage climate and disaster risk. Strengthening CWI services will, for example, empower farmers to understand the impacts of the El Nino Southern Oscillation (ENSO) and adjust the timing of crop rotations accordingly; help keep fishermen safe during the hazardous monsoon season; assist local government planners to incorporate extreme weather patterns into infrastructure investments; and allow Regional Disaster Management Agencies (BPBDs) to give more advanced warnings to communities. Simply put, strengthening climate and weather information services can help people to live safer and more prosperous lives.

Roadmap Objective

The objective of the APIK Climate and Weather Information Services Roadmap is to present the Project's strategy to develop, disseminate, and institutionalize climate and weather information services among appropriate local or national entities. More specifically, the Roadmap seeks to identify climate services that can close critical information gaps at the place-based level, and, further, describe the Project's approach to strengthening those services.

The Roadmap builds directly on APIK's Climate and Weather Information Services Assessment Report, which catalogued the existing actors, data, products, and users of climate services in Indonesia while also homing in on key gaps or weaknesses in the CWI marketplace (see the summary of the Assessment Report in Annex 2). In line with the approach of the Assessment Report, the Roadmap analyzes the "value chains" for climate services within APIK's priority regions (East Java, Southeast Sulawesi, and Maluku) and sets forth the Project's proposed technical assistance entry-points over the coming four years (2017 – 2020). While the activities are principally related to Task 3 of the APIK Project, they will also support the achievement of results under Tasks 1 and 2 and the high-level outcomes more broadly.

Report Structure

The Climate and Weather Information Services Roadmap is organized into seven chapters. The remaining six chapters are as follows:

Chapter 2 describes the concept of CWI services as a "value chain" which moves climate and weather data through a series of phases from collection (origination) to benefit realization.

Chapters 3, 4, and 5 describe APIK's approach to improving climate and weather information services in each priority province, including a brief profile of each landscape, the rationale for the selection of specific application areas, preliminary value chain analyses, and technical assistance entry-points for PY 2 and beyond. Notably, the Roadmap follows the nomenclature introduced in the WMO's Global Framework for Climate Services the when referring to the specific application areas.[2]

Chapter 6 briefly describes APIK's technical assistance strategy with national agencies such as BMKG, including how this assistance will directly address gaps in climate services value chains at the regional and local level.

Chapter 7 provides a summary of the assistance strategy presented in the Roadmap and then identifies immediate next steps.

[2] The WMO's Global Framework for Climate Services classifies activities into the following priority areas: agriculture and food security, disaster risk reduction, energy, health, and water. See: http://www.wmo.int/gfcs/priority-areas.

CWI SERVICES VALUE CHAIN

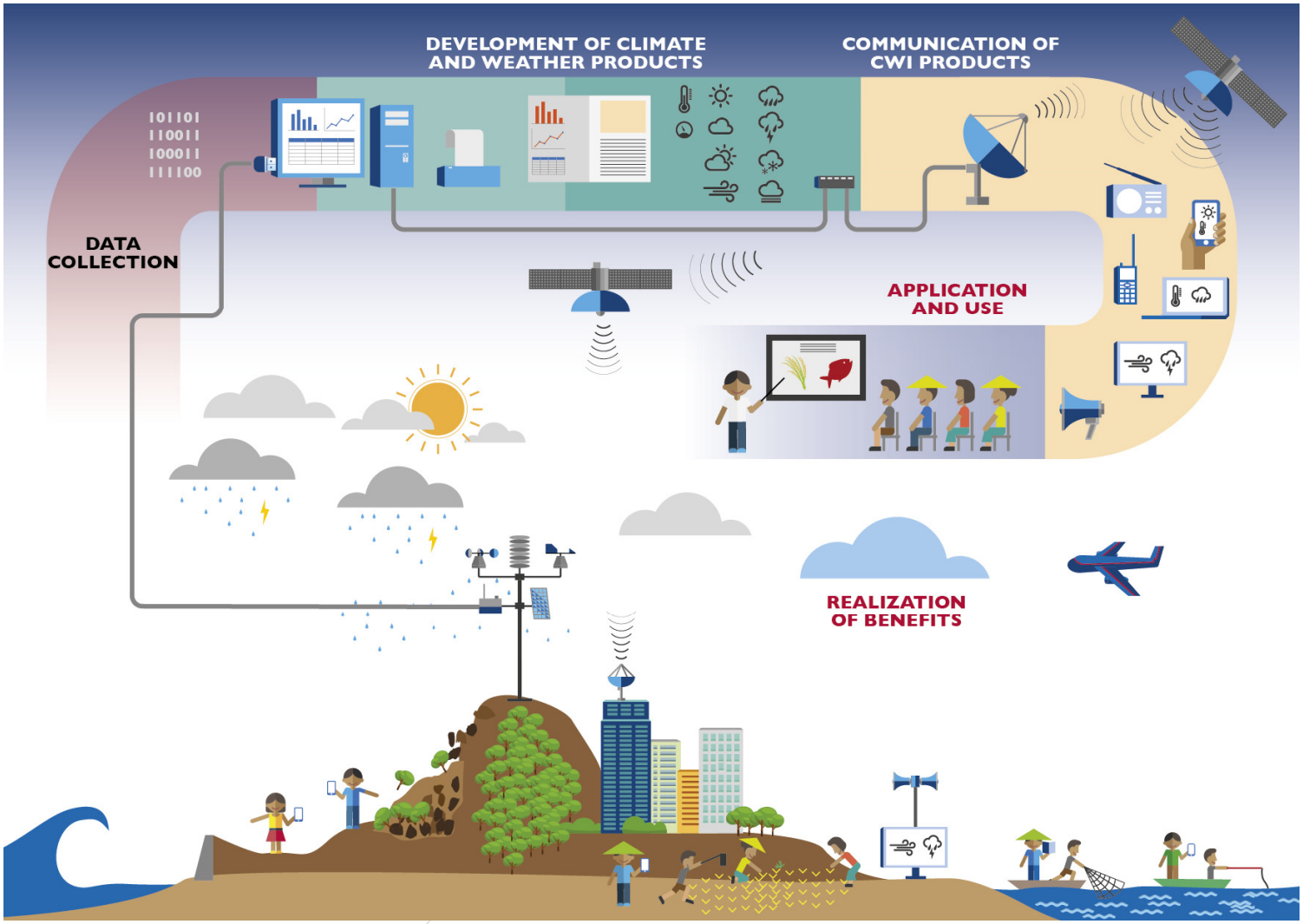
The acquisition and application of relevant, accurate, and reliable climate and weather information to support local decision-making is critical to bolstering resilience and mitigating disaster risk. While it is easy to view climate and weather information services as a *passive* process centered on the establishment of monitoring systems and the cataloging of trends, such services are most impactful when an *active* process is put in place to transform raw data into actionable information communicated to the right people at the right time. In this sense, the series of steps involved in the transformation of data into decisions are akin to a product **value chain** in which the raw materials—environmental data—are collected, processed, packaged, and disseminated for "market" consumption.

The notion of climate and weather information services as a value chain operating in the context of a local market represents an important aspect of APIK's approach to the analysis and evaluation of the effectiveness of such services in Indonesia. More specifically, adopting a value chain approach serves to:

- Identify and segment the key actors responsible for moving climate and weather information through the value chain;
- Define the roles that actors play across all the links of the value chain. Notably, a single institutional actor may (and often does) play more than one role, such as managing both the collection of data as well as the packaging of that data into a CWI product;
- Connect the "supply-side" of climate and weather information services to the "demand side", or those that collect and produce CWI services and those that apply them at the local level. In this regard, it is essential that CWI products be designed and communicated with the end-users and beneficiaries in mind; and
- Detect specific gaps or weaknesses in the value chain and target technical assistance efforts accordingly.

Exhibit 5 depicts the five stages or "links" in the climate and weather information services value chain: data collection, product development, communication/dissemination, application and use, and benefit realization. Each link in the chain is of equal importance to the achievement of the ultimate objective of CWI services, namely, helping people better manage climate and disaster risks in the context of their livelihoods and communities. For illustrative purposes, Exhibit 5 considers the value chain stages for CWI product(s) aimed at helping farmers, fisher folk, and communities make better livelihood decisions and be more prepared for natural disasters.

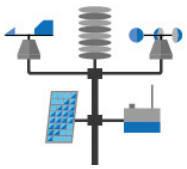
Exhibit 5 CWI Services Value Chain



Value Chain Phases

The following subsections discuss each stage of the value chain in turn, including key concepts and definitions that will be used throughout the remainder of the assessment report.

Data Collection. In the context of the climate and weather information services value chain, **data** may be defined as sets of values of qualitative or quantitative variables collected for reference or analysis that then serves as an input to products and tools further up the CWI value chain. Qualitative data generally describes attributes, properties, or qualities of the environment, and is often expressed in words rather than numbers.



Quantitative data, on the other hand, represents information that can be measured or expressed numerically, typically describing amounts, ranges, or quantities. Importantly, data may be collected *locally* (such as through direct observation or environmental sensors) or *remotely* via aerial photography or satellites. Raw climate and weather data, then, comes in

many different forms, including TRMM satellite data, in-situ weather data, crop data, elevation data, hydrological/flow data, and structured by user data preferences. Data is generally aggregated into a **dataset**, which consists of the same type of data over a given period.

Under the auspices of this assessment, a **collector** is any institution, entity, or individual that has a formal responsibility to gather, organize, and store raw climate and weather data from the environment. As discussed in detail in the next chapter, BMKG represents the largest CWI collector in Indonesia, maintaining a vast network of weather and climatology stations across the archipelago with the resulting data then made available on their website (http://dataonline.bmkg.go.id/). An example of a collector at the subnational level is the Watershed/River Management Agency (BBWS), which generally owns a separate network of automatic weather stations (AWS) installed within its jurisdiction.

A robust climate and weather information value chain begins with data that is collected at the necessary spatial and temporal resolution in a transparent, standardized, and reliable manner. One common CWI gap is that data is not collected within a geographic area that is relevant to decision-making (spatial resolution) due to the limited number of stations; a second is that data is collected infrequently, making it difficult to understand the speed of environmental change (temporal resolution). Additional complications that frequently inhibit data collection or organization include the poor maintenance of observation stations as well as the lack of transparent and standardized collection procedures. Importantly, the extent to which raw data is widely shared also represents a significant determinant of how readily the climate and weather information market develops to meet the needs of a diverse group of stakeholders.

Development of Climate and Weather Products. In the second stage of the CWI services value chain, raw environmental data is transformed into an information product through trends analysis, visualization, and packaging into an easily consumable format. Many potential users do not have the time, expertise, or resources to analyze multiple datasets, develop and interpret trends, and then present the results in a manner that is readily understandable by decision-makers. In other words, local users often need information to be packaged in ways that are usable, clear, collaboratively developed, and provide a basis for action.

Toward this end, a CWI **product** represents the output of data processing and analysis—or any organized aggregate collection thereof—to fulfill a particular purpose of a user group. Such products are often created by using a particular climate and weather information **tool**, which is a program, model, system or device that processes and analyzes data and information to fulfill a given stakeholder information need.

Developed and packaged by a **producer**, CWI products may take many different forms. BMKG, as the official producer of climate and weather information in Indonesia, offers a broad portfolio of different climate and weather products, such as daily and seasonal weather forecasts that are published via its website, mobile applications, or other channels. Indonesian universities are also common producers in Indonesia; CCROM at the Agricultural institute of Bogor, for example, has created products that illustrate downscaled climate change projections; Weather and Climate Prediction Laboratory Institute Technology of Bandung (WCPL-ITB) also contribute to weather data collection, dissemination and prediction analysis in the Bandung area. Producers may develop climate and weather products that are freely available for public use as well as for the purchase of specific clients.

Throughout the Roadmap, we also refer to **derivative products,** which are "secondary" products created from processing two or more sets of climate and weather data. For example, PVMBG and BNPB sometimes publish an exposure map for volcanic ash that combines two pre-existing analyses—a model of volcanic ash spread (based upon digital elevation, wind direction patterns, and wind speed information) accompanied by population density estimates from BNPB. In other words, the resulting volcanic ash exposure map integrates and adds value to existing analyses and products to create a new, highly tailored secondary product incorporating both weather and natural disaster risk.

Communication of CWI Products. Climate and weather information products are only helpful if potential users are aware of their existence and are able to access them. More than simply sending a text message, communication must entail a degree of marketing which explains the importance of the product and how it can be applied. For products or tools that are more complex, training may also be required in order to maximize the impact of the packaged information or a software program.

A **communicator** is an individual or entity that takes into account/plays an important role in the messaging and distribution necessary to get climate and weather information into the hands of users. The delivered information can be the original information obtained from the producer or processed into derived information as an analysis. An example of a communicator is the Ministry of Agriculture, which is responsible for the distribution of seasonal weather information to farmers at the beginning of each monsoon season. Through its Integrated Planting Calendar (*Kalender Tanam*, or KATAM), the Agency communicates important information about the upcoming season, such as whether to anticipate a dryer or wetter season than normal. Communicators use a variety of **information channels** or **modes** to deliver messages and disseminate products, including websites, text messages, instant/social messaging, radio, bulletin boards, training courses, and user forums (such as *Kontak Tani Nelayan Andalan*, or KTNA).

Application and Use. Under the fourth stage of the value chain, climate and weather information is applied to the local context and used to make decisions and formulate specific actions or strategies. The effectiveness and impact of a given CWI product or tool therefore depends upon the extent to which it actually assists in making better decisions. As such, the number of downloads or text messages may provide a good indication of the *reach* of a product, but it does not necessarily mean that the product is actually used or useful.

A user of CWI may be defined as an individual or institution that consults climate data, products, or tools in order to make a decision or fulfill a particular purpose. Depending on the data, product, or tool, users may be analysts or decision-makers, and they are often responsible for directly supporting communities, households, and individuals to apply the products. In the illustrative value chain presented in Exhibit 5 the user may be an agricultural extension officer who is consulting CWI products developed and communicated through the Ministry of Agriculture to help farmers make decisions on what commodities to grow this year and when to begin planting.

In the sense that the user represents the demand-side of the CWI market, the term **consumer** is also used interchangeably. Whether paying for a CWI product or obtaining it freely, a user nonetheless has a choice as to whether to consult the product in the first place. It is, therefore, essential that the consumer's needs be the principle driver behind the decisions on what data is collected, the types of products developed from that data, and the modes in which said products are communicated.

Realization of Benefits. The collection, packaging, communication, and application of climate and weather information come to fruition when informed actions or strategies are implemented at the local level, yielding concrete benefits to communities and households. A CWI **beneficiary**, therefore, is an individual who receives the benefits of climate data, products, or tools to fulfill a particular purpose, but does not necessarily use or interact with the product directly.

In many cases the user and the beneficiary will be one in the same, such as an individual that receives a flood alert text and decides that the best course of action is to evacuate to the home of an inland relative. Nonetheless, it is important to distinguish between "use" and "benefit" as there are also cases in which those who experience tangible assistance from a given product do not actually interact with it in any way.

In agricultural extension services, for example, a farmer that simply heeds the advice of an extension officer on what to plant and when is best viewed as a beneficiary and not a user, as the farmer does not directly consult the seasonal forecast product from the Ministry of Agriculture. It is also helpful to differentiate between use and benefit as there may be external pressures at work that prevent CWI use from translating into benefits. The lack of funding or cultural norms, for example, may block decisions or strategies informed by CWI services from implementation. Fundamentally, this means that the lack of action is not due to the CWI product or underlying data, but is instead a function of the broader enabling environment.

The Range of Value Chain Complexity

While the CWI value chain depicted in Exhibit 5 can be relatively complex with different actors at each stage collaborating across a large geographic expanse, the spectrum of climate and weather services also includes simple, highly localized services involving one or two actors at most. Indeed, it is all too easy to become caught up in the world of remote data collection, networked weather stations, intricate forecasting models, online visualization tools, smart-phone-based communication platforms, etc., and forget that communities have been observing, interpreting, discussing, and acting upon trends in the weather for centuries. The weather forecasting stone shown in Exhibit 6 is a good (and humorous) reminder that sometimes the most accurate and user-friendly climate and weather information is also the simplest.

Exhibit 6: Weather Forecasting Made Simple

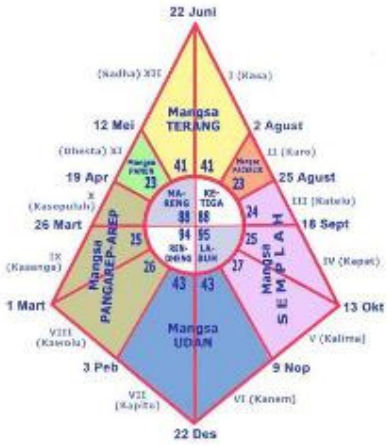
Source: http://theweatherstone.com/

Although the focus of the CWI Assessment Report is on **formal** climate and weather information services, it is therefore also important to recognize and incorporate the role of **informal** climate and weather information that is woven into the cultural fabric of a community. Such informal information often builds on a rich history of indigenous knowledge and experience and undoubtedly influences how formal CWI services are applied within the local context.

Importantly, there are many ways to simplify or "shorten" the CWI value chain. As discussed previously, a single actor can serve singularly as a collector, producer, communicator, user, or beneficiary, or in a combination of roles. The BMKG Head Office (BMKG-HO) and BMKG Regional Offices (BMKG-RO), for example, often function as collectors, producers, and communicators. Further, a local official may act as a communicator, consumer, and beneficiary. Apart using the climate and weather information for personal use, this actor is also responsible to pass the information on his or her community. Notably, in the era of crowdsourcing, more and more actors serve as collectors, producers, communicators and consumers at the same time.

Exhibit 7: "Pranata Mangsa" an old-javanese season calendar

Source: http://1001indonesia.net/



In addition to aggregating responsibilities under a single actor, a CWI service can also be localized such that all functions of the value chain are carried out in a limited geographic area. A local District Disaster Management Agency (BPBD) has the authority to manage its own automatic weather station, meaning that they can collect, package, and communicate disaster warnings independently in a short time span. Flood warning systems are often localized even further in the form of community-based warning and monitoring systems. Such an approach gives those responsible for the system a high incentive to maintain it given that they are also users and beneficiaries.

Cross-Cutting Themes of the CWI Value Chain

While the nature of the type of data collected and the products developed will be different from one sector or risk area to the next, the key phases of the CWI value chain depicted in Exhibit 5 remain the same. A key objective of this assessment report, then, is to obtain a better understanding of how information moves through these phases and where roadblocks exist that diminish the impact of this information. In this regard, the following three crosscutting criteria provide a helpful means to measure the effectiveness of climate and weather information systems:

Access. Generally speaking, "access" is the degree to which stakeholders are able to obtain the data, information, or products they need at each step of the value chain. The level of access is generally determined by what types of data is collected, the forms in which it is shared, and the mode of communication. Deficiencies in access may occur for a number of reasons, including failure to collect the relevant data, the packaging and distribution of information in incompatible formats (i.e. hard copy as opposed to digital format), or the selection of an inherently restrictive communication mode. Importantly, wealth and gender in equities are also frequently at the root of differences in levels of access.

Reliability. The "reliability" of raw data, finished products, and supporting communications and messaging considers the degree to which these pieces of information can fully depended upon to do what a stakeholder needs and expects. Reliability is multi-dimensional, and includes whether information is accurate, adheres to standard data collection processes, and is shared in a timely and predictable manner. Reliability is also closely linked to perceptions of institutional trustworthiness; people are hesitant to make decisions based on information from collectors or producers, for example, with a poor track record.

Use. Finally, "use" is the degree to which the data/information is used to make products, products are used to make decisions, and those decisions translate into action. Questions of use, in other words, occur at each step of the CWI value chain, making the notion of user-centered design all the more critical to getting the right information into the right hands at the right time.

As we review existing climate and weather products in the following chapters, we will return to the criteria or "lenses" of access, reliability, and use to frame the assessment of climate and weather information services in different sectors and geographies.

Climate Field School

One of the BMKG programs that aims to disseminate climate products to the grass roots level such as fisherfolk or farmers that living in rural or remote areas and increase their climate literacy.

EAST JAVA

Introduction

APIK will focus on the following seven districts/cities in East Java within the Brantas Watershed: Kota Batu, Kota Malang, Malang, Blitar, Mojokerto, Jombang, and Sidoarjo. The seven districts/cities make up a significant port of the Brantas landscape, starting from the upper most of the watershed in Batu (and source of the Brantas River) until the downstream in Sidoarjo (where the Brantas ultimately enters the Madura Strait).

Exhibit 8: APIK's seven targeted District/City in Brantas Watershed

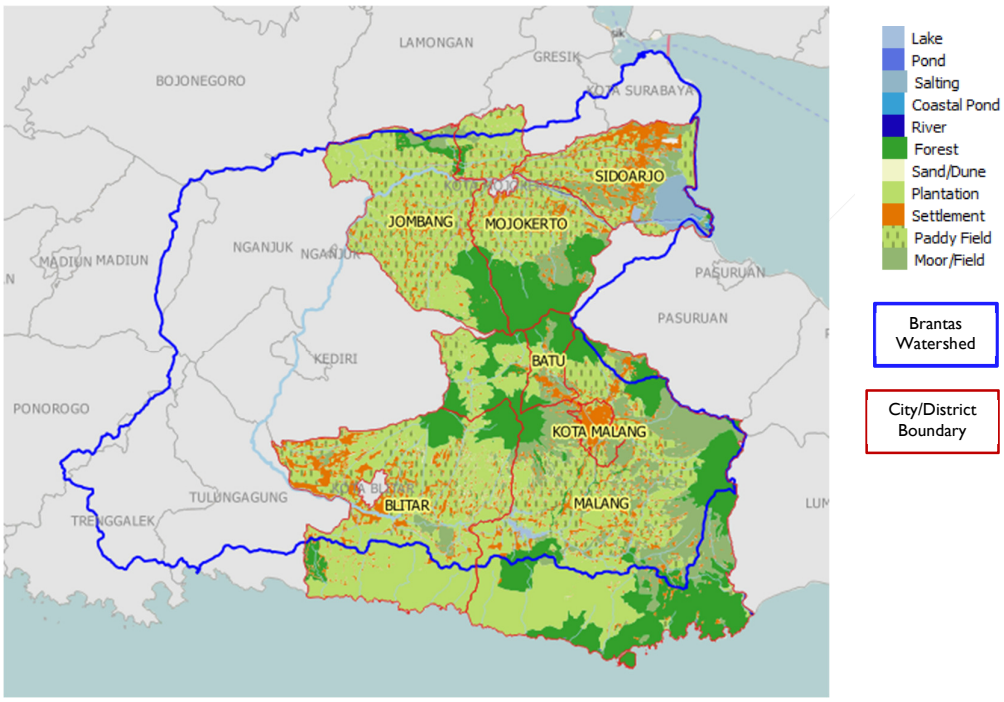


Exhibit 9 below summarizes the major climate and disaster risks facing APIK's priority municipalities in East Java.

Exhibit 9: Climate Risk affected sectors on APIK's district/city in East Java[3]

City/District	Climate and disaster risks facing the landscape
Malang City	■ Operational disruption of some sectors of the economy as a result of extreme weather and prolonged rain ■ Due to high density of population, Malang have potential issues on water supply ■ Water shortage is rated High in west part of Malang City. By 2030, the projection analysis projected that the risk categorized as Very High ■ Malang city categorized as High Risk on dengue. The incidence of dengue tends to increase prior to increment of rainfall.

[3] Compiled from APIK Project Year 2 Work Plan, Site Selection Memorandum, CWIS Assessment Report & KRAPI Report

City/District	Climate and disaster risks facing the landscape
	■ Other hydro-meteorological disaster including flood on the river bank slump areas, landslide and strong wind
Batu City	■ The upland agriculture are impacted by the climate variability (e.g. the quality of apple production is lower than before) ■ Major disaster issues include Landslide, Drought and Flash Flood ■ The threat of landslide in the area is high and it may impact tourism industry ■ During rainy season, small scale of landslide is happen in many locations in Batu ■ Urban drainage and clean water network issues
Malang District	■ The agricultural sector is one of the sectors that very open to climate change and variability including during powerful El-Nino/La-Nina influence ■ Planning and agricultural activities depends on climatic conditions ■ During dry season, drought significantly affected agriculture sector in southern part of Malang District ■ Temperature rise has already impacted productivity of agricultural land ■ Hydro-meteorological disasters dominate by Flood, landslide and strong wind ■ More concern on flood risk due to 5 watersheds and regional system
Jombang District	■ Manufacture industry are big users of Brantas river water ■ Recent disaster includes Drought, Flood and flash flood, landslide on the Arjuna mountain area ■ Agriculture, mostly rice farmers affected by drought ■ In some region (Jatigedong and Trawasan) the flooding comes once or twice a year and inundates both agriculture and residential areas ■ The extreme weather and floods affected plant production both in terms of quality and quantity and sometimes even crop failure ■ Some farmers facing crop failure due to the high intensity of rainfall and floods which inundated his paddy field nearly every year ■ The long period of rainfall season is not good for corn growth; it can decrease the quality and quantity of corn, and the heavy rainfall at the harvesting time can bring a great loss and crop failure.
Mojokerto District	■ Landslide is the main disaster risk, followed by flooding and drought ■ Drought has been an annual phenomenon that occurs in several villages in Mojokerto. In September 2013, drought occurred in 35 villages in 11 sub-districts. The most affected area was paddy field areas, while water was obtained from neighboring villages ■ The climate stress has decreases the yield and crop quality and increasing plant and pest diseases ■ Climate impact on rice farming is significant
Blitar District	■ Main livelihood: Agriculture and plantations. ■ The big hydroelectric plant is located in Karang Kates Blitar, together with Malang District. This plant will depend on the water resources in the upstream. ■ Recent disaster includes Flood, landslide, and strong winds. ■ The other risk are water scarcity and high tide in southern of Blitar ■ Rain fall fluctuation has negatively impacted the electricity production
Sidoarjo District	■ Around 29.99% of the area is aquaculture in the eastern part of the district. Aquaculture industry in this region has been affected by the erratic weather and extreme weather conditions such as high waves ■ Characterized by low lying land (Bantas downstream) often hit by floods ■ Seasonal variability and extreme weather are also a risk for farmers and fisher folk ■ Flood and seasonal changes impact the aquaculture industry productivity

City/District	Climate and disaster risks facing the landscape
	■ Rice farming in Sidoarjo is also impacted by climate variability, although the number of rice field is getting smaller due to urbanization which also creates water resource challenges ■ Porong is one of the sub-districts considered as high risk to flooding

Application Area Selection Rationale

Aligned with WMO's Global Framework for Climate Services, we divide the application areas into five areas: agriculture and food security, disaster risk reduction, energy, health and water. For PY 2, the priority areas for APIK in East Java are **agriculture and food security** and **disaster risk reduction** (e.g. early warning system) specifically on floods, landslides and drought. However, some activities in PY 2 will also have an impact on other areas such as water and health, and APIK will specifically shift to these areas in PY 3. APIK also plans to carry out activities related to water scarcity, especially in anticipation of the impact of 2017's summer season.

Agriculture in East Java is the principal source of income for the population, including in several of APIK working cities/districts. For the record, the agricultural sector also includes agro-tourism and downstream agriculture such as salt farming and fish farming. Almost all community livelihoods in APIK's East Java cities/districts are engaged in the agricultural sector on one manner or another.

Many cities and districts in East Java are prone to **flooding** and **landslides** (as described in Exhibit 9). The increase of extreme weather events has raised the risk of floods and landslides in the region in recent years. Flood risk is exacerbated in urban areas by the lack of proper drainage facilities; drainage infrastructure that does exist rarely incorporates the extreme events associated with climate change, further heightening the potential for disastrous flooding. Land use change and a burgeoning population also contribute to East Java's vulnerability, making disaster risk reduction an important starting point for APIK in PY 2.

Agriculture and Food Security

Context

The agricultural sector (in this subchapter defined as upland, midland, aquaculture and salt farming) needs considerable CWI service improvement. Currently, many farming communities have not taken advantage of climate services to inform their farming practices. During the assessment, farmers stated they need CWI related to the timing of the start of the rainy season to inform planting and harvesting, information regarding seasonal variability, as well as daily weather forecasts (that include rainfall, temperature, humidity, wind direction, and weather prediction). The profile of Farmer Husein on page 36 below provides a snapshot of the unique needs and challenges faced by farmers in East Java.

Preliminary Value Chain Analysis

The following chart illustrates APIK's high-level understanding of the CWIS value chain for the agriculture and food security in East Java.

Exhibit 10: Preliminary Value Chain Analysis for Ag and Food Security Value Chain in East Java

CWIS Value Chain Analysis		
Geography: East Java, Brantas Watershed **Climate and Weather Threat Trends:** Climate Variability such as La-Nina/El-Nino, Drought, Unpredictable Weather, Extreme Rainfall		**Application Area:** Upland agriculture, focusing on food crop, vegetables and fruits. Lowland agriculture, focusing on food crop and horticulture farming. Aquaculture, focusing on pond farming and salt farming.
Phase	**Context**	**Gaps**
Benefit Realization  Decisions implemented yielding concrete benefits to people and communities.	**Beneficiary:** • Farmers located in the uplands of the Brantas Watershed (e.g. vegetables, fruit). • Farmers located in the mid-stream of the Brantas Watershed (e.g. rice). • Fish and Salt Farmers **Benefit:** • Maximization of crop and pond yield and quality in the upcoming season, which supports household incomes, improves food security and agro-tourism.	• Only a few farmers who aware of the climate variability threat (e.g. ENSO, Extreme Weather), it makes most of them doesn't seek CWI to support their farming decision.
Use and Application  Information used to make decisions in local context.	**User(s):** The primary users of seasonal forecast products are Ag. extension officers, although some farmers also directly review the forecasts independently. **Decision Type:** The timing of planting, harvesting, drying day, anticipate pests, prevent high wave enter the pond, spread the seed, and adjustment on cultivation processes.	• Limited and low capabilities of Extension Officers to adapt new CWI products; • Limited farmers climate literacy and knowledge how to maximize the utilization of the CWI products; • The socialization program such Climate Field School does not cover many villages; • Many farmers still using manual observation, traditional method, and follow DJF-JJA-rule for planting and harvest planning.

Phase	Context	Gaps
Communication Information reliably communicated through trusted mode.	**Communicator(s): Primary**: BMKG; **Secondary**: agriculture agency, plantations agency, animal husbandry dept., forestry service, fishery agency, Ag. Extension, Sugar Factory, Ranch Company, BBWS and BPBD. **Channel(s):** Monthly Ag Extension Meetings and Training; Kontak Tani; Sugar Farmers Community Meeting; word of mouth among community member, Electronic Media (Television, Radio, Website, Instant Messaging Group and Social Media); and Manual Correspondence (e.g. Letter).	• Limited access mode (e.g. not all fisher folk use handphones or smartphones, not all farmers join the farmer's community); • BMKG Bulletin for monthly seasonal forecast was not distributed properly to the hands of community member; • Most of the farmers access the CWI from TV, meanwhile the information from TV have limited information.
Product Development Data transformed to information via analysis and packaging.	**Product(s) and Producers:** • BMKG Karangploso produces a monthly rainfall forecast bulletin. Similar information is also captured in the KATAM planting calendar issued by Ministry of Agriculture. • BMKG provides daily weather prediction, wave height information, wind direction and near real-time early warning	• Some farmers are complaining that the format that is difficult to understand; • Some farmers need for more detailed CWI that is specific to their village (i.e. greater spatial resolution); • The monthly rainfall analysis in Bulletin is length (50+ pages), text heavy and too many technical terms that farmers don't understand.
Data Collection Data collected in standardized manner at needed resolution.	**Collector(s)**: BMKG Karangploso Station, East Java Irrigation agency. **Raw Data Needs:** Daily rainfall data, regional forecast analysis runs. **Data Sources**: • BMKG Karangploso operates 36 ARG, 14 AWS, 7 AAWS • BMKG Karangploso and Irrigation agency operates ±992 manual rainfall gauges. • BMKG Juanda open radar data and publish Early Warning for Extreme Weather • BMKG-HO provides regional observations through satellite imagery	• There is an issue in the process of data collection of Rainfall Station that managed in collaboration between BMKG and Irrigation Department; • No proper data sharing procedure between collectors.

"I have lost 150 million Rupiah from cabbage crop failure due to excess of rainfall. My Sugarcane quality is reduced and the transportation is disrupted."

"We need more socialization of weather and climate information to farmers such as counseling and training, so that we can reduce the impact of disasters and minimize loss."

Name	Farmer Husein
Age	46-55 yr
Livelihood	Farmer
Village	Wonokerto, Malang District
Landscape	Mid-stream of Brantas, Hilly, Rural, Farming Area
Main Commodity	Sugarcane, Corn, Paddy
Land	± 1 Ha
Secondary	Vegetables (eggplant, cabbage, etc.)
Yearly Commodity	Wood
Secondary Livelihood	Cattle (Chicken, Goat, etc.)

Climate Changes Perceived
Raised temperature, higher extreme rainfall, unpredictable weather, shorter dry season (this year), longer dry season (last year).

Climate Change Impact
- Crop failure & reduce crop quality (sugarcane immersion) during La-nina year.
- Harvest transportation disrupted.

Adaptation Strategy
Changing Variety for Paddy

Experienced Disaster
- Flood due to Dam Muhardjo Failure (around 2012 – 2014)
- Water Scarcity, Dam Muhardjo is dry during 80s

Indigenous Knowledge
Pranata Mongso (Traditional Season Calendar)

Source of Weather & Season Information
- Farmers FGD called "Kontak Tani/Forum Temu Kemitraan" placed at Sugar Factory Krebet.
- TV, News Paper, Whatsapp Group

Role in CWI dissemination
Disseminate to Friends, Community or Colleagues using sms, Whatsapp, Telephone, Email.

Disaster Risk Reduction

User Context

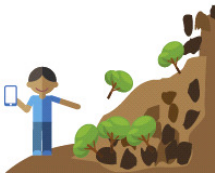
Many riverbanks community that are exposed to the dangers of flooding, landslides and drought lack the capacity to exploit climate and weather information services as a means to mitigate risk. Currently there are several villages in APIK's municipalities with very high risk of flooding and landslides. For example, Sitiarjo Village is in a flood prone area because the village is located in a natural basin where two rivers converge. However, there are no official procedures in place to publish flood or landslide early warning alerts to the riverbanks community using the data from BMKG sensors. This is despite the fact that BMKG Juanda has Radar that can observe cloud movement every 10 minutes with accuracy above 80%.

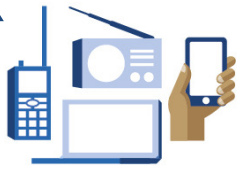
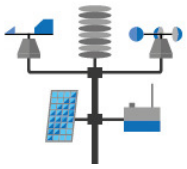
Preliminary Value Chain Analysis

The following chart illustrates APIK's high-level understanding of the CWIS value chain for the flood/landslide early warning systems (Disaster Risk Reduction) in East Java.

Exhibit 11: CWIS Value Chain for Early Warning Systems (Disaster Risk Reduction) in East Java

CWIS Value Chain Analysis	
Geography: East Java, Brantas Watershed	**Application Area:** Disaster Reduction focusing on Flood, Landslide and Drought
Climate and Weather Threat Trends: Intense rainfall, extreme weather, prolonged dry days	

Phase	Context	Gaps
 Decisions implemented yielding concrete benefits to people and communities.	**Beneficiary:** the community exposed to flood and landslide (e.g. riverbank, hilly settlement, unstable areas) **Benefit:** The exposed communities are safe from the landslide and flood threat. They receive sufficient warning information in spatial and timely manner to evacuate before disaster event occur.	• In several village there is no intervention yet from the local officials for early warning system or how community members should deal with landslide and flood threats
Use and Application  Information used to make decisions in local context.	**User(s):** BPBD and exposed community **Decision Type:** ▪ When to be vigilant, when to prepare for evacuation, when to immediately evacuate ▪ Prepare for the catastrophic impact on cropland, plantation or pond	• The users are not well trained by the local disaster management agency (BPBD) • Fewer community who are trained to use the product of CWI for early warning purposes

Phase	Context	Gaps
Communication  Information reliably communicated through trusted mode.	**Communicator(s):** Primary: BMKG, BBWS and Perum Jasa Tirta I; Secondary: BPBD, local volunteers, Head of Village/RT/RW, Local Media, Community Radio, other SKPDs. **Channel(s):** Electronic Media (Television, Radio, Website, Instant Messaging and Social Media), Handy Talkie, Mosque Speaker, Siren, Slit drum, etc.	• Lack of BPBD staff to interpret the Radar data • The utilization of social media for CWI dissemination by BPBD is not optimal • Not all the exposed community members use handphones or smartphones • Not all villagers have a network of communication to disseminate information related to the threat of landslides and floods
Product Development  Data transformed to information via analysis and packaging.	**Product(s) and Producers:** BMKG provides daily weather prediction, wave height information, wind direction and near real-time early warning including radar images. Perum Jasatirta I provide Community-based early warning system for several villages	• Some community member need more detailed CWI (e.g. early warning) that is specifically for their village (i.e. greater spatial resolution)
Data Collection  Data collected in standardized manner at needed resolution.	**Collector(s)**: BMKG (Primary), Perum Jasatirta I and BBWS Brantas (Secondary) **Raw Data Needs:** High-resolution real-time (temporal and spatial) weather information. **Data Sources**: Weather Forecast, Early Warning and Near-realtime Radar information (BMKG Juanda), Rainfall and water level information (Perum Jasatirta I and BBWS Brantas)	• Lack of raw data sharing procedure and coordination between collectors, especially for Disaster Management purposes. • Lack of in-situ instrument to monitor real time weather and water level • Lack of specific instrument to monitor landslide hazard at several landslide-prone area • The existing EWS provided by Jasa Tirta I only covers Bengawan Solo watershed

Technical Assistance Entry-Points

APIK will conduct technical assistance activities to address the gaps outlined in the preliminary value chain analysis in the previous subsection. We will work with key partners including the central government (e.g. BMKG-HO, Ministry of Agriculture, Ministry of Marine and Fishery), vertical institutions (e.g. BMKG Stations, BBWS), SKPDs (e.g. BPBDs, Irrigation Agency, Agricultural Agency, BPDAS), Local Business (e.g. Perum Jasatirta I, PT Jatinom, Sugar Plantation), NGOs and Universities (e.g University of Brawijaya, ITS, Pattiro Foundation). Where appropriate and feasible, APIK will also work together with non-local businesses (e.g. Telkomsel, INTEL) or innovator communities (e.g. Maker Movement, Start-up Companies). We will open up opportunities for cooperation through, for example, the resilience fund.

Some programmatic interventions will serve to benefit the public writ large (e.g. improvement dissemination using social media, improvement of high resolution forecast). Others, however, will specifically target certain communities facing highly localized risks, such as farmers in a particular village, or flood-exposed communities along a waterway. In this regard, based on the results of the CWIS assessment, APIK will target the following villages due to their unique risk profiles: Sumber Brantas (Upstream), Wonokerto and Karangsari (mid-stream) Kupang and Segoro Tambak (Downstream).

As mentioned in PY 2 Work Plan document, APIK East Java has the following major focus areas:

Exhibit 12 East Java's Major Focus Areas according to Workplan PY 2

No.	Focus
EJ-1	Execution of partnership agreements at the provincial and local government levels.
EJ-2	Setting up an effective coordination mechanism for Brantas Watershed landscape, with provincial government as the facilitator.
EJ-3	Support vulnerability assessment and adaptation strategic planning at the landscape level in partnership with the province of East Java
EJ-4	APIK will improve awareness of the local government on importance of the spatial planning to address flood, landslide and drought related issues
EJ-5	Capacity building of local governments and other Pokja members
EJ-6	Develop a provincial strategy for climate and weather information systems
EJ-7	Mapping of private sector in the Brantas Watershed upstream, midstream and downstream followed by dialogue of climate change perceptions and specific business risks.
EJ-8	Documenting two case studies on good adaptation practices from East Java

Exhibit 13 describes the initial entry-points to strengthen East Java's climate services for all geographic areas. Each entry-point will directly link to and reinforce activities under other APIK tasks and Resilience Fund awards.

Exhibit 13: PY 2, 3, 4 and 5 CWIS Strengthening Entry Points for East Java

PY	Phase	Entry-Point	APIK's Added Value	Main Beneficiaries and Application Areas	Key-partner	Task and WP Link.
2, 3	 Data Coll.	Implement flood or landslide EWS at Brantas Watershed including facilitate data sharing procedure between collectors, Conduct FGD for site selection, Integrate the existing sensors, Development and Implementation	Encourage all related local agencies to open and share the data from all weather and hydrological sensors for the benefit of disaster management	▪ Communities exposed to flooding and landslides (DRR)	▪ BMKGs, BPBDs, BPDAS and all related SKPDs ▪ Village Officials, Local Volunteers ▪ Perum Jasatirta I	T2, T4, T5, RF, EJ-2
2-4	 Product Dev.	Improve the spatial and temporal resolution (e.g. down to village level, three hourly) of the weather prediction utilizing the existing radar information and regional forecast. Implementation can be derived to the agricultural sector, fisheries, DRR, tourism, etc.	We support Meteorological Dept. BMKG-HO, to develop the prototype of high resolution temporal and spatial weather prediction. APIK will responsible in term of the product packaging and dissemination.	▪ Farmers (Ag. and Food Security) ▪ Communities exposed to hydromet. Hazard (DRR)	▪ BMKG-HO ▪ BMKG Juanda	T2
2, 3	 Comm.	Improve dissemination process, technique, packaging and presentation (incl. standardization of format, wording and images) of CWI for all Channels (e.g. Website, Television, Social Media, Instant Messaging)	APIK will support BMKG to produce the user-centered design product that suitable with any mode for various user types. APIK will support the local stakeholders to build standard procedure of dissemination to reach broad range of users.	▪ Farmers (Ag. and Food Security) ▪ Communities exposed to hydromet. Hazard (DRR)	▪ BMKGs ▪ BPDAS ▪ All related SKPDs ▪ Local Media Partner ▪ Local business entities (e.g. sugar factory, ranch company)	T2, T4, T5
2-5	 Use and App.	Conduct training/ workshop/ socialization/ product marketing (e.g. Climate Field School for farmers) to improve the farmers knowledge, literacy and utilization of the CWI	APIK will assist communities to ensure that the community is increased utilization of weather and climate information, particularly in overcoming obstacles in agricultural practices.	▪ Farmers (Ag. and Food Security)	▪ BMKGs, KKP, Ag. agency, Ag. Ext., BPBD, DKP	T2

The complete long-term plans (including other secondary activities) are described on ANNEX III.

Cashew Trees

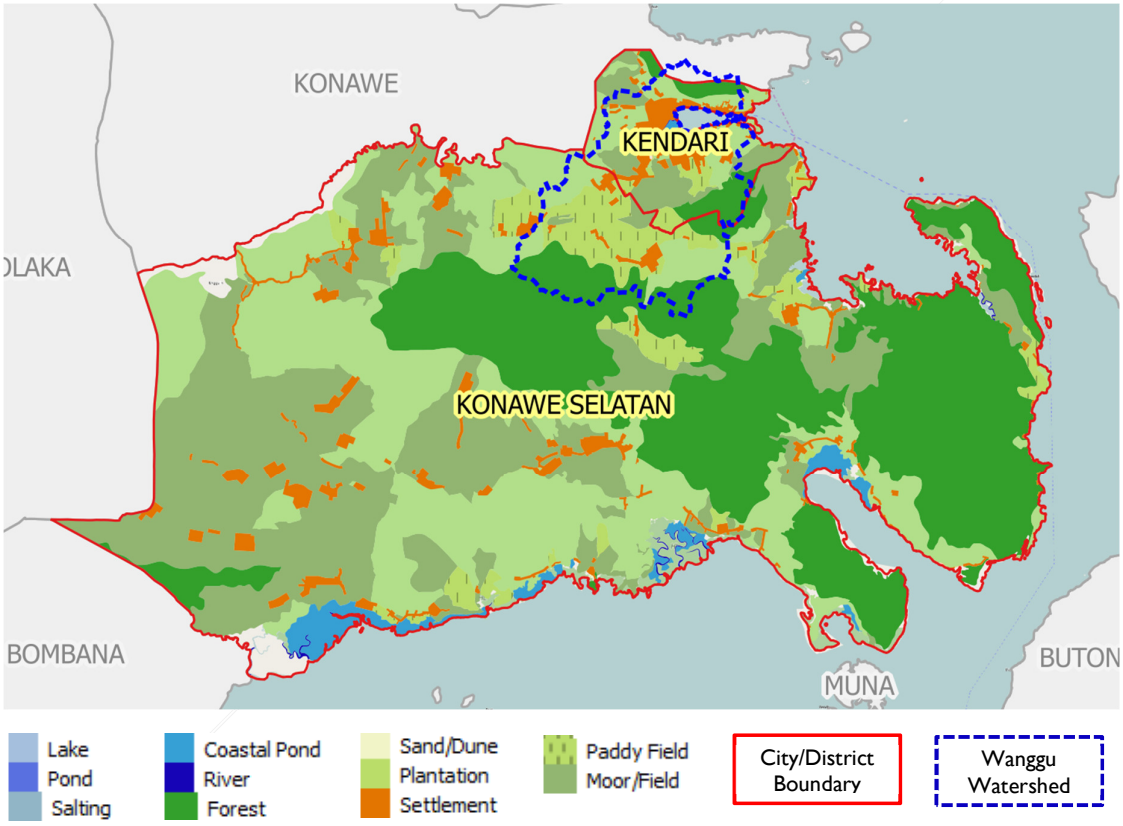
Most of people in Kendari have cashew in their yard and they had low production this year due to frequent rainfall. High rainfall intensity increases pest and diseases. The cashew flower will fall out and not develop with high intensity of rainfall.

SOUTHEAST SULAWESI

Introduction

Southeast Sulawesi is characterized by an extensive coastal landscape as well as a dense, but rapidly degrading, rain forest in the center of the province. Kendari is the main city in Southeast Sulawesi with a total population of approximately 314,126 people (2013) located around the edges of Kendari Bay. South Konawe District is situated in the southern part of the province, where the headwaters of the Wanggu River—the biggest river in the province—originate. Both the coastal and watershed landscapes of Southeast Sulawesi have important influences on the region's economic development, and thus the sustainable management of these landscapes in the face of climate change is vital to engendering economic prosperity.

Exhibit 14: APIK's City and District in Southeast Sulawesi



Increasingly erratic weather patterns in Southeast Sulawesi are having significant impacts on local economies and livelihoods. Protracted droughts have particularly affected irrigated agriculture, increased the risks of forest fires, and reduced fodder production for livestock. Local fishermen and seaweed producers also are affected by recent climate trends as warming sea temperatures (and coastal pollution) are pushing fish to deeper waters, reducing the size and quality of annual fish catches, and causing seaweed producers to shift to a hardier variety that brings a lower market price. Southeast Sulawesi is especially prone to climate change and hydrometeorology disasters such as flood, tidal surges, landslide, drought, storm, and extreme waves. Notably, Southeast Sulawesi's vulnerability is heightened by a lack of an appropriate and integrated disaster management system – such as local disaster management regulations,

local action plan for disaster risk reduction, contingency plans, early warning systems, etc. Exhibit 15 offers a brief overview of climate risks that affect Southeast Sulawesi.

Exhibit 15: Climate and disaster risks facing the landscape on APIK's district/city in Southeast Sulawesi

City/District	Climate and disaster risks facing the landscape
Kendari City	■ Key hazards include flood, landslide, and coastal abrasion / erosion ■ Hydro-meteorological disasters faced include floods from the Wanggu river, as well as landslide and coastal erosion ■ Environmental issues include increased sedimentation in the Kendari bay ■ Land use change in Wanggu Watershed is exacerbating the severity of flood events ■ Unpredictable and erratic weather conditions outside of historical trends are negatively impacting the ability of fisher folk to make a sustained income ■ Shifting seasonal patterns and increased frequency of extreme weather events are negatively impacting farmer crop yields and quality
Konawe Selatan District	■ Key hazards include flooding, typhoons, storms, landslides, and coastal abrasion / erosion. ■ Flash floods and landslides are increasing in frequency; in 2013 seven sub-districts were flooded after one intense storm event; villages such as Lamokula and Laikandonga are beginning to suffer from flash flooding during the rainy season ■ Warming sea water, changing currents and seasonal patterns are negatively impacting seaweed production; the ice-ice bacteria is becoming more prevalent and killing big seaweed beds ■ Warming sea water is said to also be reducing fish stocks for fisher folk ■ Longer rainy seasons are increasing pests/diseases (rat, neck blast), which are decreasing rice yields for paddy farmers ■ Cacao and banana crops are facing increased pest/diseases from increased rainfall; cashew flowers fall out prematurely due to increased rainfall, which prevents nuts from developing.

Application Area Selection Rationale

In SE Sulawesi, APIK will work in both watershed and coastal landscapes by focusing our CWIS strengthening activities around **agriculture and food security** (including fisheries, farming and aquaculture) and **disaster risk reduction** (specifically for floods, high waves, and landslides). APIK will support improved climate services for a variety of users and beneficiaries in Konawe Selatan, including fisher folk, seaweed producers, inland farmers, and plantation and forestry businesses. In Kendari City, the Project will focus on early warning systems for 37 villages identified during the assessment as highly vulnerable to flooding and landslides.

As confirmed in the CWIS Assessment Report and USAID's IMACS report, the utilization of weather and climate information services is still very low for both Kendari City and Konawe Selatan. Given that most people rely principally on personal observations, past experience, and natural signs to understand weather and climate conditions, APIK will emphasize the socialization of the use and application CWIS products.

Agriculture and Food Security

Context

The fisher folk surveyed for the Assessment Report identified needs for better information concerning wind, wave height, temperature, rainfall, currents, seasonal prediction and fishing

grounds. While extreme weather forecasts are important for safety purposes, the non-disaster oriented datasets are needed to help fisher folk adjust their fishing schedules to optimize their return on investment for each fishing trip (i.e. costs include fuel, labor, boat maintenance, etc.). In the aquaculture sector, during long dry seasons or long rainy seasons, fish farmers need more fuel to pump water to their production areas and maintain salinity levels. Seafood processing businesses also expressed the need for seasonal forecasts to optimize their operational investments, such as scheduling labor, logistics support, and estimating drying times.

Farmers of a wide variety of crops expressed the importance of more precise and timely information on optimal planting season, drought early warning to encourage water management, and pest management practices. According to the assessment, farmers receive most of their CWI from television and some from extension officers (the users for CWIS products). Those we surveyed expressed great interest in learning more about how to access and use CWIS products. A profile of an APIK target beneficiary in SE Sulawesi – Fisherman Kamba – is outlined on page 47 below.

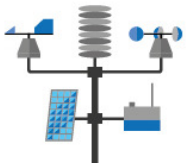
Preliminary Value Chain Analysis

The following chart illustrates our high-level understanding of the CWIS value chain for the agriculture and food security application in Southeast Sulawesi.

Exhibit 16: Preliminary Analysis of the Climate Services Value Chain for Ag and Food Security in SES

CWIS Value Chain Analysis		
Geography: Southeast Sulawesi (Kendari and Konawe Selatan) **Climate and Weather Threat Trends:** Climate variability such as La-Nina/El-Nino, unpredictable and erratic weather, strong winds.		**Application Area:** Agriculture and food security including marine fisheries, land-based farming and aquaculture.
Phase	**Context**	**Gaps**
Benefit Realization  Decisions implemented yielding concrete benefits to people and communities.	**Beneficiary:** • Coastal Communities (e.g. fisher folk, seaweed and fish pond farmers) • Food crop farmers (e.g. paddy), dry land farmers (e.g. cassava, corn), plantation farmers (e.g. cashew, cacao), fruit farmers (e.g. rambutan, duku) • Small poultry farmers **Benefit:** • Maximization of catch, crop and pond yields, which support household incomes, and improve food security.	• There is little research on the impact of CWI products such as seasonal forecasts in Southeast Sulawesi when it comes to improving crop yields/fishing catch.

Phase	Context	Gaps
Use & Application  Information used to make decisions in local context.	**User(s):** The primary users of seasonal forecast products are extension officers, although some fisher folk and farmers also directly review the forecasts independently. **Decision Type:** • The timing of planting; harvesting, drying day; anticipating pests, anticipating high waves that may enter ponds, how to spread the seed, and adjustment on cultivation processes. • Time for catching fish (safe sailing); sailing distance information; fishing ground location.	• Many farmers and fisher folk still using manual observation and traditional methods, following DJF-JJA-rule for planting and harvest planning; • Limited and low capabilities of Extension Officers to adapt new CWI products; • Limited climate literacy and knowledge how to maximize the utilization of the CWI products among fisher folk; • Low coverage of educational programs such as Climate Field School does not cover many villages; • Lack of CWI used for water management
Communication  Information reliably communicated through trusted mode.	**Communicator(s): Primary**: BMKG; **Secondary**: DKP, extension agents, SMEs, agriculture agencies. **Channel(s):** Monthly Fishery Extension Meetings and Training; Fisher Folk Meetings; word of mouth among community member, Electronic Media (Television, Radio, Website, Instant Messaging Group and Social Media), Electronic Signage and Manual Correspondence (e.g. Letter).	• Limited access mode (e.g. not all fisher folk use handphones or smartphones, not all farmers join the farmer's community); • BMKG Bulletin for monthly seasonal forecast is not given directly to community members; • Most of the electronic signage in the ports is not working; • Fishing grounds information is not widely disseminated; • Most of the fisher folk and farmers access the CWI from TV, which generally provides very limited information.
Product Development  Data transformed to information via analysis and packaging.	**Product(s) and Producers:** • BMKG produces a monthly rainfall forecast bulletin. Similar information is also captured in the KATAM planting calendar issued by Ministry of Agriculture. • BMKG provides daily weather prediction, wave height information, wind direction and near real-time early warnings	• CWI product format still difficult to understand (e.g. wave height, monthly bulletin); • The existing CWI product has low spatial resolution/does not cover village level; • The monthly rainfall analysis bulletin is lengthy (50+ pages), text heavy and uses too many technical terms that farmers don't understand; • In messaging application, users receive an overly low resolution image accompanied by confusing terminology.

	Phase	Context	Gaps
	Phase	**Context**	**Gaps**
Data Collection	 Data collected in standardized manner at needed resolution.	**Collector(s)**: BMKG Maritime Kendari and BWS IV Kendari **Raw Data Needs:** Daily rainfall data, regional forecast analysis runs, 24-hour weather observation **Data Sources**: • 15 AWS and AAWS • 100 rain gauge stations spread over Southeast Sulawesi • Radar near airport • BMKG-HO provides regional observations through satellite imagery • 48 ARR, 24 AWLR, 18 Climatology Instrument	• Limited instrument and storage; • Poor equipment maintenance; • No Climatological Station at Southeast Sulawesi; the closest one is in Maros (South Sulawesi); however in 2017 BMKG plans to open Climatological Station at Kendari

Name	Fisherman Kamba
Age	More than 65 yr.
Livelihood	Fishing
Village	Punggaloba, Kendari City
Landscape	Coastal, Urban, Down-stream of Wanggu
Main Commodity	Pompano, Mullet, Groper, Rabbitfish, Red Snapper Fish
Boat	Type "*Katinting*" with 5,5 PK Machine
Fishing Frequency	6 times a week
Market	Kendari Fish Auction and neighborhood
Fishing Catch	± 50.000-200.000 per trip during good weather

Climate Changes Perceived
Increased temperature, unpredictable weather, shorter dry season & longer rainy season (this year), and season pattern changes.

Climate Change Impact
- Fish catches and quality decline
- Must travel further for fertile fishing grounds
- Shortage of water resources
- Sea shell decline

Adaptation Strategy
Postpone or adjust fishing schedule

Experienced Disaster
- Strong winds and high waves caused Coastal Flood in settlement area during wet season.
- Water shortage during dry season

Indigenous Knowledge
Observe the natural signs such as air condition, clouds and thunder

Source of Weather & Season Information
- Fisherfolk community, fisheries officers in the fish auction
- TV (Metro TV and TVRI), Radio such as RRI

Role on CWI dissemination
Disseminate verbally to friends and family, community or colleagues, fisher folk communities.

Disaster Risk Reduction

Context

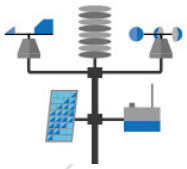
Many villages in SE Sulawesi are exposed to flood, flash flood, drought and landslide hazards, particularly in the Wanggu Watershed and other sub-watersheds in Konawe Selatan (e.g. Pundedaho River). The exposed communities generally need more context specific disaster early warning information for hydro meteorological events such as intense rainfall or drought onset.

Preliminary Value Chain Analysis

The following chart illustrates our high-level understanding of the CWIS value chain for the disaster risk reduction application in Southeast Sulawesi.

Exhibit 17: Preliminary Analysis of the Climate Services Value Chain for DRR in SES

CWIS Value Chain Analysis		
Geography: Southeast Sulawesi, Wanggu Watershed **Climate and Weather Threat Trends:** Flooding, landslide, drought		**Application Areas:** Disaster Risk Reduction
Phase	**Context**	**Gaps**
Benefit Realization  Decisions implemented yielding concrete benefits to people and communities.	**Beneficiary:** the community exposed to flood and landslide (e.g. riverbank, basin village, hilly settlement, unstable areas) **Benefit:** The exposed communities are safe from the landslide and flood threat. They receive sufficient warning information in spatially accurate and timely manner to evacuate before disaster event occurs.	• In several villages there is no sufficient intervention from the local officials for early warning systems, and no exercises or plans on how to deal with landslide and flood threat
Use and Application  Information used to make decisions in local context.	**User(s):** BPBD and exposed community **Decision Type:** • Preparations in the face of potentially catastrophic impact on pond, cropland and plantation (e.g. drought, flood) • Reduce the frequency of marine accidents • Know when to be vigilant, when to prepare for evacuation, when to immediately evacuate	• The users are not well trained by the local disaster management agency (BPBD) • No existing EWS sensors or sirens near their villages • Fewer communities who are trained to use the product of CWI for early warning purposes

Phase	Context	Gaps
Communication  Information reliably communicated through trusted mode.	**Communicator(s):** Primary: BMKG and BWS; Secondary: BPBD, local volunteers, Head of Village/RT/RW, Local Media, Community Radio, other SKPDs. **Channel(s):** Electronic Media (Television, Radio, Website, Instant Messaging and Social Media), Walkie Talkie, Mosque Speaker, Siren, etc.	• No sirens or loudspeakers in some villages. • Internal capability issues on BPBD staff • Not all the exposed community members use handphones or smartphones • Not all communities have a network of communication to disseminate information related to the threat of landslides and floods • The utilization of social media for CWI dissemination by BMKGs and BPBDs is not optimal. Only several BPBD post significant messages and have significant followers on twitter.
Product Development  Data transformed to information via analysis and packaging.	**Product(s) and Producers:** BMKG provides daily weather prediction, wave height information, wind direction and near real-time early warning including radar images.	• Some community members need for more detailed CWI products (e.g. early warning) that is specifically for their village (i.e. greater spatial resolution).
Data Collection  Data collected in standardized manner at needed resolution.	**Collector(s)**: BMKG Maritime Kendari and BWS IV Kendari **Raw Data Needs:** Daily rainfall data, High-resolution real-time (temporal and spatial) weather information, Early Warning Information **Data Sources**: • 15 AWS, AAWS, 100 rain gauge stations spread over Southeast Sulawesi, and Radar • BMKG-HO provides regional observations through satellite imagery • 48 ARR, 24 AWLR, 18 Climatology Instrument	• No existing EWS sensors in many areas; • Lack of raw data sharing procedures and coordination between collectors, especially for disaster management purposes; • Limited in-situ instrumentation to monitor real time weather and water level; • Lack of specific instruments to monitor landslide hazards at several flood and landslide-prone areas.

Technical Assistance Entry-Points

Based on the preliminary CWIS value chain analyses, the APIK team has identified a set of technical assistance entry points along each segment of the chain itself (see Exhibit 19). Following our strengthening strategy, we will rationalize these activities by focusing in on target CWIS beneficiaries located in specific geographies. The APIK target villages in SE Sulawesi are:

- Coastal communities at Punggaloba, Benu-benua, Sodohoa, Lapulu, Poasia, Petoha, Nambo, Sambuli at Kendari City; and Awunio, Roraya, Batu Jaya, Rumba-Rumba at Konawe Selatan District;
- Upstream communities at Baruga and Lalodati in Kendari City; Mata Wolasi, Lamokula, Laikandonga and Leya Villages at Konawe Selatan.

Our target beneficiaries for the DRR application activities are the local communities themselves, and we plan to engage the local BPBD in each municipality to home in on how best to support the strengthening of early warning systems. For the agriculture and food security application, we plan to work with beneficiaries in coastal livelihoods including fishing, aquaculture, and seaweed farming. The team will also target inland farmer beneficiaries involved in farming rice, cashew and cacao (plantations), cassava and corn (dryland farmers), and *rambutan* and hamlet (fruit farmers).

Following our initial field consultations with target beneficiaries in SE Sulawesi, the team will prioritize and tailor the relevant technical assistance entry points from to ensure APIK's value chain strengthening activities provide clear benefit to our target audience.

All activities will align with and build off the approved PY2 work plan and inform future work plans. Broad activities are detailed in Exhibit 18.

Exhibit 18 High Level PY-2 APIK Activities Planned for Southeast Sulawesi

No.	Focus
SES-1	Capacity building to CCA/DRR Working Group (Pokja API/PRB)
SES-2	Support the local government to prepare a detailed spatial plan (RDTR-Rencana Detil Tata Ruang)
SES-3	Vulnerability/Risk Assessment
SES-4	Initiate Community-based CCA/DRR
SES-5	Utilization of the CWIS by stakeholders in the capture fishery and seaweed aquaculture sectors, as well as by the cocoa, maize and rice producers in the area

Note that the entry points in Exhibit 19 are illustrative, and that the complete long-term set of entry points (including other secondary activities) is attached as ANNEX III.

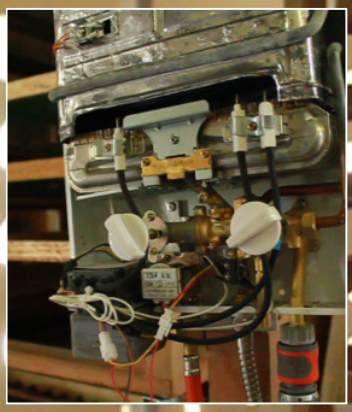
Exhibit 19 PY-2, 3, 4 and 5 CWIS Strengthening Entry Points for Southeast Sulawesi

PY	Phase	Entry-Point	APIK's Added Value	Main Beneficiaries and Application Areas	Key-partner	Task and WP Linkages
2-4	 Data Coll.	Implement flood or landslide EWS at Wanggu Watershed including facilitate data sharing procedure between collectors, conduct FGD for site selection, integrate the existing sensors, development and implementation	Encourage all related local agencies to open and share the data from all weather and hydrological sensors for the benefit of disaster management	▪ Communities exposed to flooding and landslides (DRR)	BPBDs, BMKGs, BPDAS, BWS Sultra, Village Officials, Local Volunteers, Grants winner	T2, T4, T5, RF
2, 3	 Comm.	Improve dissemination process, technique, packaging and presentation (incl. standardization of format, wording and images) of CWI for all Channels (e.g. Website, Television, Social Media, Instant Messaging)	APIK will support BMKG to produce the user-centered design product that suitable with any mode for various user types. APIK will support the local stakeholders to build standard procedure of dissemination to reach broad range of users including to tackle the marine safety issues	▪ Communities exposed to hydromet. Hazard (DRR)	BMKGs, BPDAS, All related SKPDs, Local Media Partner, Local business entities (e.g. PT KAKAO KALA)	T2, T4, T5
2-5	 Use and App.	Conduct training/ workshop/ socialization/ product marketing (e.g. Climate Field School) to improve the farmers and fisher folk knowledge, literacy and utilization of the CWI	APIK will assist communities to ensure that the community is increased utilization of weather and climate information, particularly in overcoming obstacles in agricultural and fishery practices.	▪ Farmers and Fisher folk (Ag. and Food Security)	BMKG-HO, KKP, KEMENTAN, BMKGs, Ag. agency, Ag. Extension, BPBD, DKP	T2, SES-5
2-3	One or two phase	APIK will support the new BMKG Kendari Climatological Station that planned to be established in February 2017	APIK will support them in term of accelerate the data collection from the local irrigation department, support the dissemination procedure, conduct climate field school, and plan some solution to tackle the coastal vulnerabilities issues (e.g. coastal erosion, storm surge, marine safety)	▪ All	BMKG Kendari Climatological Station	T2

The complete long-term plans (including other secondary activities) are described on ANNEX III.

PT Kamboti Usaha Maluku

One Nutmeg Company tries to tackle the Climate Variability by building drying machines that use solar energy.



MALUKU

Introduction

APIK is working in four islands in the Maluku Province, namely the islands of Ambon, Saparua, Haruku and Nusalaut (together these are called the "*Lease*" Islands). This covers two administrations, the city of Ambon and part of the Maluku Tengah region. In addition, APIK has just started working in the Aru Island, which will be incorporated into the CWIS roadmap later in PY-2.

In the "*Lease*" Islands, climate change is contributing to livelihood insecurity and producing shifts in labor patterns—from fishing to farming (and back) as well as from rural work to urban employment. In recent years, unpredictable and extreme weather, winds, and tides have run contrary to expected patterns. Traditional fishing grounds have been adversely impacted as fish have moved to deeper waters and fish stocks have declined. Many fishermen now work at least part time in manual labor, and a great many return to family-owned land and turn to farming as an alternative livelihood. Yet, farming has its own problems as a result of climate shifts. Farmers state that dry spells have been longer in recent years and productivity has declined. Sea level rise and coastal erosion also are observable in many locations around Ambon Island and threaten many smaller islands, where precarious housing structures are highly exposed to natural hazards.

Exhibit 20: Ambon-Lease Island Land Cover

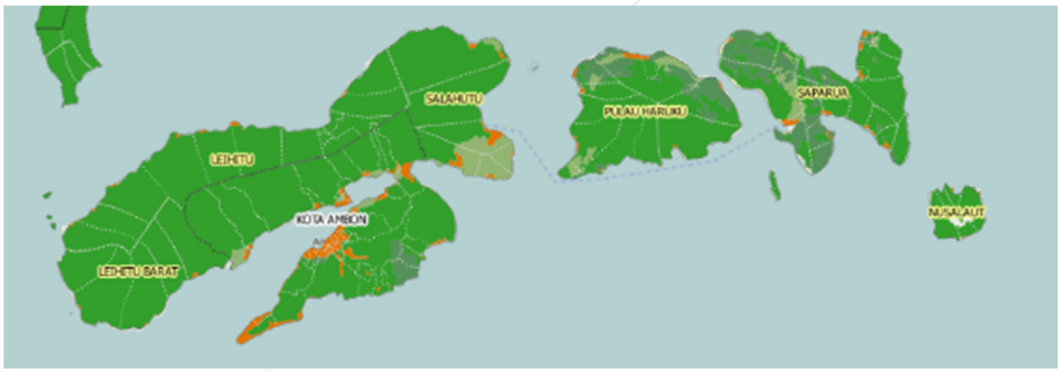


Exhibit 21 offers a brief overview of climate risks that impact the Maluku/Lease Island landscape.

Exhibit 21: Climate and disaster risks facing the landscape on APIK's islands in Maluku (Lease Islands)

City/District	Climate and disaster risks facing the landscape
Ambon Island	■ Increased storm intensity and failing urban drainage in Ambon City have increased the threat of flash floods ■ The coastal area of Ambon is threatened by coastal erosion and high waves; Hatiwe, Tawiri, Laha, Airmanis, and Hatu beaches have reportedly experienced significant coastal changes ■ Nearby Urimesing, is subject to regular flooding nearly every rainy season when the river overflows its banks, affecting houses in the communities along the edges of the waterway

City/District	Climate and disaster risks facing the landscape
	■ Several farmers noted during APIK's consultations that a protracted dry season the previous year decreased the quantity of nutmeg and cloves harvested, while a wetter rainy season reduced the quality of the crops and caused prices to fall ■ Negeri Soya and Hatalae are principally exposed to flooding and landslides associated with high intensity rainfall ■ In late May 2016, during the peak of the rainy season, landslides also struck communities in Negeri Soya leading to three casualties ■ Landslides have occurred each of the past three years in Negeri Hatalae due to high rainfall intensity and reduced recharge area, with 10 homes impacted by the landslide events ■ Some village such as Negeri Leahari are highly vulnerable to hydro meteorological disasters such as flooding, coastal inundation, extreme weather events (e.g. whirlwind, storm, and high wave) and drought ■ 2015 El Nino exacerbated forest fires and water shortages in some area ■ Disasters have also impacted public health and the incidence of water borne diseases, most recently in the form of a dengue outbreak in 2016 ■ Severe drought in 2015 which, among other impacts, killed many clove trees
Haruku Island	■ Coastal erosion issues for the last five years; lack of coastal protection makes the island vulnerable to sea waves and storm surges ■ Erratic weather patterns and climate change affecting fish catches, changing the location of fishing grounds, and undermining crops ■ In 2016, dozens of homes located at coastal area in Rohomoni Village have become threatened by coastal erosion ■ The predominant hydro-meteorological disasters in and around Haruku Island are flooding, landslide, drought, and extreme weather ■ An abnormally protracted dry season in 2015 has since led to the death of thousands of clove and nutmeg trees ■ High waves are posing an increasing threat to some villages ■ Coastal erosion could lead to social issues around the boundary marker between two Villages (Negeri)
Saparua Island	■ The predominant hydro-meteorological risks facing the communities of Saparua Island are coastal flooding, drought, extreme weather and "puting beliung" winds ■ Uncertainty in the weather, increased rainfall, and longer rainy seasons impact the livelihoods by decreasing the number of days for fishing, shifting the location of fishing grounds, and decreasing the quantity and quality of crop yields ■ Loss of clove trees due to droughts and a longer dry season during El Nino ■ Some fisher folk are unable to fish in more distant waters due to the dangers posed by erratic weather patterns ■ Water insecurity is increasing in some areas, such as Negeri Portom, where the severity of the dry season forced the community to purchase water ■ In some area like Negeri Sirisori, the drought also exacerbated forest fires
Nusalaut Island	■ According to isohyet map from Dirjen Cipta Karya, 1996 –high rainfall pattern has been dominating climate condition of Nusalaut Island ■ This island is highly vulnerable to storms and massive floods, particularly during rainy season ■ The coastal and marine areas of Nusalaut are yet to be recorded in any "Area Status" (Status Kawasan) which means that no proper treatment/efforts to minimize degradation of coastal ecosystem are currently in place ■ The predominant hydro-meteorological disasters in Nusalaut Island are coastal flooding, extreme weather, and landslides

City/District	Climate and disaster risks facing the landscape
	■ Fishing yields appear to have decreased while local fisher folk must also travel farther out to sea to find fertile fishing grounds ■ Wetter rainy seasons have yielded increased pests for farmers to deal with; for example, caterpillars are infesting clove trees causing the leaves to yellow and prematurely dry out ■ Negeri Titawai, massive landslides occurred in 2013 following heavy rains. Furthermore, coastal flooding in Negeri Ameth during high tides that same year impacted many homes that were not protected by a sea wall

Application Area Selection Rationale

Hydro-meteorological disasters in the city of Ambon and Lease Islands are increasing from year to year. In 2013, Ambon City experienced flash floods, flooding, landslides, and coastal erosion that caused significant losses. Marine incidents due to bad weather are on the rise due to lack of awareness and poor safety practices among the fishing community. The 2015-2016 La-Nina has also affected inter-island transportation routes between Ambon and Banda, which impact local economic activity. The local government in Ambon City and Maluku Tengah have expressed interest in improving their use of CWIS tools, thus APIK will focus assistance on the application area of **disaster risk reduction** in the region.

On the **agriculture and food security** side, the most prominent livelihood in the Lease Islands is marine fishing. For coastal communities, weather uncertainty shortens the time fisher folk spend at sea, limits their sailing distance, and does not allow them to maximize their investment in fishing trips. When facing a poor fishing season, these fisher folk turn to alternative livelihoods such as farming clove, nutmeg, *durian, salak, langsat,* and mangosteen, as well as planting seasonal vegetables. Recent climate impacts have caused a drop in crop productivity, water shortages, and sectoral impacts such as the inability to sufficiently sun-dry cloves, resulting in lower market prices for the crop.

Agriculture and Food Security

Context

Many **fisher folk** in the Maluku/Lease Island landscape still rely heavily on traditional seasonal patterns and their traditional knowledge (e.g. *Nanaku*). Fisher folk engaged by APIK during the assessment suggested that they need information such as weather and wave height forecasts, extreme weather warnings, and optimal fishing grounds data. They currently receive CWIS from BMKG via television and SMS. A profile of an APIK target beneficiary in the Maluku/Lease Island landscape – Fisherman La Mochtar – is provided on page 56 below.

Many local **farmers** do not regularly use CWI and do not realize the important role of CWI in the context of agribusiness. Interviews during the assessment indicated that a large opportunity exists to help build farmer capacity to understand how to apply CWIS information for decision making, specifically around optimal planting windows and how to respond to an impending drought event.

Name	Fisherman La Mochtar
Age	46-55 yrs.
Livelihood	Fishing
Village	Negeri Lima, Maluku Tengah District
Landscape	Rural, Coastal, Hilly, Downstream Way Ela River
Main Commodity	Tuna and Lema Fish
Boat	Rented from cold storage company
Fishing Frequency	5 times a week
Secondary Livelihood	Farming (Cloves, Nutmeg, Olive, Cassava)
Land Area	3Ha

Climate Changes Perceived
Unpredictable weather, shorter dry season (this year), longer dry season (last year).

Climate Change Impact
- Reduced Fish Catch
- Reduced crop quality
- Increase in Pest and Plant Diseases

Planting Time
Time of planting cloves during the west monsoon. After eight years, they have been fruitful and are ready to be harvested

Adaptation Strategy
Changing Variety, growing cassava during the dry season when nutmeg and cloves are not producing.

Experienced Disaster
In July 2013, due to the high intensity of rainfall around the afternoon, Way Ela Dam was collapsed causing 470 houses and some public buildings to be washed away; 5,233 people were displaced and three people died.

Indigenous Knowledge
Nanaku, by looking at the movement of the clouds, one can tell that fast movement yields rain or strong winds. West and east monsoon season becomes the standard.

Source of Weather & Season Information
- Television

Role on CWI dissemination
Delivered orally to the community

Preliminary Value Chain Analysis

The following chart illustrates our high-level understanding of the CWIS value chain for the agriculture and food security application in the Maluku/Lease Island landscape.

Exhibit 22: CWIS value chain for the agriculture and food security application in the Maluku

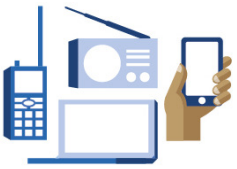
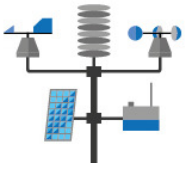
CWIS Value Chain Analysis

Geography: Maluku, Lease Islands

Application Area: Agriculture and Food Security including fisheries, perennial crop, food crop and horticulture production

Climate and Weather Threat Trends: Climate variability such as La-Nina/El-Nino, unpredictable and erratic weather, strong wind, high waves

Phase	Context	Gaps
Benefit Realization  Decisions implemented yielding concrete benefits to people and communities.	**Beneficiaries:** • Fisher folk • Perennial crops farmers and food crop / horticulture farmers **Benefit:** • Maximization of fishing catch and crop yield, which supports household incomes, and improves food security • Reduce the frequency of marine accidents • Preparations in the face of potentially catastrophic impact on plantation (e.g. drought) and pest control	• Many local farmers and fisher folk do not realize the important role of weather information; further training is needed for the local farming or fishing community on the application of climate and weather information in the context of agribusiness and marine applications
Use and Application  Information used to make decisions in local context.	**User(s):** The primary users of seasonal forecast products are Marine and Fishery Dept., the extension officers, and POKWASMAS. Some fisher folk or farmers also directly review the forecast. **Decision Type:** ▪ Fisher folk need to know when is the best time for catching fish (safe sailing); How far and how long they can sail; where is the fishing ground. ▪ The timing of planting, harvesting, drying day (e.g. nutmeg and cloves), anticipate pests and pestilence.	• Many farmers/fisher folk still using manual observation, traditional methods, and follow DJF-JJA-rule or winds for seasonal planting and harvest, planning or fishing • Some programs from MoMF (KKP) (e.g. PDPT, SIMAIL, SPI) only cover limited villages • Many fisher folk do not use CWI for fishing, leads to frequent marine incidents • Lack coordination between BMKG and other SKPDs • Limited Extension Agents for each village and lack of extension program in several villages • Less farmers using KATAM

Phase	Context	Gaps
Communication  Information reliably communicated through trusted mode.	**Communicator(s):** **Primary**: BMKG; **Secondary**: DKP, SMEs, agriculture agency, extension agents, plantations agency, forestry service, animal husbandry agency **Channel(s):** Electronic Media (Television, Radio, Single-Sideband modulation (SSB) for radio communication, SMS, Instant Messaging Group and Social Media), Manual Correspondence (e.g. Letter), word of mouth among community member. Marine and Fishery Agency disseminates SIMAIL to fishery extension agents	• BMKG Pattimura have limited internet network • Lack of dissemination effort by the local SKPDs • Limited access mode (e.g. not all fisher folk using handphone or smartphone) • Bulletin published by BMKG for monthly seasonal forecast was not distributed properly • Most of the fisher folk and farmers access the CWI from TV, meanwhile the information from TV is quite limited • Poor communication format for instant messaging
Product Development  Data transformed to information via analysis and packaging.	**Product(s) and Producers:** • BMKG provides daily weather prediction, wave height information, wind direction and near real-time early warning • BMKG produces seasonal predictions, monthly rainfall analyses, and annual rainfall analyses in the form of a booklet	• Fisher folk and farmers complain that the format is still difficult to understand (e.g. fishing ground information from BPOL is not easy to read) • Some fisher folk do not trust the accuracy of the official CWI • Some fisher folk need more detailed CWI that is specifically for their village (i.e. greater spatial resolution) • Inaccuracy of predictions
Data Collection  Data collected in standardized manner at needed resolution.	**Collector(s)**: BMKG Pattimura Meteorological Station, BMKG Kairatu Climatological Station **Raw Data Needs:** Daily rainfall data, High-resolution real-time (temporal and spatial) weather information, Early Warning Information, Water Level, temperature, wind speed, soil moisture **Data Sources**: • 1 Radar, AWS, 1 AWOS, CMSS, 15 Rain gauge (at Ambon Island), 2 Anemometer, 1 Barometer • Stevenson screen, Rain Gauge, Thermometer, Evaporation Pan, Soil Thermometer, Cup Counter Anemometer, etc.	• Limited instrument and storage • Lots of broken equipment

Disaster Risk Reduction

Context

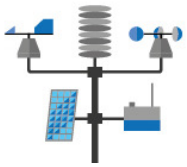
Most villages in the Maluku/Lease Island landscape that are exposed to flood and landslides do not have any early warning systems in place for the predominant hydro-meteorological disasters: coastal flooding, storms, and landslides. Some settlements see significant coastal flooding at high tides as they are not protected by a sea wall. The exposed communities generally need more context specific disaster early warning information for hydro-meteorological events such as intense rainfall or drought onset.

Preliminary Value Chain Analysis

The following chart illustrates our high-level understanding of the CWIS value chain for the disaster risk reduction in the Maluku/Lease Island landscape.

Exhibit 23: CWIS value chain for the disaster risk reduction in the Maluku

CWIS Value Chain Analysis Template		
Geography: Maluku, Lease Islands	**Application Areas:** Disaster Reduction focusing on flood, landslide, drought, coastal erosion, and extreme weather	
Climate and Weather Threat Trends: Intense Rainfall potentially increase flood and landslide; Intense High Waves causing coastal erosion; Long dry season/El-Nino increases drought and forest fire risk		
Phase	**Context**	**Gaps**
Benefit Realization  Decisions implemented yielding concrete benefits to people and communities.	**Beneficiary:** the community exposed to flood and landslide (e.g. riverbank, basin village, hilly settlement, unstable areas); the coastal community exposed to high waves; **Benefit:** The exposed communities are safe from the landslide and flood threat. They receive sufficient warning information in spatial and timely manner to evacuate before disaster event occur. The exposed coastal villages are safe from coastal erosion due to high waves;	• In several villages there is not sufficient intervention from the local officials for early warning systems and or exercise on how to deal with landslide and flood threats; • In several villages there isn't sufficient warning for high waves.
Use and Application  Information used to make decisions in local context.	**User(s):** BPBD and exposed community **Decision Type:** When to issue alarm for evaluation, when to prepare for evacuation, when to immediately evacuate.	• The users are not well trained by the local disaster management agency (BPBD) • Fewer community who are trained to use the product of CWI for early warning purposes

Phase	Context	Gaps
Communication  Information reliably communicated through trusted mode.	**Communicator(s):** Primary: BMKG; Secondary: BPBD, local volunteers, Head of Nagari, Local Media, Community Radio, other SKPDs, Syahbandar. **Channel(s):** Electronic Media (Television, Radio, Website, Instant Messaging and Social Media), faximile, newspaper, walky talkie, Mosque Speaker, mobile loudspeaker (known locally as "tabaos"), Siren, etc.	• Not all the exposed community members use handphones or smartphones • Limited network of communication • The utilization of social media for CWI dissemination by BMKGs and BPBDs is not conducted • At some villages, they did not received warning from the officials related to the upcoming disaster
Product Development  Data transformed to information via analysis and packaging.	**Product(s) and Producers:** BMKG provides daily weather prediction, wave height information, wind direction and near real-time early warning.	• Some community member need for more detailed CWI (e.g. early warning) that is specifically for their village (i.e. greater spatial resolution)
Data Collection  Data collected in standardized manner at needed resolution.	**Collector(s)**: BMKG Pattimura Meteorological Station, BWS Maluku **Raw Data Needs:** Daily rainfall data, High-resolution real-time (temporal and spatial) weather information, Early Warning Information, Water Level **Data Sources**: • 1 Radar, AWS, 1 AWOS, CMSS, 15 Rain gauge (at Ambon Island), 2 Anemometer, 1 Barometer • 39 ARR, 10 Climatological Instrument, 20 AWLR	• Lack of raw data sharing procedure and coordination between collectors, especially for Disaster Management purposes • Less in-situ instruments to monitor real time weather and water level • Lack of specific instrumentation to monitor landslide hazard at several flood and landslide-prone areas • No existing EWS sensors or sirens near their villages

Technical Assistance Entry-Points

Based on the preliminary CWIS value chain analyses, the APIK team has identified a set of technical assistance entry points along each segment of the chain itself (see Exhibit 25). Following our strengthening strategy, we will rationalize these activities by focusing in on target CWIS beneficiaries located in specific geographies. The APIK target villages in the Maluku/Lease Island landscape are:

- Soya, Paso, Hatife Besar, Negeri Lima and Allang Village at Ambon Island;
- Negeri Haruku and Wassu Village at Haruku island; and
- Ihamahu village at Saparua Islands.

Our target beneficiaries for the DRR application activities are the local communities themselves, and we plan to engage the local BPBD in each geography to home in on how best to support the strengthening of early warning systems. For the agriculture and food security application, we plan to work with beneficiaries whose primary livelihood is marine fishing, well as farmers involved in planting a mix of crops, including clove, nutmeg, durian, salak, langsat, mangosteen, and seasonal vegetables like cassava and corn.

Following our initial field consultations with target beneficiaries in the Maluku/Lease Island landscape, the team will prioritize and tailor the relevant TA entry points from Exhibit 25 to ensure APIK's value chain strengthening activities provide clear benefit to our target audience.

All activities will align with and build off the approved PY2 work plan and also inform future work plans. Broad activities are detailed in Exhibit 24.

Exhibit 24: High Level PY2 APIK Activities Planned for Maluku/Lease Islands

No.	Focus
MA-1	At the local government level, the APIK Maluku team will integrate climate change issues into Ambon city and Maluku Tengah District's RPJMD, including the necessary budgetary allocations.
MA-2	Strengthening local government capacity in DRR/CCA planning at selected unit both in Ambon and Central Maluku District, totaling 50 people.
MA-3	Implement VA and Adaptation Strategic Planning at provincial level.
MA-4	APIK will help the local government design a geospatial data center bringing efficiency and fostering synergy among local government agencies particularly in addressing flood, landslide and coastal hazards in the spatial plan. This will also feed into the government one-map policy.
MA-5	Engage local partners in CWIS development, product design, and utilization.
MA-6	To enable better climate and weather information dissemination APIK will strengthen the three regional command centers (PUSDALOPS) in province, Ambon City and Central Maluku and 15 working groups at the community level.
MA-7	Facilitate the hydro-metrological disaster risk assessment in Maluku Tengah.
MA-8	Facilitate the formulation of local regulation on disaster management.
MA-9	Collaborate with Harta Samudra (tuna/pelagic fishing) as a private sector partner for addressing risk reduction, CWIS demand, and CCA/DRR investment.
MA-10	Collaboration with other USAID projects such as SEA and TATTs

Note that the entry points in Exhibit 25 are illustrative, and that the complete long-term set of entry points (including other secondary activities) are described in ANNEX III.

Exhibit 25: PY-2, 3, 4 and 5 CWIS Strengthening Entry Points for Maluku

PY	Phase	Entry-Point	APIK's Added Value	Main Beneficiaries and Application Areas	Key-partner	Task and WP Linkages
2-4	 Data Coll.	Implement flood or landslide EWS at Ambon Island including facilitate data sharing procedure between collectors, conduct FGD for site selection, integrate the existing sensors, development and implementation	Encourage all related local agencies to open and share the data from all weather and hydrological sensors for the benefit of disaster management	▪ Communities exposed to flooding and landslides (DRR)	BPBDs, BMKGs, BWS Maluku, BPDAS, Village Officials, Local Volunteers, Grants winner	T2, T4, T5, RF, MA-5
2, 3	 Comm.	Improve dissemination process, technique, packaging and presentation (incl. standardization of format, wording and images) of CWI for all Channels (e.g. Website, Television, Social Media, Instant Messaging)	APIK will support BMKG to produce the user-centered design product that suitable with any mode for various user types. APIK will support the local stakeholders to build standard procedure of dissemination to reach broad range of users including to tackle the marine safety issues.	▪ Communities exposed to hydromet. Hazard ▪ Farmers and Fisher folk (Ag. and Food Security)	▪ BMKGs, BPDAS ▪ All related SKPDs ▪ Local Media Partner ▪ Local business entities	T2, T4, T5, MA-5, MA-6, MA-9
2-5	 Use and App.	Conduct training/workshop/ socialization/ product marketing (e.g. Climate Field School for fisher folk, Weather Field School for jr. or sr. high school students)	▪ APIK will assist communities to ensure that the community is increased utilization of weather and climate information, particularly in overcoming obstacles in fishery and planting practices and promote the safe sailing campaign.	▪ Fisher folk and Farmers (Ag. and Food Security) ▪ Jr./Sr. High school students	▪ BMKG-HO, KKP, KEMENTAN ▪ BMKGs, Ag. agency, Ag. Extension, BPBD, DKP	T2, MA-5

NATIONAL LEVEL TECHNICAL ASSISTANCE

In addition to conducting technical assistance at the regional level, APIK will also support national agencies in improving the packaging, dissemination, and uptake of climate and weather information services. Such efforts will directly tie to assistance the regional level, however, keeping the user and beneficiary at the fore.

Improve the resolution of the weather prediction

As mentioned on the technical assistance entry-points for East Java, APIK will support BMKG to improve the spatial and temporal resolution (e.g. down to village level at three hour intervals) of the weather prediction products utilizing the existing radar information and regional forecast. The existing forecast does not adequately meet the information needs at the village level. This product can support agricultural sector in East Java. APIK will pick one or two specific locations for testing this approach. As discussed with BMKH-HO Meteorology Department, they will support the numerical modeling aspect of the process and APIK will support the product packaging, dissemination, and communication strategy.

Development of CWI Dissemination Module

APIK will coordinate with the BMKG Head Office, Public Relation and Dissemination Division to standardize communication and dissemination processes, techniques, packaging and presentation (including standardization of format, wording and imagery) of climate and weather services for all channels (e.g. Website, Television, Social Media, Instant Messaging). This process also requires intensive coordination with local partners and related local government working units (SKPDs).

Development of CWI Packaging Module

Both Climatology and Meteorology Department at BMKG-HO will be our major partner in developing the packaging of each product that we will improve, because most of the CWI products are produced and published by their division. We will intensively collaborate with BMKG station in the region, because they were issued a forecast on a regular basis for their region. Especially for Maluku and SES, maritime products will be our priority.

Climate Field Schools

Climate field schools represent an important medium for building the climate literacy of farming communities. To maximize the impact of these field schools, APIK will support the updating of the training modules as well as consider how to increase the reach of such field schools. We anticipate that this effort will extend for the life of the project. Towards this end. APIK will collaborate with BMKG (Applied Climatology Division), Ministry of Agriculture, and National Extension Agency. As non K/L partners, University of Indonesia, CCROM or IPB also will join to support the improvement. For CFS for fisher folk improvement, we will closely work with BMKG (Maritime Meteorology Division), Ministry of Marine and Fishery (KKP) and

Agency for Human Resources Development of Marine and Fisheries (BPSDMKP) to improve the module.

SUMMARY AND NEXT STEPS

Building from the broad evaluation of climate services described in the APIK Climate and Weather Information Services Assessment Report, the CWI Roadmap sets forth the Project's strategy for improving the development and dissemination processes that are so vital to ensuring that climate services are both *used* and *useful*. To narrow our focus and make clear impact, the Roadmap identifies in each of the three regions (East Java, SE Sulawesi, and Maluku): (1) priority application areas for technical assistance, (2) specific climate services value chains within those priority areas, and (3) the targeted users and beneficiaries that are ultimately served by each respective value chain. Based on this narrowed focus, we have then carried out preliminary value chain analyses to home in on existing gaps or weaknesses and, further, enumerated entry-points for the Project's technical assistance in PY2 and beyond.

Importantly, the Roadmap represents a starting point for strengthening the CWIS value chains identified in each region. In other words, the value chain analysis tables for DRR and Agriculture and Food Security illustrate APIK's working knowledge of the context and existing gaps that prevent climate and weather data and information from reaching users and translating into benefits. Following our strengthening strategy, in PY2 APIK will engage directly with target users and beneficiaries and work from there up the value chain to further detail activities that will lead to improved use and application of CWIS products at the ground level.

Based on our research for the Assessment Report, we anticipate that most CWIS strengthening activities will be focused around the **communication** phase and the **use and application** phase. While a critical mass of CWIS products exist – such as seasonal prediction, extreme weather early warning, climate variability, and fishing grounds – most people still only use daily forecast information. Thus, the majority of APIK activities early in the process will focus on socialization of BMKG products to beneficiaries through Climate Field School training, as well as identifying other less costly channels to continue CWIS beneficiary education.

The team envisions that the thematic focus of PY-2 will be on CWIS product socialization, with the idea that once beneficiaries understand how to apply these tools to enhance their livelihoods and safety, the APIK team can then pivot our assistance from PY-3 forward to product enhancement. Exhibit 26 below presents the timeline for PY2 activities.

Notably, while the Roadmap presented four to five priority interventions in each region, APIK will remain flexible and look for opportunities to expand and scale this work. In this regard, Annex 3 includes a more complete list of possible technical assistance entry-points for consideration in PY3, PY4, and PY5. Above all, APIK will align CWI activities with other aspects of the Project's work plan to ensure that they are mutually reinforcing, working collectively to improve place-based resilience.

Exhibit 26 Priority Climate Services Activities for PY 2

Reg	2017 (PY-2)									
	January	February	March	April	May	June	July	August	September	
National	Improve the spatial & temporal resolution									
	Develop CWI Dissemination Module									
	Develop CWI Packaging Module									
	CFS Improvement							CFS Improvement		
East Java			Implement flood or landslide EWS							
		Improve the spatial & temporal resolution								
			Improve CWI Dissemination							
			Climate Field School							
SES			Implement flood or landslide EWS							
			Improve CWI communication packaging							
			Improve CWI Dissemination							
			Climate Field School							
Maluku			Implement flood or landslide EWS							
			Improve CWI communication packaging							
			Improve CWI Dissemination							
			Climate Field School							

Adaptasi Perubahan Iklim dan Ketangguhan

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ANNEXES

ANNEX I: APIK's HIGH LEVEL INDICATOR

Exhibit 27: APIK's High Level Indicators

RESULT NO.	INDICATOR	UNIT	BASE-LINE	LOP TARGET
High-Level Result 1	Number of people trained in climate change adaptation or disaster risk reduction (with at least 30% demonstrating increased CCA/DRR capacity)	Number of people	0	30,000 people trained 9,000 people with increased capacity
High-Level Result 2	Number of institutions with improved capacity to assess or address climate change and natural disaster risks	Number public of institutions	0	40
High-Level Result 3	Number of laws, policies, regulations, or standards addressing climate change adaptation or disaster risk reduction formally proposed, adopted, or implemented	Number of laws, policies, etc.	0	50
High-Level Result 4	Amount of investment mobilized (in USD) for climate change or disaster risk reduction as supported by USG assistance	USD equivalent	0	3,000,000
High-Level Result 5	Number of people supported by the USG to adapt to the effects of climate change or be more resilient to natural disasters (with at least 40% women)	Number of people	0	30,000 people supported 12,000 are women
High-Level Result 6	Number of people using climate information or implementing risk-reducing actions to improve resilience to climate change or natural disasters	Number of people	0	4,000 people

ANNEX II: SUMMARY OF ASSESSMENT REPORT

The APIK team conducted the CWI assessment over the period of April to November 2016. Led by the Project's Climate and Weather Information Specialist, the assessment was carried out in a collaborative manner with key sector actors at the national and subnational levels. The purpose of APIK CWI Assessment is to better understand the current capabilities and needs of stakeholders in Indonesia to generate, provide, and use weather and climate information. The Assessment Report will then serve as the basis for the development of this document, which details the Project's approach to improve the development, provision and uptake of information in ways that support the aforementioned high-level outcomes on a sustainable basis, particularly at the local level. Many of the findings and the facts written in the CWI Assessment Report will serve as a reference for the strategy in this Roadmap. Authors advise readers to read the CWI Assessment Report to find out more detailed results of the previous assessment.

Climate and weather information (CWI) services are used by a wide range of actors in Indonesia—public, private, and civil society—to fulfill specific, placed-based needs, from maximizing crop yields to navigating coastal waters to warning communities of impending flood risk. Recent advances in technology enable meteorologists to capture larger quantities of more precise weather data, while community leaders, farmers, and fisher folk increasingly have access to that data via mobile connectivity. Nevertheless, the CWI services marketplace remains quite fragmented with varying levels of coordination along the 'value chain' of service provision that collects raw data and translates it into useful information for beneficiaries.

Through the Climate and Weather Information Services Assessment, USAID's Adaptasi Perubahan Iklim dan Ketangguhan (APIK) Project catalogues the existing actors, data, products, and users of CWI services in Indonesia with the aim of identifying key gaps in the marketplace. Detail from this *Assessment* report will then inform the forthcoming APIK CWI Services Roadmap, which will analyze specific CWI value chains within APIK's priority regions and inform the Project's technical assistance entry-points over the coming four years.

Assessment Approach and Method

Broadly speaking, climate and weather information services consist of the hardware (sensor networks, weather station infrastructure, and IT equipment), software (trained staff, recognized communication and dissemination platforms, local awareness) and the supporting institutional arrangements (codified roles and responsibilities, data sharing policies, dedicated funding) that facilitate the systematic collection, analysis, packaging, communication, and use of meteorological, hydrological, and climate data. Robust CWI services are integral to Indonesia's National Action Plan on Climate Change Adaptation (RAN-API) in the context of hydro-meteorological disaster risk reduction and development planning. At the international level, the World Meteorological Organization (WMO) also recognized the critical role of improved climate services, establishing the Global Framework for Climate Services in 2012 as a worldwide mechanism for coordinated actions to enhance the quality, quantity, and application of climate services (see http://www.wmo.int/gfcs/).

Climate and weather information services are most impactful when an *active* process is put in place to transform raw environmental observations into actionable information communicated to the *right people* at the *right time*. Toward this end, the APIK assessment team used the concept of a climate and weather information *value chain* to frame the institutional

roles and action steps required in the transformation of data into decisions. These steps are: (1) raw data collection and organization, (2) product development, (3) communication and dissemination, (4) application and use, and (5) benefit realization. The notion of climate and weather information services as a value chain operating in the context of a local market allows us to: identify and segment the key climate and weather services actors; define the roles that such actors play across all the links of the value chain; connect those that collect and produce CWI services (the "supply side") and those that apply them at the local level (the "demand side"); and detect specific gaps or weaknesses in the value chain and target technical assistance efforts accordingly.

Regarding methodology, the CWI Services Assessment was completed over a period of approximately eight months, from April through November of 2016. The APIK assessment team engaged in consultations with national level actors (i.e. top-down) as well as a wide range of stakeholders at the subnational and community levels (i.e. bottom-up) in APIK's priority provinces of East Java, Southeast Sulawesi, and Maluku. The team principally used structured, key informant interviews as well as focus group discussions (FGDs) across all levels to gather inputs and perspectives. The results of this intensive stakeholder engagement process were then synthesized by the APIK assessment team and compiled in the full report, which details the current status of the actors, data, and products along the value chain. The concluding chapter of the report then provides a summary analysis of services gaps identified by the APIK assessment team at each step of the value chain, including those at the national and subnational levels, in the public and private sectors, as well as at the community level.

Key CWI Institutions, Products and Communication Modes

The *institutional landscape* of climate and weather information services is, not surprisingly, dominated by the National Meteorological and Climate Agency (BMKG). According to prevailing government regulations, BMKG represents the primary *collector* of climate and weather data and *producer* of tailored climate products. More specifically, Presidential Decree No. 61 of 2008 states that the Agency is obligated to conduct governmental tasks in the field of meteorology, climatology and geophysics, including, but not limited to data collection and management, analysis and delivery of weather and climate change information to public and private stakeholders at both the national and subnational levels, communication of disaster warnings to relevant institutions and agencies, and the implementation of research and development. To fulfill these mandates, BMKG operates 122 meteorology stations, 31 geophysics stations, and 21 climatology stations across the archipelago.

A wide variety of public and private organizations play targeted, supporting roles in the climate and weather information services landscape. The National Disaster Management Agency (BNPB) represents an important *producer* and *communicator* of disaster preparedness and response products accompanied by broad reach through Local Government Disaster Management Authorities (BPBDs). National planning and technical ministries play a role in translating climate and weather data into specific sectors; the Ministry of Agriculture, for example, helps farmers to apply climate information to maximize crop yields, while the Ministry of Public Works and Housing works across administrative boundaries to manage water resources within a given drainage basin.

The CWI institutional landscape extends well outside the public sector, however, to include research organizations (e.g. universities), media entities (e.g. television stations, radio, and print media), as well as commercial entities. While most of these are engaged in the

communication and use of climate and weather products, some also collect their own observations directly. The Weather and Climate Prediction Laboratory at the Bandung Institute of Technology, for example, collects and publishes its own weather data using local instrumentation.

The array of CWI institutional actors currently develop and disseminate a diverse portfolio of *climate and weather information products*, some for internal use only and others available to the public. Notable products and systems commonly referenced during assessment interviews included:

- Daily and weekly weather forecasts collectively generated by BMKG Stations and Head Office, as well as seasonal climate predictions;
- Downscaled climate change projections for temperature and precipitation change with a resolution of four square kilometers, also generated by BMKG;
- Vulnerability Inventory Index Information System (SIDIK) and the Early Warning System for Forest and Land (Sipongi), both of which are managed by the Ministry of the Environment and Forestry (KLHK);
- Landslide Early Warning System, InAWARE (a Disaster Preparedness and Response Platform), and the Disaster Risk Map, all of which fall under the Disaster Management Authority (BNPB);
- The Integrated Planting Calendar (KATAM) and Resilience and Food Security Maps promulgated by the Ministry of Agriculture;
- Disaster Mitigation, Adaptation and Environmental Information System (SIMAIL) that supports coastal communities and is managed by the Ministry of Fisheries (KKP);
- Hydrology, Hydrometeorology and Hydrogeology Information System (SIH3) coordinated by BMKG with the Ministry of Public Works and Housing and the Ministry of Minerals and Geologic Resources;
- Bandung Metropolitan Early Warning System (ITB); and
- Flood Forecasting and Warning System (FFWS) and Flood Early Warning and Early Action System (FEWEAS) established and operated by Perum. Jasa Tirta.

The modes of *communication and dissemination* of climate and weather information services are equally diverse, and include internet sites, social media (specifically Twitter, Facebook, and WhatsApp) print media, televised broadcasts, national and local radio programs, smartphone applications, and short message services (SMS). In a country well known for its rapid uptake of social media and digital technology, it is noteworthy that, based on APIK's interviews, digital communications do not necessarily translate well to more rural communities. In communities in Southeast Sulawesi and Maluku, for example, many informants reported that they obtain climate and weather information from television, word of mouth, or loud speakers (in the case of emergencies).

Summary of Findings across the Value Chain

Based on more than 650 individual interviews including representatives from 11 national government agencies, 152 local government agencies across cities and districts in 3 provinces, 61 businesses, representatives from media and research institutions and community members from over 70 villages, the following summarizes the key findings of the CWI Services Assessment across the stages of the value chain:

Data Collection and Processing:

While BMKG has (and continues to make) investments in the reliable collection of observational data, significant spatial and temporal gaps persist. The instrumentation necessary to collect climate data with a sufficiently high spatial and temporal resolution is not yet established in many places, but especially in the more remote areas outside of the Island of Java. Further, where instrumentation was set up, a lack of standardized/automated collection methodologies and maintenance greatly impact the quality and utility of the data. For example, 992 manually operated rain gauges in East Java require staff to visit them daily and record data in a log book, which then must be summarized and sent monthly to the irrigation office, where it is then compiled and distributed via email to BMKG. A lengthy manual process like this contributes to poor data quality – as does the fact that many of the gauges no longer function properly.

A lack of open data policies continues to inhibit the sharing of climate information, inhibiting warning systems, the improvement of models, and the proliferation of climate research. The APIK assessment team found that, at present, climate and weather data collectors tend to focus on the gathering of environmental data in accordance with their own needs, failing to recognize that other producers, communicators, and users may have related yet distinct information needs that can only be fulfilled if the raw data is maintained in a specific format and is of sufficient granularity (i.e. spatial and temporal resolution).

Even when data is in the public domain, important gaps often exist and platforms to access those datasets are not always reliable. From the perspective of data needs, APIK found that historical weather data sets are typically the most in demand, but that the completeness of those data sets is an important area of improvement for BMKG. That said, the majority of users surveyed report being satisfied with the available data *types*, such as ENSO, Sea Surface Temperature (SST), Extreme Climate, Flood Potential, Water Balance, Days without Rainfall, and Season and Climate Prediction.

The assessment team also found that most CWI data users access the information through inter-ministerial/agency correspondence. The agencies themselves often access the data through sending a formal request letter to BMKG. While much of BMKG's data can be accessed directly through the website, most people interviewed stated the website functionality needs improvement. The CWIS users from BNPB also highlighted a clear need for better integration between platforms, such as connecting the Multi Hazard Early Warning system with radar data to enhance its reliability.

Product Development:

Like many climate and weather marketplaces around the world, product development in Indonesia is supply-driven, lacking a clear focus on the needs of users and beneficiaries. The needs of the data collection institution often shape product development. For example, wave height maps are often disseminated in low-resolution format, making it difficult for fisherman to discern the conditions in local waters. Similarly, technical jargon used by government officials frustrates public users, who in reality must play the role of 'product developer' to actually analyze and use CWI data sets. Given most local government survey respondents shared their unhappiness with community use of CWI data, a considerable opportunity exists to connect users and producers for product development purposes. In this regard, APIK did not find any widely used feedback mechanisms in which users and producers interact to help improve existing products.

Notably, most institutional products focus on early warning for disaster risk reduction purposes, while very few incorporate climate adaptation concerns such as shifts in seasonality. This is due in part to product demand as well as data gaps – for example, manual rain gauges do not capture one of the most anticipated changes in local climate, namely, the hourly intensity of rainfall.

One of the main challenges for CWIS across the different landscapes is that each area has its own risk characteristics depending on the local context and issues. From the watershed point of view, at the upstream level the main issues include land use change and water scarcity coupled with landslides or flash flood threats. In cities, the common issue is urban flooding, with mismanaged rivers and drainage systems increasing the risk. Coastal flooding, erosion, and sea level rise are threatening seaside communities, and land use decisions can exacerbate those risks, as seen with the Bajo people who traditionally build houses above the coastal sea water. For some coastal areas, especially those downstream from big rivers, there is greater risk of landslides and flash flooding. Therefore, in order to ensure local needs are met, CWIS must be contextualized and relevant for each area. There is no "one size fits all" solution.

The assessment results show that climate variability is affecting community livelihoods, especially those relying on natural resources. Many farmers face common issues, such as difficulty determining the beginning of the rainy season, which impacts when to plant their crops and how to manage pest control in different and varied weather conditions. In some places there are also water shortage issues, especially during the dry season for rain fed paddy fields. For coastal communities, the weather uncertainty shortens the time fisher folk spend at sea and limits their sailing distance.

In the tourism sector, weather uncertainty and the strength of El-Nino/La-Nina has proven to disrupt operational activities. For example, local marine tourism has been impacted by dive site coral bleaching issues due to increasing sea water temperature. Agro-tourism is also affected by climate change as well, since the activity is dependent on agricultural products to draw tourists to a region.

Dissemination and Communication:

Local TV and radio are the primary channels people use to access timely weather information, although digital communication modes are playing an increasing role in some areas. Communities with limited access to smartphones or the internet rely heavily on traditional media (through daily weather forecasts or special announcements for extreme weather events on television, radio or amateur radio broadcast) and often disseminate weather information verbally through group or village meetings. In Southeast Sulawesi and Maluku, wave height information is an important data point that is routinely broadcasted by the local media. Informal, community-based radio is especially useful in fishing communities.

That said, digital communications are on the rise. BMKG and BPBD, for example, both use social media to disseminate CWI messages, with Twitter being the most popular tool. Some remote communities receive climate and weather information through SMS (short messaging service), but this is highly dependent on signal strength and thus it is generally not on a regular basis. Further, instant message groups have become increasingly popular at the local government level as well, often used to exchange weather information among staff at SKPDs (local government departments). Information that can be displayed is quite comprehensive,

ranging from text, images and links to websites. Again, however, this mode is only available in areas with an affordable and strong mobile internet signal (GPRS, HSDPA, etc.).

Local staff and volunteers represent a critical link in communicating climate and weather information at the community level. APIK found that local actors such as agricultural extension officers, disaster coordinators, and BPBD volunteers play a fundamental role in disseminating climate and weather information at the grassroots level. Such individuals are interacting with potential users and beneficiaries on a daily basis, and are able to take sometimes complex CWI products and translate them in a manner that is meaningful to farmers and fishermen. Some disaster coordinators have also started their own instant messaging groups among them to exchange early warning information.

CWI dissemination is not just about posting data and products, but requires targeted marketing and capacity building. CWI users are ultimately "consumers", meaning that they have choices on whether to use a product or not. First and foremost, they need to be aware what products exist through active marketing that targets specific segments of the climate and weather information marketplace. Also, users must feel comfortable with the product and be convinced of its usefulness. Notably, APIK encountered several existing government programs that aim to enhance the capacity of the public to apply climate services, including the Climate Field School program, PKPT / PDPT, Indonesia Coastal School, Agricultural Extension and Fishermen, and Proklim. Unfortunately, these have not reached scale – for example, Climate Field School Stage 3 for farmers covers less than 10% of the total villages in APIK regions (East Java, SE Sulawesi, Maluku), and the same program for fisher folk has not yet reached the village level based on our assessment.

The lack of marketing and familiarity with climate services also impacts local government uptake. For example, the Livestock Agency in Malang District stated that they never obtain regular CWI from BMKG; instead, they rely on historical knowledge concerning the seasons or television broadcasts. Similarly, the SIDIK system on climate vulnerability, a derivative product of KLHK, represents an example of a product that has not been socialized properly in with the local BAPPEDA.

Application and Use:

Existing climate and weather products struggle to reach the "last mile" of beneficiaries, often failing to make it to the communities and households where they are most needed. Many communities facing climate change risks are not yet using the climate and weather services produced by national authorities. Various ministries have produced climate and weather information products, such as the Disaster Mitigation, Climate Change and Environmental Information System (SIMAIL) run by the Ministry of Maritime Affairs and Fisheries, the Kalender Tanam Terpadu (KATAM) planting calendar produced by the Ministry of Agriculture, and BMKG's monthly rainfall analysis. All of these tools could be of considerable benefit were they to reach intended users. Unfortunately, none are being used at scale by farmers and fisher folk; this assessment found only two respondents familiar with KATAM and two others who had heard of the SIMAIL product. Similarly, many local governments are still not optimally utilizing services to inform programs or strategic planning. Such difficulties with "last mile" service delivery are a common challenge for climate and weather information services, which reflects the importance of the aforementioned emphasis on marketing and capacity building.

Many stakeholders continue to rely on personal observations and traditional climate knowledge, especially when more "formal" climate services are not available. Most of the communities visited by APIK continue to use their own indigenous knowledge for predicting weather and seasonality rather than accessing formal services produced by BMKG. While traditional methods such as *Nanaku* or *Pranata Mangsa* (traditional seasonal calendar) have been used for centuries, many respondents admit that these methods are not entirely reliable. Further, the long-standing "DJF-JJA-rule" (i.e. monsoonal pattern) that many farmers have relied upon appears less and less consistent. It is especially difficult to predict the onset and potential impacts of the La-Nina and El-Nino events. Some farmers understand La-Nina as the condition of "the Wet Dry Season", but many are not fully socialized on how the seasonal characteristics of the event can impact their crops.

While users are moderately satisfied with formal CWI products, there is still progress to made. APIK surveys find that user satisfaction of BMKG products is 3.44 on a scale of 1-5 (1=Not satisfied; 2=Less satisfied; 3=Satisfied, but need some improvement; 4=Satisfied; 5=Very satisfied). The areas of weakness identified by respondents include interoperability, guidelines, and geographical coverage. The surveys also found a need for data not currently captured by BMKG, including evaporation, evapotranspiration, and solar radiation information.

At the national level, there is consensus that improvement is needed in the reliability of existing weather forecast products as well as hot spot and smoke distribution information. For marine weather and wave forecasts, the assessment found that most users are satisfied with current products.

Opportunities for Strengthening the CWI Services Marketplace

While this assessment provides a 'lay of the land' in term of CWIS, to identify areas of opportunity for value chain strengthening, the next step for APIK is to complete a specific analysis of CWI value chains for key social and economic sectors in East Java, SE Sulawesi, and Maluku under the auspices of the **CWI Roadmap**. Chapters 4-6 in this assessment provide an overview of CWIS in each of these APIK geographies, which will inform the sector specific analyses and determine where APIK support could make scalable impact in CWIS that enhances the lives and livelihoods of communities in our focus regions.

Nonetheless, as discussed in Chapter 7 CWIS assessment report, there are a myriad of opportunities to strengthen the CWI marketplace available for further consideration and analysis under the forthcoming roadmap. Briefly, these opportunities include:

- Socializing and building capacity on user-centered design (UCD) process and methods at local BMKG stations. An initial UCD analysis should be conducted on existing CWI products operated by local governments such as water resources, health, DRR, forest fires, and marine/agriculture information (e.g. planting calendar, ground fishing information, flood modeling, ground water modeling, SiPongi). Some products may simply need user manuals and training, while others may need a larger overhaul to bolster their utility.
- Homing in on specific sectors and regions to analyze areas of opportunity. For example, for DRR, the program could evaluate the existing Landslide Early Warning System in the three APIK regions to identify how to improve reliability, coverage,

maintenance, procedure, etc. Another opportunity lies in piloting the Multi-Hazard Early Warning System as a way to enhance the value chain analysis for the product.

- Leveraging field staff such as extension workers, disaster volunteers, and POKWASMAS as critical "communications assets" for CWIS. Within the right structure, these assets could play a key role connecting product developers with product users and beneficiaries. Another recommendation is to create a partnership between BMKG and local media outlets. Members of the media we spoke with suggested a need to better understand the potential impacts of climate change and extreme weather events on public health, motorist safety, and agriculture, for example – as opposed to simply receiving forecasts from BMKG.
- Building on the national Hydrology, Hydrogeology, and Hydrometeorology Information System (SIH3) as a framework for institutional coordination, data collection, and data processing. This may involve conducting regional focus groups among national and subnational agencies to develop a roadmap to fully implement SIH3 in their regions. Data collection and processing gaps cannot all be addressed at once, so using the SIH3 framework will provide structure to solve current issues in a standard and documented fashion that can be applied across sectors and geographies; and
- Working with communities to identify approaches to community-based monitoring and early warning systems, such as by using affordable, open-source technologies to measure rainfall levels or river height. Should adequate network coverage be available, these technologies can be automated to send alert notices via SMS to local leaders and disaster preparedness volunteers.

Taken together, the findings and opportunities presented in the Assessment Report provide a firm foundation for developing an effective strategy to strengthen climate and weather services in Indonesia, helping to realize the potential of such systems to foster place-based resilience in an era of increasing meteorological and hydrological uncertainty.

ANNEX III: Complete STRENGTHENING ACTIVITY PLAN

Exhibit 28: PY 2, 3, 4 and 5 CWIS Strengthening Activities for East Java

PY	Phase	Activities	APIK's Added Value	Main Beneficiaries and Application Areas	Key-partner	Task and WP Linkages
2, 3	 Data Coll.	Implement flood or landslide EWS at Brantas Watershed including facilitate data sharing procedure between collectors, Conduct FGD for site selection, Integrate the existing sensors, Development and Implementation	Encourage all related local agencies to open and share the data from all weather and hydrological sensors for the benefit of disaster management	▪ Communities exposed to flooding and landslides (DRR)	▪ BMKGs, BPBDs, BPDAS and all related SKPDs ▪ Village Officials, Local Volunteers ▪ Perum Jasatirta I	T2, T4, T5, RF, EJ-2
2-4	 Product Dev.	Improve the spatial and temporal resolution (e.g. down to village level, three hourly) of the weather prediction utilizing the existing radar information and regional forecast. Implementation can be derived to the agricultural sector, fisheries, DRR, tourism, etc.	We support Meteorological Dept. BMKG-HO, to develop the prototype of high resolution temporal and spatial weather prediction. APIK will responsible in term of the product packaging and dissemination.	▪ Farmers (Ag. and Food Security) ▪ Communities exposed to hydromet. Hazard (DRR)	▪ BMKG-HO ▪ BMKG Juanda	T2
2, 3	 Comm.	Improve dissemination process, technique, packaging and presentation (incl. standardization of format, wording and images) of CWI for all Channels (e.g. Website, Television, Social Media, Instant Messaging)	APIK will support BMKG to produce the user-centered design product that suitable with any mode for various user types. APIK will support the local stakeholders to build standard procedure of dissemination to reach broad range of users.	▪ Farmers (Ag. and Food Security) ▪ Communities exposed to hydromet. Hazard (DRR)	▪ BMKGs ▪ BPDAS ▪ All related SKPDs ▪ Local Media Partner ▪ Local business entities (e.g. sugar factory, ranch company)	T2, T4, T5
2-5	 Use and App.	Conduct training/ workshop/ socialization/ product marketing (e.g. Climate Field School for farmers) to improve the farmers knowledge, literacy and utilization of the CWI	APIK will assist communities to ensure that the community is increased utilization of weather and climate information,	▪ Farmers (Ag. and Food Security)	▪ BMKGs, KKP, Ag. agency, Ag. Ext., BPBD, DKP	T2

PY	Phase	Activities	APIK's Added Value	Main Beneficiaries and Application Areas	Key-partner	Task and WP Linkages
			particularly in overcoming obstacles in agricultural practices.			
2, 3	 Data Coll.	Support data collection process from irrigation department, APIK will help BMKG to improve their collection procedure and technique	APIK will ensure to accelerate the production of Monthly Prediction analysis. Farmers will received the seasonal information earlier to support their planting plan	▪ Food Crop Farmers (Ag. and Food Security)	▪ BMKG Karangploso ▪ Irrigation agency ▪ Public Works agency	T2
2	 Product Dev.	Improve the product packaging and presentation of the existing CWI Product (e.g. seasonal forecast Bulletin)	APIK will help BMKG to redesign its Bulletin using user-centered concept and involving the local farmers community to participate in the design process.	▪ Farmers (Ag. and Food Security)	▪ BMKG Karangploso	T2
2, 3	 Use and App.	Improve the community capacity to respond landslide, flood and drought threat with utilizing the CWIS	APIK will ensure the exposed community can respond the hydromet hazard by training them to utilize the CWIS properly. We also will train the BPBDs to use all the tools and facility provided by BMKG or other trusted sources.	▪ Communities exposed to hydromet. Hazard (DRR)	▪ BPBDs ▪ BMKGs ▪ Village Officials ▪ Local Volunteers	T2
2	 Use and App.	Support Vulnerability/Risk Assessment for East Java in the field of Agricultural and DRR (e.g. drought, flood, landslide)	APIK will: provide the socialization of downscaled climate projection information from BMKG for east java and support the data for the VA analysis.	▪ Communities exposed to hydromet. Hazard (DRR)	▪ Pokja Members	T2, EJ-3

Exhibit 29: PY 2, 3, 4 and 5 CWIS Strengthening Activities for Southeast Sulawesi

PY	Phase	Activities	APIK's Added Value	Main Beneficiaries and Application Areas	Key-partner	Task and WP Linkages
2-4	 Data Coll.	Implement flood or landslide EWS at Wanggu Watershed including facilitate data sharing procedure between collectors, conduct FGD for site selection, integrate the existing sensors, development and implementation	Encourage all related local agencies to open and share the data from all weather and hydrological sensors for the benefit of disaster management	▪ Communities exposed to flooding and landslides (DRR)	▪ BPBDs, BMKGs, BPDAS, BWS Sultra, Village Officials, Local Volunteers, Grants winner	T2, T4, T5, RF
2, 3	 Comm.	Improve dissemination process, technique, packaging and presentation (incl. standardization of format, wording and images) of CWI for all Channels (e.g. Website, Television, Social Media, Instant Messaging)	APIK will support BMKG to produce the user-centered design product that suitable with any mode for various user types. APIK will support the local stakeholders to build standard procedure of dissemination to reach broad range of users including to tackle the marine safety issues	▪ Communities exposed to hydromet. Hazard (DRR)	▪ BMKGs, BPDAS, All related SKPDs, Local Media Partner, Local business entities (e.g. PT KAKAO KALA)	T2, T4, T5
2-5	 Use and App.	Conduct training/ workshop/ socialization/ product marketing (e.g. Climate Field School) to improve the farmers and fisher folk knowledge, literacy and utilization of the CWI	APIK will assist communities to ensure that the community is increased utilization of weather and climate information, particularly in overcoming obstacles in agricultural and fishery practices.	▪ Farmers and Fisher folk (Ag. and Food Security)	▪ BMKG-HO, KKP, KEMENTAN, BMKGs, Ag. agency, Ag. Extension, BPBD, DKP	T2, SES-5
2-3	One or two phase	APIK will support the new BMKG Kendari Climatological Station that planned to be established in February 2017	APIK will support them in term of accelerate the data collection from the local irrigation department, support the dissemination procedure, conduct climate field school, and plan some solution to tackle the coastal vulnerabilities issues (e.g. coastal erosion, storm surge, marine safety)	▪ All	▪ BMKG Kendari Climatological Station	T2

PY	Phase	Activities	APIK's Added Value	Main Beneficiaries and Application Areas	Key-partner	Task and WP Linkages
2	 Data Coll.	Support data collection process from irrigation department, APIK will help BMKG to improve their collection procedure and technique	APIK will provide tools and training to improve the data collection process. We will collaborate with third party or local universities to develop the tools.	■ Food Crop Farmers (Ag. and Food Security)	■ BMKGs ■ Irrigation agency ■ Public Works agency	T2
2	 Product Dev.	Improve the product packaging and presentation of the existing seasonal forecast Bulletin	APIK will help BMKG to redesign its Bulletin using user-centered concept and involving the local farmers community to participate in the design process.	■ Farmers (Ag. Food Security, and DRR)	■ New BMKG Climatological Station	T2
2	 Comm.	Improve CWI communication packaging for various channel (e.g. most popular one: television), with consists of more local context (higher spatial resolution)	With our communication specialist, APIK will encourage the local media to support BMKG in disseminating the CWI to the public.	■ Farmers (Ag. and Food Security) ■ Communities exposed to hydromet. Hazard (DRR)	■ BMKGs ■ Local Media Partner	T2
2, 3	 Use and App.	Improve the community capacity to respond landslide, flood and drought threat with utilizing the CWIS	APIK will ensure the exposed community can respond the hydromet hazard by training them to utilize the CWIS properly. We also will train the BPBDs to use all the tools and facility provided by BMKG or other trusted sources.	■ Communities exposed to hydromet. Hazard (DRR)	■ BPBDs ■ BMKGs ■ Village Officials ■ Local Volunteers	T2
2	 Use and App.	Support Vulnerability/ Risk Assessment for SES in the field of Agricultural and DRR (e.g. drought, flood, landslide)	APIK will: provide the socialization of downscaled climate projection information from BMKG for SES and support the data for the VA analysis.	■ Communities exposed to hydromet. Hazard (DRR)	■ Pokja Members	T2, SES-3

PY	Phase	Activities	APIK's Added Value	Main Beneficiaries and Application Areas	Key-partner	Task and WP Linkages
3	 Use and App	Improve the ability of local government to invest and maintain on early warning system at their region	We are planning to introduce them the technological approach in managing the disaster, conduct training how to invest in early warning technology	■ Communities exposed to hydromet. Hazard (DRR)	■ BPBD ■ BWS Kendari	T2

Exhibit 30: PY 2, 3, 4 and 5 CWIS Strengthening Activities for Maluku

PY	Phase	Activities	APIK's Added Value	Main Beneficiaries and Application Areas	Key-partner	Task and WP Linkages
2-4	 Data Coll.	Implement flood or landslide EWS at Ambon Island including facilitate data sharing procedure between collectors, conduct FGD for site selection, integrate the existing sensors, development and implementation	Encourage all related local agencies to open and share the data from all weather and hydrological sensors for the benefit of disaster management	■ Communities exposed to flooding and landslides (DRR)	■ BPBDs ■ BMKGs ■ BWS Maluku ■ Village Officials ■ Local Volunteers ■ Grants winner	T2, T4, T5, RF, MA-5
2, 3	 Comm.	Improve dissemination process, technique, packaging and presentation (incl. standardization of format, wording and images) of CWI for all Channels (e.g. Website, Television, Social Media, Instant Messaging)	APIK will support BMKG to produce the user-centered design product that suitable with any mode for various user types. APIK will support the local stakeholders to build standard procedure of dissemination to reach broad range of users including to tackle the marine safety issues.	■ Communities exposed to hydromet. Hazard ■ Farmers and Fisher folk (Ag. and Food Security)	■ BMKGs, BPDAS ■ All related SKPDs ■ Local Media Partner ■ Local business entities	T2, T4, T5, MA-5, MA-6, MA-9

PY	Phase	Activities	APIK's Added Value	Main Beneficiaries and Application Areas	Key-partner	Task and WP Linkages
2-5	 Use and App.	Conduct training/workshop/ socialization/ product marketing (e.g. Climate Field School for fisher folk, Weather Field School for jr. or sr. high school students)	APIK will assist communities to ensure that the community is increased utilization of weather and climate information, particularly in overcoming obstacles in fishery and planting practices and promote the safe sailing campaign.	■ Fisher folk and Farmers (Ag. and Food Security) ■ Jr./Sr. High school students	■ BMKG-HO, KKP, KEMENTAN ■ BMKGs, Ag. agency, Ag. Extension, BPBD, DKP	T2, MA-5
2-4	 Product Dev.	Improve Fishing Ground Maps by develop specific packaging for specific areas (Lease Islands)	APIK in collaboration with BMKG and KKP will support to improve the existing fishing ground map that produced by BPOL. APIK will focuses on packaging the product and ensure to be delivered and used by the fisher folk	■ Fisher folks (Ag. and Food Security)	■ BMKG-HO, BPOL, KKP ■ BMKG Pattimura, DKP	T2, MA-5
2	 Comm.	Improve CWI communication packaging for various channel (e.g. engage or establish local radio community)	APIK will work closely with the local amateur radio community station to spread the CWI to the public. If the station is not there yet, APIK will support to initiate the community.	■ Farmers (Ag. and Food Security) ■ Communities exposed to hydromet. Hazard (DRR)	■ BMKGs ■ Local Media Partner	T2, MA-5, MA-6
2, 3	 Use and App.	Improve the community capacity to respond hydrometeorological threat with utilizing the CWIS	APIK will ensure the exposed community can respond the hydromet hazard by training them to utilize the CWIS properly. We also will train the BPBDs to use all the tools and facility provided by BMKG or other trusted sources.	■ Communities exposed to hydromet. Hazard (DRR)	■ BPBDs ■ BMKGs ■ Village Officials ■ Local Volunteers	T2, MA-5

PY	Phase	Activities	APIK's Added Value	Main Beneficiaries and Application Areas	Key-partner	Task and WP Linkages
2	 Use and App.	Support Vulnerability/ Risk Assessment for SES in the field of Agricultural and DRR (e.g. Sea Level Rise, Rough Sea, Coastal Flood)	APIK will: provide the downscaled climate projection for Maluku and support the data for the VA analysis.	■ Communities exposed to hydromet. Hazard (DRR)	■ Pokja Members	T2, MA-5, MA-3
3	 Use and App.	Improve the ability of local government to invest and maintain on early warning system at their region (e.g. conduct seminar, workshop or training)	We are planning to introduce them the technological approach in managing the disaster, conduct training how to invest in early warning technology	■ Communities exposed to hydromet. Hazard (DRR)	■ BPBD ■ BWS Maluku	T2, MA-5
3	 Use and App.	Campaign marine safety for fisher folk and coastal community to reduce marine incident	APIK in collaboration with DKP, POKWASMAS and extension will campaign safe sailing practice, utilizing the existing CWIS from BMKG	■ Fisher folk (DRR)	■ DKP ■ POKWASMAS ■ Fishery Extension ■ BMKG	T2, MA-5