UN Climate Technology Centre and Network (CTCN), an operational arm of UNFCCC

Ministry of Forests and Environment, Government of Nepal

# Customized weather and climate information system for climate-resilient agriculture in Nepal

**Contract No.: UNEP/2022/339 (Umoja # 4700023937)**

## Report on Development of Implementation Planning and Communication Documents

**4th February 2023**

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# List of Acronyms

| | |
|---|---|
| **AICC** | Agriculture Information and Communication Center |
| **API** | Application Programming Interface |
| **CCMD** | Climate Change Management Division |
| **CTCN** | Climate Technology Centre and Network |
| **DHM** | Department of Hydrology and Meteorology |
| **GDP** | Gross Domestic Product |
| **GLOF** | Glacial Lake Outburst Flood |
| **ICT** | Information and Communications Technology |
| **IDS** | Integrated Development Society |
| **INDC** | Intended Nationally Determined Contributions |
| **M&E** | Monitoring & Evaluation |
| **MOALD** | Ministry of Agriculture and Livestock Development |
| **MOFE** | Ministry of Forests and Environment |
| **MSTE** | Ministry of Science, Technology and Environment |
| **NARC** | Nepal Agricultural Research Council |
| **NDE** | National Designated Entity |
| **NDRI** | Nepal Development Research Institute |
| **NWP** | Numerical Weather Prediction |
| **O&M** | Operation and Maintenance |
| **PP** | Project Proponent |
| **SEN** | The Small Earth Nepal |
| **SMS** | Short Message Service |
| **SWG** | Stakeholder Working Group |
| **TA** | Technical Assistance |
| **TEC** | Technology Executive Committee |
| **UN** | United Nations |
| **UNEP-CCC** | United Nations Environment Programme Copenhagen Climate Centre |
| **UNFCCC** | United Nations Framework Convention on Climate Change |
| **USAID** | United States Agency for International Development |

# 1 Background and Rational

Nepal has been ranked as the 9th most affected country towards climate change (Eckstein et al., 2018[1]) but is one of the least contributors to the emissions of greenhouse gases (0.11% of global share). Nepal was identified as one of the four global hotspots for climate change risk and impact of climate change is seen in various sectors like biodiversity, agriculture, livestock, water sources, soil, tourism, health, etc. (MoSTE, 2014[2]). According to DHM (2015), during the last four to five decades, the rate of increase in annual maximum temperature (0.04 °C yr-1) over the country was significantly higher than the rate of increase in minimum temperature (0.01 °C yr-1). The occurrence of cold days and nights has decreased significantly during the last few decades (World Bank 2020[3]).

Temperature is projected to increase in the future climates under both low and high emissions scenarios and in the medium (0.92–1.07°C) and long-term (1.72–1.82°C) (MoFE, 2019[4]). This increase in temperature is likely to be more visible during the dry months (December–May) (World Bank 2020). An increase in the number of 'hot' days will be 19–27 days by 2045 and 26–43 days by 2065 (MoFE, 2019). The High Mountains are likely to experience the greatest warming of all the regions, and the west is likely to warm more than the eastern regions (MoFE, 2019).

The annual rainfall has significantly decreased at the rate of 3.7 mm (-3.2%) per month per decade and under various climate change scenarios n is projected to reduce in a range of 10 to 20% across the country by the end of this century (INDC of Nepal, 2016[5]). This rate of decrease in rainfall was more significant during monsoon (Jun-Sep) period (World Bank, 2020). Rainfall is increasingly falling as rain instead of snow in the high mountains, resulting in a loss of water (174 gigatons) in the Himalayan glaciers (USAID 2017[6]). During the last few decades, there was an increasing trend in the occurrence of extreme rainfall events, especially over western mid-hills and central high mountain regions. Central lowland regions have been receiving more daily extreme rainfall leading to increased incidences of flash floods (Karki et. al. 2017[7]). The increasing high intensity rainfall over the western mountainous region is indicative of a higher risk of soil erosion and landslides (Karki et. al., 2017). The severity and frequency of drought is increasing, which are more significant for droughts of longer timescales (Dahal et. al., 2016[8]).

[1] Eckstein, D., Hutfils, M.-L., and Winges, M. (2018). Global Climate Risk Index 2019: Who Suffers Most from Extreme Weather Events? Weather-related Loss Events in 2017 and 1998 to 2017. Berlin: German watch Nord-Süd Initiative eV.

[2] MoSTE. (2014). Second national communication report to UNFCCC. http://unfccc. int/ resource / docs/ natc/ nplnc2.pdf

[3] World Bank (2020) Climate Change Knowledge Portal. https://climateknowledgeportal.worldbank.org.

[4] MoFE (2019) Climate change scenarios for Nepal for National Adaptation Plan (NAP). Kathmandu: Ministry of Forests and Environment (MoFE).

[5] INDC of Nepal (2016). https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Nepal/1/Nepal_INDC_08 Feb_2016.pdf

[6] USAID (2017) Climate Risk Profile: Nepal. Available at: https://www.climatelinks.org/ resources/climate-risk-profile-nepal

[7] Karki, R. *et al.* (2017) 'Rising Precipitation Extremes across Nepal', *Climate*, 5(1), p. 4. http://doi.org/10.3390/cli5010004

[8] Dahal, P. *et al.* (2016) 'Drought risk assessment in central Nepal: temporal and spatial analysis', *Natural Hazards*, 80(3), pp. 1913–1932.

In the future climates, rainfall is likely to be more erratic, though it is likely that it will increase in the future climate throughout the country especially in the central and western regions. Winters are projected to be drier, whilst summers along with the monsoon are likely to be wetter in the future climate scenarios (MoFE, 2019). Overall, Nepal is one of the most vulnerable countries to climate change, water-induced disasters and hydro-meteorological extreme events such as droughts, storms, floods, inundation, landslides, debris flow, soil erosion and avalanches. Summer monsoon rains may increase threefold, resulting in more frequent summer flooding (World Bank 2020). The number of wet and extremely wet days will not only increase the likelihood of flash flooding, but also other water-induced hazards like landslides and soil erosion (MoFE 2019).

## 1.1 Climate Change impact on Agricultural sector

The economy of Nepal is highly dependent on agriculture and nearly 26.5% of the country's GDP is being contributed by agriculture sector. Agriculture also provides 65% of total employment in the country. Rice is the major crop (30% crop area) in the country followed by maize (19%), wheat (15%) and vegetables (6%). Only 21% of total land area in the country is cultivable (AICC, 2015[9]) and about 47% cultivable area is still under rain fed condition (MoAD, 2016[10]). Over 80 per cent of the farmers rely on subsistence rainfed farming with less than 1 hectare of land and only 2–3 livestock units (Govt. of Nepal, 2015[11]). High level of poverty reduces the ability to invest in improved farming techniques, access to formal financial schemes or diversify livelihoods, and finally increases the risk of food insecurity during crops fail (UNDRR, 2019[12]). The climate change causes a shift weather patterns, hence new pests are likely to emerge and threaten sensitive crops (Ramasamy and Regmi, 2014[13]). Farmers are vulnerable to erratic rainfall patterns as well as increases in peak temperatures, floods, droughts, and landslides. Farmers are not a homogeneous class and poorer farmers as well as those from disadvantaged social groups face additional barriers in accessing financial, technical or social support to help overcome climatic challenges (Gautam and Andersen, 2016[14]). Some of the direct impacts of climate change on agriculture are mentioned as follows.

- During the last three decades approximately 3.5 million people in Nepal were directly affected by extreme weather calamities (Patra and Terton, 2017[15]).

9 AICC (2015). Krishi diary 2015. Government of Nepal, Nepal: Agricultural Information and Communication Centre, Department of Agriculture. Harihar Bhawan, Lalitpur, Nepal.

10 MoAD (2016). Statistical Information on Nepalese Agriculture 2015/16. Ministry of Agricultural Development, Monitoring, Evaluation and Statistics Division, Agri. Statistics Section, Singh Durbar, Kathmandu, Nepal.

11 Government of Nepal (2015) Agriculture Development Strategy (ADS) 2015 to 2035. http://extwprlegs1.fao.org/docs/pdf/nep171433.pdf

12 UNDRR (2019) Disaster Risk Reduction in Nepal Status Report 2019. Bangkok, Thailand: United Nations Office for Disaster Risk Reduction (UNDRR), Regional Office for Asia and the Pacific. Available at: https://reliefweb.int/sites/reliefweb.int/files/resources/68230_6nepaldrmstatusreport.pdf

13 Ramasamy, S. and Regmi, K. R. (2014) Managing climate risks and adapting to climate change in the agriculture sector in Nepal. Food and Agriculture Organization of the United Nations (Environment and natural resources management series, 22)

14 Gautam, Y. and Andersen, P. (2016) 'Rural livelihood diversification and household well-being: Insights from Humla, Nepal', Journal of Rural Studies, 44, pp. 239–249.

15 Patra, J. and Terton, A. (2017). Review of current and planned adaptation action in Nepal. CARIAA Working Paper no. 20. International Development Research Centre, Ottawa, Canada and UK Aid, London, United Kingdom

- The increase in annual rainfall with decrease in rainy days associated with increase in extreme heavy rainfall events due to climate change causes flash flood over low lying areas and subsequent crop losses in Terai plains (IDS, 2014[16])
- It was estimated that up to 90% of crop losses in Nepal are caused by weather and climatic extremes, especially drought and flood causing about 40% and 23% crop loss, respectively (Ramasamy and Regmi, 2014).
- Costs due to the impacts of climate variability and extreme events are estimated at US$ 270-360 million $yr^{-1}$ which is about 1.5 to 2% of the country's GDP (IDS of Nepal, 2014).
- Simulation modeling analysis showed that climate change in Nepal is likely to reduce the yield of maize by -16.1%, potato by -8.9%, sugarcane by -8.0% and lentil -4.9% by 2050 (Robinson et al, 2015[17]).
- The backward communities often live next to forests and rely heavily on forest resources to meet their basic needs are particularly vulnerable to the impacts of climate change due to deforestation caused by landslides, soil erosion or forest fires (Ramasamy and Regmi, 2014). These groups often live on marginalized land that is low-lying, adjacent to rivers or in urban slums also situated in exposed areas.
- Climate change is already resulting in drier winters and less snowfall, leading to the drying up of water sources prior to the monsoons (Ramasamy and Regmi, 2014).
- Droughts and increased water evaporation due to higher temperatures are adversely affecting 1) streams, which are vital for irrigation; and b) the availability of water during the growing season. This will adversely affect agricultural productivity and contribute towards further crop losses (Joshi and Joshi, 2019[18]).
- Erosion of the fertile topsoil on deforested hillsides and on riverbanks will also expose crops to damage and destruction from more frequent hailstorms and thunderstorms (Joshi and Joshi, 2019).
- In the higher altitudes of the Himalayas, increasing temperatures are increasing the frequency of Glacial Lake Outburst Flood (GLOF), leading to landslides, soil erosion and flash floods downstream (MoSTE, 2014[19]).

Furthermore, due to climate change Nepal suffers scarcity of rainfall, erratic rainfall, heat stress, drought, flooding, land degradation, desertification, deforestation, and other natural disaster. The changes in climate, therefore, have a heavy impact on this agricultural sector. Hence, managing the risks associated

[16] IDS (2014). Economic Impact Assessment of Climate Change in Key Sectors in Nepal. IDS-Nepal: Kathmandu, Nepal.

[17] Robinson, S., Mason-D'Croz, D., Islam, S., Sulser, T., Gueneau, A., Pitois, G., & Rosegrant, M. W. 2015. The International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT): Model description for version 3 (IFPRI Discussion Paper). Washington, D.C: International Food Policy Research Institute.

[18] Joshi, G. R. and Joshi, B. (2019) 'Climate Change Impact on Agricultural Sector of Nepal: Implications for Adaptation and Resilience Building', in Thapa, G., Kumar, A., and Joshi, P. K. (eds) *Agricultural Transformation in Nepal: Trends, Prospects, and Policy Options*. Singapore: Springer, pp. 119–155

[19] Ministry of Science, Technology and Environment (MSTE) (2014). Nepal second national communication to United Nations Framework Convention on Climate Change.

with increasingly variable climate is a key to successfully adapting agricultural farming, and to reducing the cycle of poverty, vulnerability and dependence brought about by climate-related disasters. However, a common problem in developing countries like Nepal is the lack of integrated means of processing and delivering agro- meteorological information to the farming communities. Even with improved agricultural technology, including improved level of farm inputs, the agricultural sectors of these countries operate below their potential level owing to the challenges imposed by the marked intra-seasonal weather and inter-annual climate variability.

Although lots of data and information are available at various agencies in Nepal (e.g., agricultural research institutes, meteorological monitoring stations, agricultural advisory agencies, etc.) but this country lacks a formal system that integrates data from different sources and translate raw information into accessible forms that are understandable and relevant to decision-making. Hence, there is need to engage all the relevant actors so that a better understanding of the sensitivity of farming practices can be developed and more relevant information can be produced.

In the context of above, the aim of this project is to customize the weather and climate information products, issued by the Department of Hydrology and Meteorology (DHM), to the needs of the local farmers in coordination with other relevant departments, for sustainable development in Nepal agricultural sector.

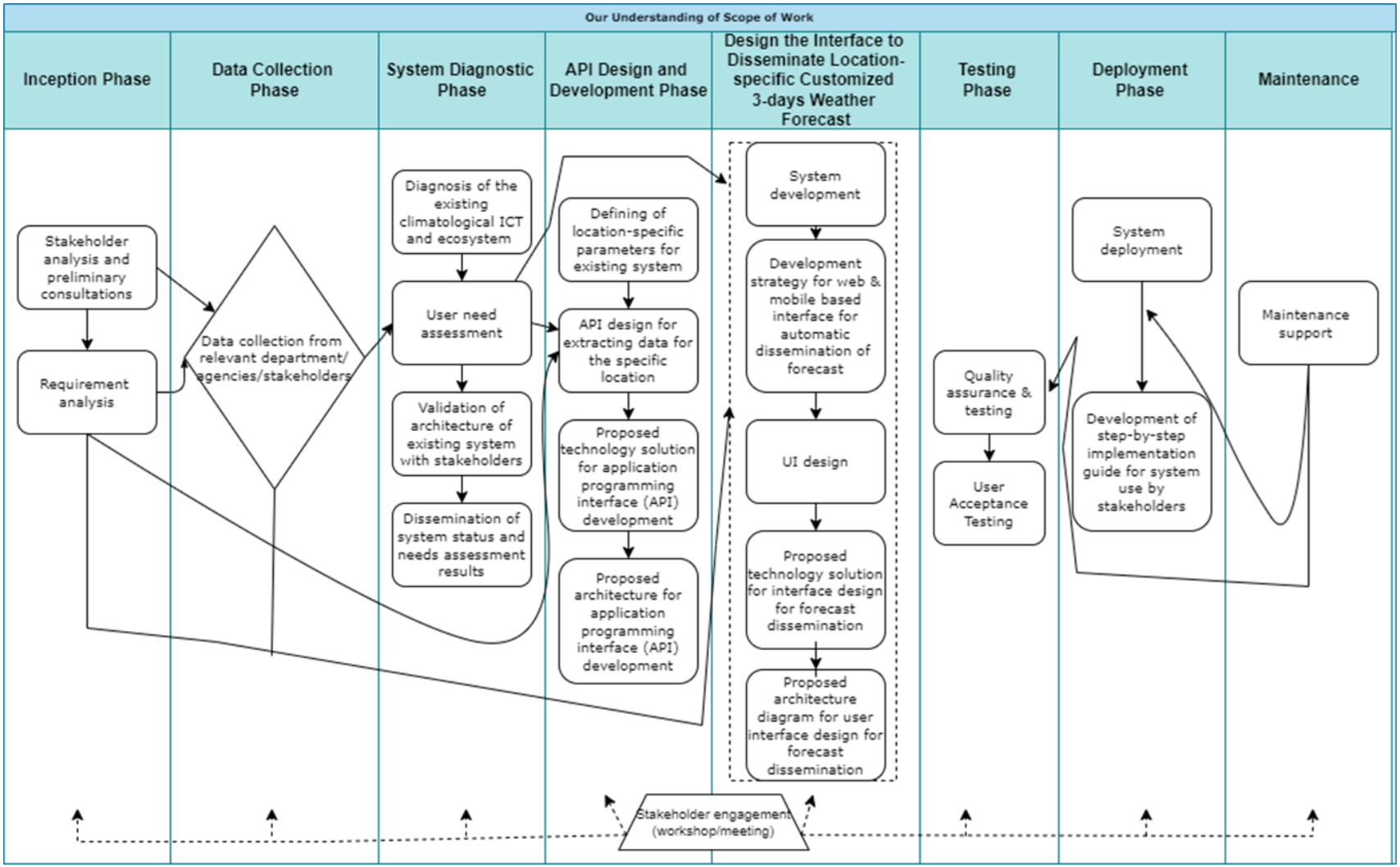
## 1.2 Existing weather observation network in Nepal

The Department of Hydrology and Meteorology (DHM) currently operates more than 500 rain gauges (automatic and manual) across the country. Even though, the mountainous region covers more than 50% geographical area of the country, while density of rain observation network over this region is very sparse (10% of total rain gauge network). Currently, The Department of Hydrology and Meteorology (DHM) maintains a country wide networks of 337 rainfall stations, 154 hydrometric stations, 20 sediment stations, 68 climatic stations, 22 agrometeorological stations, 9 synoptic stations and 6 Aero-synoptic stations (http://dhm.gov.np). Data are made available to users through published reports, bulletins, and computer media outputs diskettes. DHM publishes data on an annual basis.

# 2 Objective and Scope of work

The overall objective of this study is to develop an Application Programming Interface (API) for the automatic dissemination of location-specific customized 3-days weather forecast to farmers through mobile and internet-based information dissemination mechanisms SMS and to develop a weather information dissemination system in selected communities. The project also envisioned the development of farmer's capacities to utilize the weather and climate information. The overall scope of work has been portrayed in Figure 1.

However, this report highlights on development of implementation planning and communication documents.




*To include also:Verification and correction of bias of 3-day weather forecast prior to their use in subsequent activities (in collaboration with MFD)

**Figure 1: Overall scope of the Technical Assistance (TA)**

# 3 Purpose of this report

This document provides the detailed workplan, M&E plan with specific, measurable, achievable, relevant, and time-bound indicators to be used to monitor and evaluate the timeliness and appropriateness of the implementation. Besides, this document also discusses impact statement of the technical assistance and implementation plan.

# 4 Monitoring & Evaluation (M&E) framework to monitor the TA during project implementation phase

A robust M&E system needs to be in place to help in the monitoring of the project activities and the periodic evaluations. In the light of this detailed M&E framework has been developed for the monitoring of project during the project implementation phase. It should be noted that M&E framework is a live document which needs to be updated periodically as the implementation progresses.

Basic Information of the Technical Assistance (TA) and M&E framework to monitor the project during the implementation phase of this TA has been furnished in Table 1 and Table 2 respectively.

**Table 1: Basic Information of the Technical Assistance (TA)**

| **Basic Information of the Technical Assistance (TA)** | |
|---|---|
| **Title of response plan** | Customized weather and climate information system for climate-resilient agriculture in Nepal |
| **Technical assistance reference number** | Ref: LTR/2022/659/CTR |
| **Country/ countries** | Nepal |
| **NDE focal point and organization** | Mr. Sharad Babu Pageni, Ministry of Forests and Environment (MOFE)/ Climate Change Management Division (CCMD), Government of Nepal<br>Email: sbpageni@gmail.com<br>Phone: +977-9841484987 |
| **Sector(s) addressed** | Agricultural |
| **Technologies supported** | Agro-meteorological information system to strengthen climate resilient agricultural system in Nepal |
| **Implementation period and total duration** | 9th September 2022 to 8th September 2023 (1 year) |
| **Total budget for implementation** | USD 142,750.00 |
| **Designer of the response plan** | Dr. Dhiraj Pradhananga, The Small Earth Nepal, Gwarko, Lalitpur, Nepal.<br>Email: dhiraj@smallearth.org.np<br>Phone: +977-9847694139 |
| **Implementer of response plan** | RMSI Pvt. Ltd., India (lead firm) |

| Basic Information of the Technical Assistance (TA) | |
|---|---|
| | Nepal Development Research Institute (NDRI), Nepal, (Sub-consultant)<br>ERMC (P.) Ltd., Nepal (Sub-consultant)<br>Email: uttam.singh@rmsi.com / murari.lal@rmsi.com |

**Table 2: M&E framework to monitor the project during the implementation phase of this TA**

| A) Outputs and Activities | B) Indicator | C) Expected results | D) Method & frequency for data collection | E) Comments |
|---|---|---|---|---|
| **Output-1: Development of implementation planning and communication documents.** | | | | |
| Activity 1.1: A work plan of all activities, deliveries, outputs, deadlines and responsible persons/ organizations | • List of activities to be carried out to achieve a certain task.<br>• Tentative timeline to deliver the assigned tasks. | • A detailed workplan to implement the project. | • In-house activity | |
| Activity 1.2: Development of monitoring and evaluation (M&E) plan with specific, measurable, achievable, relevant, and time- bound indicators used to monitor and evaluate the timeliness and appropriateness of the implementation. | • List of activities along with expected results.<br>• List of indicators to evaluate the project progress. | • A detailed M&E document to evaluate the project during the project implementation phase. | • In-house activity | |
| Activity 1.3: A CTCN Impact Description formulated in the beginning of the technical assistance | • Challenge<br>• CTCN assistance<br>• Anticipated impact<br>• Anticipated co-benefits from the TA | • A Detailed Impact Description document, which will be updated once the project is fully delivered. | • In-house activity | |

| A) Outputs and Activities | B) Indicator | C) Expected results | D) Method & frequency for data collection | E) Comments |
|---|---|---|---|---|
| and update/revised once the technical assistance is fully delivered. | • Gender aspects of the TA<br>• Anticipated contribution to NDC<br>• The narrative story<br>• Contribution to SDGs<br>• Reference to knowledge products | | | |
| Activity 1.4: A Closure and Data Collection report completed at the end of the technical assistance | • Lessons learned<br>• Recommendations<br>• Illustration of the TA and photos<br>• Impact Statement<br>• A. Output and Outcome indicators | • A detailed Technical Assistance (TA) Closure Report to be submitted at the end of the TA. | • In-house activity | |
| **Output-2: Map Stakeholders and establish a Stakeholder Working Group (SWG)** | | | | |
| Activity 2.1: Map Stakeholders | • Number of relevant stakeholders contacted. | • Identification of appropriate stakeholders (i.e., institutions & organizations) to be brought on board to create the SWG. | • Through in-person with the different stakeholders. | |
| Activity 2.2: Establish a stakeholder working group | • Number of stakeholders finally identified for the creation of SWG. | • Establishment of a Stakeholder Working Group (SWG) comprised of 10 members from the identified stakeholders to work together in order to implement this TA successfully. | • In-house activity | |

| A) Outputs and Activities | B) Indicator | C) Expected results | D) Method & frequency for data collection | E) Comments |
|---|---|---|---|---|
| Activity 2.3: Conduct an inception meeting | • Number of relevant participants attended the physical meeting in Nepal. | • Successfully completion of meeting physically in Nepal and subsequently preparation of Minute of Meeting (MoM). | • Through physical meeting. | |
| **Output 3: Diagnose the existing system and define the needs** | | | | |
| Activity 3.1: Diagnose the existing climatological and meteorological information system in Nepal | • Documents and information which need to be collected from DHM and subsequently assessed on the available services of the DHM related to climatological and meteorological information, which can be used for the farming communities and other relevant stakeholders as per the weather and climatic conditions in their operational activities. | • Verification and subsequently carrying out bias correction in the 3-day NWP generated forecast data.<br>• Reviewing and understanding of weekly agro-met advisory bulletins being prepared by the Nepal Agricultural Research Council (NARC) and DHM at the regional level and how the information is disseminated to the public. | • Sending list of data and information request through email and subsequently physical visit to DHM and NARC offices. | In process. |
| Activity 3.2: Series of meetings with the stakeholder working group and meteorologists and weather forecasters to validate the | • Number of meetings (through combination of physical and virtual meeting) conducted with the relevant experts from Department of Hydrology and Meteorology (DHM) and the SWG. | • Improve in understanding of increase in the uptake level and usefulness of 3-day weather forecast products which will help to improve the quality of this services through incorporating new techniques through this TA. | • Through in-person and virtual meetings. | |

| A) Outputs and Activities | B) Indicator | C) Expected results | D) Method & frequency for data collection | E) Comments |
|---|---|---|---|---|
| architecture of the existing system | | • Improve in understanding of increase in the quality of agro-met advisories and dissemination mechanisms through this TA in order to improve the efficiency level in the farming practices and subsequently improve the livelihood of the farming communities<br>• Validation of architecture of the existing climatological and meteorological information system of DHM by the implementer and presented the results to the SWG.<br>• Defining the changes required in the existing system in consultation with the SWG to meet the project requirements. | | |
| Activity 3.3: Identify the needs of the users on weather forecast | • Number of weather-forecast users whom implementer contacted to understand requirements for the weather forecast and customized products such as weather | • Analysis of inputs received from the users of weather forecast and advisories using structured questionnaire set.<br>• Drafting of user need assessment report based on the analysed | • Through in-person and virtual meetings with the users using structured questionnaire set. | |

| A) Outputs and Activities | B) Indicator | C) Expected results | D) Method & frequency for data collection | E) Comments |
|---|---|---|---|---|
| | forecast based agro-met advisories. | results of inputs received from the users. | | |
| Activity 3.4 Organize a half day meeting with the stakeholder working group to disseminate the needs identified | • Number of feedbacks received from the SWG members on the user need assessment report. | • Successfully completion of meeting and subsequently revision of user need assessment report based on feedbacks of the SWG members. | • Virtual meeting. | |
| **Output 4: Design an application programming interface (API) for the automatic dissemination of location specific customized 3-days weather forecast** | | | | |
| Activity 4.1: Define location-specific parameters for the existing system | • Number of location-specific parameters which need to be incorporated in the API.<br>• For each of the parameters, a data type and a max and minimum values. | • Defining of architecture for the Application Programming Interface (API) that will enable the automatic dissemination of location-specific customized 3 days weather forecast and should be compatible with the existing systems. | • In-house activity | |
| Activity 4.2: Design of the system that will extract the data for the specific location | • Number of features to be considered for the smooth functioning of API for the extraction of data and generation of customized 3-day weather forecast and subsequently disseminate them automatically such as ability to scale-up, ability to | • Fully functional up & running API for the automatic dissemination of location specific customized 3-day weather forecast to the users. | • In-house activity | |

| A) Outputs and Activities | B) Indicator | C) Expected results | D) Method & frequency for data collection | E) Comments |
|---|---|---|---|---|
| | scale dynamically, ability to maintain system uptime, security, fast processing database, asynchronous, quick response time, etc. | | | |
| Activity 4.3: Design the localized weather forecast bulletin | • Types of contents to be included in the weather forecast bulletin.<br>• Format in which weather forecast bulletin to be generated using API such as map, graph, table, etc. to be included in the bulletin. | • Well-designed location-specific report to be generated at a given interval (say 3-day) automatically from the API. | • In-house activity | |
| Activity 4.4: Develop a framework for the use of this API | • Types of operation and maintenance (O&M) to be required to manage the developed API uninterrupted such as checking of server and application log files for the any issues on daily basis, data updation on regular basis, etc.<br>• Number of concerned persons (i.e., administrators) who will be responsible for the O&M of the system. | • Protocols for the administrators of the system for the O&M of the developed API in a precise manner i.e., who will be responsible for each component of the API, who will have the right to edits, who will be responsible to ensure the data quality and security, and expected cost of O&M of the system. | • In-house activity | |
| Activity 4.5: Full day meeting with the | • Number of feedbacks received from the SWG | • Updated API after incorporating of SWG feedbacks for the | • Virtual/physical meeting | |

| A) Outputs and Activities | B) Indicator | C) Expected results | D) Method & frequency for data collection | E) Comments |
|---|---|---|---|---|
| Stakeholder working groups to present the API designed | members on the developed API for the automatic dissemination of location specific customized 3-day weather forecast to the users. | automatic dissemination of location specific customized 3-day weather forecast to the users. | | |
| **Output 5: Design the interface to disseminate location-specific customized 3-days weather forecast to farmers using identified communication mechanisms including mobile and Internet-based SMS** | | | | |
| Activity 5.1: Analyze technological options | Review of features of the identified technological options (i.e., communication mechanisms such as mobile- and Internet-based SMS) using following aspects<br>• Presentation Layer<br>• Business Layer<br>• Geo Server<br>• Data Layer<br>• Integration Layer<br>• Budget required to implement the identified technological options. | • List of existing most appropriate technologies that can be used to disseminate location-specific customized 3-days weather forecast through several appropriate communication mechanisms to the farmers.<br>• Pros and cons of each of listed technologies to be used for the dissemination of customized 3-days weather forecast.<br>• Business models for each of these prioritized technologies that can be used for their respective implementation. | • In-house activity | |
| Activity 5.2: Stakeholder working group meeting to discuss the conditions of use of the identified | • Feedbacks and suggestion received from the SWG members on the identified technological options and associated options. | • Final technology and associated conditions to be used for the development of interface to disseminate location-specific | • Virtual/physical meeting | |

| A) Outputs and Activities | B) Indicator | C) Expected results | D) Method & frequency for data collection | E) Comments |
|---|---|---|---|---|
| communication mechanisms including mobile- and Internet-based SMS | | customized 3-days weather forecast to farmers. | | |
| Activity 5.3: Design the communication system that will enable farmers to access location-specific customized 3-days weather forecast by identified communication mechanisms including mobile- and Internet-based SMS | • Number of features to be considered for the smooth functioning of interface to disseminate location-specific customized 3-days weather forecast to farmers such as ability to scale-up, ability to scale dynamically, ability to maintain system uptime, security, fast processing database, asynchronous, quick response time, etc. | • Fully functional up & running interface to disseminate location-specific customized 3-days weather forecast to farmers using identified technology (i.e., communication mechanisms such as mobile- and Internet-based SMS). | • In-house activity | |
| Activity 5.4 Half Day meeting to present the SMS design to the SWG as well as the selected communities | • Number of feedbacks received from the SWG members on the developed interface to disseminate location-specific customized 3-days weather forecast to farmers. | • Updated interface after incorporating of SWG feedbacks to disseminate location-specific customized 3-days weather forecast to farmers. | • Physical meeting in Nepal | |
| **Output 6: Test the designed API and identified communication mechanisms including mobile- and Internet-based SMS technologies in the selected communities** | | | | |
| Activity 6.1: Pilot the development of | • Number of farmers receiving the customized 3-days | • Well tested developed API and identified communication | • To be carried out in the selected communities. | |

| A) Outputs and Activities | B) Indicator | C) Expected results | D) Method & frequency for data collection | E) Comments |
|---|---|---|---|---|
| application programming interface (API) for the automatic dissemination of location-specific customized 3-days weather forecast to farmers in a user-friendly language through identified communication mechanisms in selected communities of Nepal | weather forecast on real time basis smoothly through developed API and communication systems. | systems for the dissemination of customized 3-days weather forecast automatically after fixing the bugs which will come across during the piloting the system at the selected communities. | | |
| Activity 6.2: Half a day demonstration workshop to present the API and identified communication mechanisms to the Stakeholder Working Group | • Number of feedbacks received from the SWG members on the developed API and communication systems for the dissemination of customized 3-days weather automatically to the users. | • Updated API and communication systems after incorporating of SWG feedbacks for the automatic dissemination of location specific customized 3-day weather forecast to the users. | • Physical workshop | |
| Activity 6.3: Solve the bugs | • Number of bugs which will come across during testing and demonstration phase of API and communication systems. | • Fully operational up & running API and communication systems for the automatic dissemination of location specific customized 3-day weather forecast to the | • In-house activity | |

| A) Outputs and Activities | B) Indicator | C) Expected results | D) Method & frequency for data collection | E) Comments |
|---|---|---|---|---|
| | | users after fixing the bugs which will come across during the demonstration and testing phase. | | |
| Activity 6.4: 2 hours demonstration meeting | • Uninterrupted functioning of developed API and communication systems. | • Final approved API and communication systems to be finally deployed at DHM/NARC/selected communities' server. | • Virtual meeting | |
| **Output 7: Deploy the system in the selected communities, build capacity of local government, farmers and civilsociety, and develop strategy for upscaling the system** | | | | |
| Activity 7.1: On-site 3 days' workshop to present the system to the selected local government, local farmers and civil society | • Number of persons identified as an administrator to operate and manage the API and communication systems.<br>• Number of persons identified to include in the training program for improving their ability to practice agricultural activities as per the weather and climatic conditions in order to develop the climate resilient agricultural system. | • Trained administrators to manage the API and communication systems.<br>• Strengthened capacity among the selected local government, local farmers, and civil society to use as well as promote ICT based system (i.e., developed API and communication system) in order to plan for greater climate resiliency in agricultural production and food security. | • To be carried out in the selected communities. | |
| Activity 7.2: Capacity building at the commune level | • Number of farmers subscribing to use API system to use weather forecast information and agro-met | • Improved capacity among the farming communities to practice farming as per the weather | • Through mix of virtual and physical meetings. | |

| A) Outputs and Activities | B) Indicator | C) Expected results | D) Method & frequency for data collection | E) Comments |
|---|---|---|---|---|
| | advisories in their agricultural activities. | condition to build climate resilient agricultural system | | |
| Activity 7.3: Scale up step by step implementation guide and strategy for upscaling the system in Nepal | • Step-by-step guiding points for the scaling-up the developed API and communication systems. | • Detailed guidelines and strategies for short and medium terms to scale-up this type of API and communication systems in other territories of Nepal. | • In-house activity | |
| Activity 7.4: Stakeholder working group meeting to introduce the Scale up step by step implementation guide, strategy and action plan | • Number of feedbacks received from the SWG members on the guidelines and strategies to scale-up the API and communication systems. | • Final guidelines and strategy document to scale-up this type of API and communication systems in other territories of Nepal after incorporating SWG suggestions and feedback. | • Virtual meeting | |

# 5 Impact Description for the existing TA

Impact Description for the existing TA, which will be updated once the TA will be fully delivered, has been furnished in Table 3.

**Table 3: Impact Description for the existing TA**

| Impact Description | |
|---|---|
| **Challenge** | The economy of Nepal is highly dependent on agricultural sector and nearly 26.5% of the country's GDP is being contributed by this sector. Agricultural sector also provides about 65% of total employment in the country. Over 80% of the farmers rely on subsistence rainfed farming with less than 1 hectare of land and only 2-3 livestock units.<br><br>However, climatic hazards such as drought and flood are increasing in frequency and severity, thus harming agricultural production in Nepal. Farmers have little access to basic weather forecasting information, which impedes their ability to adapt their agricultural planning and practices accordingly. |
| **CTCN assistance** | To provide technical assistance on Customized weather and climate information system for climate-resilient agriculture in Nepal. The objective of the technical assistance is to develop an application programming interface (API) for the automatic dissemination of location-specific customized 3-days weather forecast to farmers in a user-friendly language through appropriate dissemination mechanisms that will be tested in selected communities in Nepal. |
| **Anticipated impact** | By establishing an ICT-based system for collecting and disseminating data (i.e., weather forecast data) and customized products (i.e., agro-met advisories) that meets the needs of the farming communities, the technical assistance aims to strengthen stakeholders with information that will improve their ability to plan for greater climate resiliency in agricultural production and food security. |
| **Anticipated co-benefits from the TA** | The greatest co-benefit of the project will be the retention of people to farm after improvement in the agricultural production through increased uptake of the climate technology (in this case it is improvement in availability of quality weather forecast and customized products), which will benefit the local economy and the county as a whole. |

| Impact Description | |
|---|---|
| **Gender aspects of the TA** | The project will provide guidance for better gender mainstreaming in climate change work to improve the agricultural production and build climate resilient agricultural system. |
| **Anticipated contribution to NDC** | • To strengthen weather risk forecasting and early warning for food security in Nepal particularly in vulnerable agro-ecological zones of Nepal.<br>• Strengthen weather forecasting capabilities, including early warning systems and the availability of information on weather forecast and customized products such as agro-met advisories to cope with weather shocks and increase the agricultural production. |
| **The narrative story** | Nepal government requested assistance through the CTCN to improve climate information services and weather forecasts, produced by national bodies, dissemination in rural and remote areas as currently due to unavailability of this service hindering the agricultural systems to be climate-smart and more productive.<br>Hence, it is requested from CTCN to provide Technical Assistance on an application programming interface (API) for the automatic dissemination of location-specific customized 3-days weather forecast to farmers in a user-friendly language through appropriate dissemination mechanisms that will be tested in selected communities in Nepal.<br>This project attempts to customize the weather and climate information products, issued by the Department of Hydrology and Meteorology (DHM), to the needs of the local farmers. The project will adopt a participatory approach with the objective to bridge the ever-existing gaps between the weather/climate change science and their users. |
| **Contribution to SDGs** | 1. NO POVERTY: End poverty in rural areas through development of climate resilient agricultural system.<br>2. ZERO HUNGER: End hunger, achieve food security and improved nutrition and promote sustainable agriculture through introduction of climate resilient agricultural system. |

| Impact Description | |
|---|---|
| | 3. CLIMATE ACTION: Take urgent action to combat climate change and its impacts on agricultural sector. |
| **Reference to knowledge products** | United Nations Environment Programme Copenhagen Climate Centre (UNEP-CCC) and United Nations Framework Convention on Climate Change (UNFCCC) Technology Executive Committee (TEC). (2022). Climate Technology Progress Report 2022. Copenhagen, Denmark.<br><br>https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TEC_documents/f6cb095702554785b53f09b73db063b7/e17ce3e0ef0e4c6ab0c1d78633503a1a.pdf<br><br>United Nations Environment Programme Copenhagen Climate Centre (UNEP-CCC) and United Nations Framework Convention on Climate Change (UNFCCC) Technology Executive Committee (TEC). (2021). Technology and nationally determined contributions. Stimulating the Uptake of Technologies in Support of Nationally Determined Contribution Implementation.<br><br>https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/techandndc/c93353c94cfc4a1daa013f27ea92df2f/bdc9d4fab72f44c283a0f35fb72ecc8e.pdf |

# 6 Work plan

Detailed work plan for this Technical Assistance (TA) entitled, "Customized weather and climate information system for climate-resilient agriculture in Nepal)" has been furnished in Table 4.

**Table 4: Detailed implementation plan of the Technical Assistance**

| Sr # | Tasks | Timeline | | | | | | | | | | | | | Responsible persons / organizations | Deliverables |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep -22 | Oct-22 | Nov -22 | Dec -22 | Jan-23 | Feb -23 | Mar -23 | Apr -23 | May -23 | Jun -23 | Jul-23 | Aug-23 | Sep -23 | | |
| 1 | Project kick-off meeting of the TA | | | | | | | | | | | | | | CTCN, RMSI, NDE, & PP | |
| 2 | Development of detailed workplan of TA implementation | | | | | | | | | | | | | | Dr. Murari, Dr. Uttam, & Mr. Ashutosh | **Mandatory Output:** Development of implementation planning and communication documents |
| 3 | Literature review to collect background information | | | | | | | | | | | | | | Dr. Murari & Dr. Uttam | **Output 1**: Map stakeholder |

| Sr # | Tasks | Timeline | | | | | | | | | | | | | Responsible persons / organizations | Deliverables |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep -22 | Oct-22 | Nov -22 | Dec -22 | Jan-23 | Feb -23 | Mar -23 | Apr -23 | May -23 | Jun -23 | Jul-23 | Aug-23 | Sep -23 | | |
| 4 | Mapping of key stakeholders of this study which have been identified as MOFE, DHM, MOALD, NARC, NAERC, AITC, DOA, KKC, two well recognized NGOs (e.g., 3S Foundation AgriNepal, 3SFAN and Forest Action Nepal, FAN, etc.), and Farmers' Organization. | | | | | | | | | | | | | | Dr. Murari, Dr. Uttam, Dr. Rajendra, & Dr. Sujata | s and establish a stakeholder working group (SWG) |
| 5 | Establishment of a stakeholder working group (SWG) from the identified stakeholders which will be comprised of 10 persons from the aforementioned organizations. They will provide a technical overview and a high-level guidance at every stage of the implementation of this study. | | | | | | | | | | | | | | Dr. Murari, Dr. Uttam, Dr. Rajendra, & Dr. Sujata with the support of National Designated Entity (NDE) & Project Proponent (PP) | |

| Sr # | Tasks | Timeline | | | | | | | | | | | | | Responsible persons / organizations | Deliverables |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep -22 | Oct-22 | Nov -22 | Dec -22 | Jan-23 | Feb -23 | Mar -23 | Apr -23 | May -23 | Jun -23 | Jul-23 | Aug-23 | Sep -23 | | |
| 6 | Detailed description of the stakeholder working group, with name and contact details of the members, respective institutions, gender, etc. | | | | | | | | | | | | | | Dr. Murari, Dr. Uttam, Dr. Rajendra, & Dr. Sujata | |
| 7 | Conducting a physical inception meeting with the SWG in Nepal just after formation of SWG. | | | | | | | | | | | | | | Dr. Murari, Mr. Ashutosh, Dr. Rajendra, & Dr. Sujata with the support of NDE & PP | |
| 8 | Minute of the inception meeting including a list of participants disaggregated by gender, the material used for the presentation | | | | | | | | | | | | | | Dr. Murari & Mr. Ashutosh | |
| 9 | Data collection and gap analysis | | | | | | | | | | | | | | Dr. Uttam, Dr. Rajendra, & Dr. Sujata | **Output 2:** Diagnose the existing |

| Sr # | Tasks | Timeline | | | | | | | | | | | | | Responsible persons / organizations | Deliverables |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep -22 | Oct-22 | Nov -22 | Dec -22 | Jan-23 | Feb -23 | Mar -23 | Apr -23 | May -23 | Jun -23 | Jul-23 | Aug-23 | Sep -23 | | |
| 10 | Diagnosis of the existing climatological and meteorological information system of Nepal. | | | | | | | | | | | | | | Dr. Murari & Mr. Ashutosh with the support of Department of Hydrology and Meteorology (DHM) | system and define the needs |
| 11 | Assessment of the users' needs for the weather forecast and advisories. | | | | | | | | | | | | | | Dr. Uttam, Dr. Rajendra, & Dr. Sujata | |
| 12 | Conducting meeting with the SWG on the user need assessment and existing climatological and meteorological information system of DHM. | | | | | | | | | | | | | | Dr. Uttam, Dr. Rajendra, & Dr. Sujata with the support of NDE & PP | |
| 13 | Minute of the SWG meeting on the user need assessment and existing climatological and meteorological information system of DHM. | | | | | | | | | | | | | | Dr. Uttam, Dr. Rajendra, & Dr. Sujata | |

| Sr # | Tasks | Timeline | | | | | | | | | | | | Responsible persons / organizations | Deliverables |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep -22 | Oct-22 | Nov -22 | Dec -22 | Jan-23 | Feb -23 | Mar -23 | Apr -23 | May -23 | Jun -23 | Jul-23 | Aug-23 | Sep -23 | |
| 14 | Verification of NWP 3-day weather forecasts products of DHM for the use of farming communities. | | | | | | | | | | | | | | Dr. Murari with the support of Department of Hydrology and Meteorology (DHM) | |
| 15 | Understanding of how weekly agro-met advisory bulletins are being prepared by NARC & DHM at the regional level and how the information is being disseminated to the public. | | | | | | | | | | | | | | Dr. Uttam & Dr. Rajendra with the support of DHM and Nepal Agricultural Research Council (NARC) | |
| 16 | Validation of architecture of existing system with SWG | | | | | | | | | | | | | | Mr. Ashutosh with the support of DHM and Nepal Agricultural Research Council (NARC) | |

| Sr # | Tasks | Timeline | | | | | | | | | | | | | Responsible persons / organizations | Deliverables |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep -22 | Oct-22 | Nov -22 | Dec -22 | Jan-23 | Feb -23 | Mar -23 | Apr -23 | May -23 | Jun -23 | Jul-23 | Aug-23 | Sep -23 | | |
| 17 | Minute of the SWG meeting on the validation of architecture of existing system with SWG. In this meeting communities, in which the API will be tested, will also be finalized. | | | | | | | | | | | | | | Mr. Ashutosh | |
| 18 | Designing of an application programming interface (API) for the automatic dissemination of location specific customized 3-days weather forecast. | | | | | | | | | | | | | | Mr. Ashutosh, Mr. Lokenda, & Mr. Abhinav | **Output 3:** Design an application programming interface (API) for the automatic dissemination of location-specific customized 3-days weather forecast |
| 19 | Report on technological options (technology fact sheets) and respective business models | | | | | | | | | | | | | | Mr. Ashutosh & Mr. Lokendra | |

| Sr # | Tasks | Timeline | | | | | | | | | | | | | Responsible persons / organizations | Deliverables |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep -22 | Oct-22 | Nov -22 | Dec -22 | Jan-23 | Feb -23 | Mar -23 | Apr -23 | May -23 | Jun -23 | Jul-23 | Aug-23 | Sep -23 | | |
| 20 | Conducting meeting with the SWG on the designed API for the automatic dissemination of location specific customized 3-days weather forecast. | | | | | | | | | | | | | | Mr. Ashutosh, Mr. Lokendra, Dr. Rajendra, & Dr. Sujata with the support of NDE & PP | |
| 21 | Minute of the SWG meeting on presention of designed API for the automatic dissemination of location specific customized 3-days weather forecast. | | | | | | | | | | | | | | Mr. Ashutosh, Mr. Lokendra, Dr. Rajendra, & Dr. Sujata | |
| 22 | Designing of the interface to disseminate location-specific customized 3-days weather forecast to farmers using identified communication mechanisms including mobile and Internet-based SMS. | | | | | | | | | | | | | | Mr. Ashutosh, Mr. Lokenda, & Mr. Abhinav | **Output 4:** Design the interface to disseminate location-specific customized 3-days weather forecast to farmers |

| Sr # | Tasks | Timeline | | | | | | | | | | | | | Responsible persons / organizations | Deliverables |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep -22 | Oct-22 | Nov -22 | Dec -22 | Jan-23 | Feb -23 | Mar -23 | Apr -23 | May -23 | Jun -23 | Jul-23 | Aug-23 | Sep -23 | | |
| 23 | Report on the design of the communication channels that will ensure that the location-specific customized 3-days weather forecast is shared with the farmers by the communication system. | | | | | | | | | | | | | | Mr. Ashutosh & Mr. Lokendra | using identified communication mechanisms |
| 24 | Conducting meeting with the SWG on the conditions of use of the identified communication mechanisms e.g., mobile and Internet-based SMS. | | | | | | | | | | | | | | Mr. Ashutosh & Mr. Lokendra | |
| 25 | Minute of the SWG meeting on discussion the conditions of use of the identified communication mechanisms e.g., mobile and Internet-based SMS. | | | | | | | | | | | | | | Mr. Ashutosh & Mr. Lokendra | |

| Sr # | Tasks | Timeline | | | | | | | | | | | | Responsible persons / organizations | Deliverables |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep -22 | Oct-22 | Nov -22 | Dec -22 | Jan-23 | Feb -23 | Mar -23 | Apr -23 | May -23 | Jun -23 | Jul-23 | Aug-23 | Sep -23 | |
| 26 | To test through piloting the developed (API) for the automatic dissemination of location-specific customized 3-days weather forecast to farmers in selected one community of Nepal. | | | | | | | | | | | | | | Dr. Murari, Dr. Uttam, & Mr. Ashutosh | **Output 5:** Test the designed API and identified communication mechanisms including mobile- and inyernet-based SMS technologies in the selected community |
| 27 | On-site 3 days' demonstration workshop to present the system to the selected local government, local farmers and civil society. | | | | | | | | | | | | | | Dr. Uttam, Mr. Ashutosh, Dr. Rajendra, & Dr. Sujata with the support of NDE & PP | |
| 28 | Minute of the demonstration workshop | | | | | | | | | | | | | | Dr. Uttam, Mr. Ashutosh, Dr. Rajendra, & Dr. Sujata | |

| Sr # | Tasks | Timeline | | | | | | | | | | | | Responsible persons / organizations | Deliverables |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep -22 | Oct-22 | Nov -22 | Dec -22 | Jan-23 | Feb -23 | Mar -23 | Apr -23 | May -23 | Jun -23 | Jul-23 | Aug-23 | Sep -23 | |
| 29 | Capacity building at the selected community to the local government, farmers, & civil society. During this phase RMSI team will oversee updating any bugs, make any amendments to the system, respond to any technical or practical questions from the administrator or the users in an acceptable timeline. | | | | | | | | | | | | | Dr. Murari, Dr. Uttam, Mr. Ashutosh, Dr. Rajendra, & Dr. Sujata | **Output 6:** Deploy the system in the selected communities and building capacity of local government, farmers and civil society |
| 30 | Scale up step by step implementation guide. | | | | | | | | | | | | | Dr. Murari, Dr. Uttam, & Mr. Ashutosh | |
| 31 | Conducting meeting with the SWG on the sacling of the developed system to other communities of Nepal | | | | | | | | | | | | | Dr. Murari, Dr. Uttam, Mr. Ashutosh, Dr. Rajendra, & Dr. Sujata with the support of NDE & PP | |

| Sr # | Tasks | Timeline | | | | | | | | | | | | Responsible persons / organizations | Deliverables |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep -22 | Oct-22 | Nov -22 | Dec -22 | Jan-23 | Feb -23 | Mar -23 | Apr -23 | May -23 | Jun -23 | Jul-23 | Aug-23 | Sep -23 | |
| 32 | Minutes of the last meeting with the SWG | | | | | | | | | | | | | | Dr. Murari, Dr. Uttam, Mr. Ashutosh, Dr. Rajendra, & Dr. Sujata | |
| 33 | Final report and TA closer | | | | | | | | | | | | | | Dr. Murari, Dr. Uttam, & Mr. Ashutosh | |

# 7 Proposed M&E framework to monitor the project during the post implementation phase of this TA in Nepal

M&E framework to monitor the project during the post project implementation phase of this TA that is when fully developed and tested ICT based system (i.e., API and communication system) for the dissemination of weather forecast information and customized products (i.e., agro-met advisories) will be introduced in the targeted population has been provided in Table 5.

**Table 5: M&E framework to monitor the project during the post implementation phase of this TA in Nepal**

| Narrative Summary | Indicators |
|---|---|
| **Impact:** Increased resilience power among the targeted population to climate variability and change through introduction of ICT based system for the weather forecast information and weather forecast based agro-met advisories. | **Indicator:** Number of farmers in the targeted population subscribing to ICT based system for the weather forecast information and weather forecast based agro-met advisories at the end of this TA and getting benefits which will result in development of climate resilient agricultural system. |
| | |
| **Outcome 1:** Reduced exposure to weather-related hazards and threats (such as heavy rainfall, flood, dry spell, etc.) due to adoption and use of ICT based system for the weather forecast information and weather forecast based agro-met advisories. | **Indicator 1:** Relevant weather-related hazards and threat information generated and disseminated to stakeholders on a timely basis through ICT-based system which will be developed under this TA. |
| ***Output 1:*** Targeted population groups covered by adequate risk reduction systems in this case it is ICT based system for the weather forecast information and weather forecast based agro-met advisories. | **Indicator 1.1:** Capacity of staff to respond to and mitigate impacts of weather-related events (such as heavy rainfall, flood, dry spell, etc.) from targeted institutions increased after introduction of ICT based system to disseminate weather forecast information and weather forecast based agro-met advisories. |
| | **Indicator 1.2:** Number of staffs trained to respond to and mitigate impacts of weather-related events (such as heavy rainfall, flood, dry spell, etc.). |
| | **Indicator 1.3:** Number of targeted institutions with increased capacity to minimize exposure to climate variability risks in the agricultural sector after introduction of ICT based system to disseminate weather forecast information and weather forecast based agro-met advisories. |

| Narrative Summary | Indicators |
|---|---|
| | **Indicator 1.4:** Number of targeted institutions benefitting from the direct access of weather forecast information and agro-met advisories and enhanced direct access modality for the weather forecast information and weather forecast based agro-met advisories. |
| | |
| **Outcome 2:** Strengthened awareness and ownership among the targeted population of adaptation and climate risk reduction processes through usage of ICT based system for the weather forecast information and agro-met advisories. | |
| ***Output 2:*** Targeted population groups participating in adaptation and risk reduction awareness activities through adoption of ICT based system for the weather forecast information and agro-met advisories. | **Indicator 2.1:** Percentage of targeted population awareness of predicted adverse impacts of climate change and of appropriate responses through ICT based system for the weather forecast information and agro-met advisories. |
| ***Output 2.2:*** Strengthened capacity of national and subnational stakeholders and entities to capture and disseminate knowledge and learning for the usage ICT based system for the weather forecast information and agro-met advisories to manage the weather-related events in the agricultural activities. | **Indicator 2.2.1:** Number of technical committees/associations formed to ensure transfer of knowledge on the ICT based system for the weather forecast information and agro-met advisories. |
| | **Indicator 2.3.1:** Number of tools and guidelines developed (thematic, sectoral, institutional) and shared with relevant stakeholders to promote for the adoption of ICT based system for the weather forecast information and agro-met advisories. |
| | |
| **Outcome 3:** Increased adaptive capacity within agricultural sector after using ICT based system for the weather forecast information and agro-met advisories to manage the weather-related events in the agricultural activities. | **Indicator 3.1:** Increased responsiveness of agricultural sector services to evolving needs from climate variability and change after introduction of ICT based system for the weather forecast information and weather forecast based agro-met advisories. |
| | **Indicator 3.2:** Improved agricultural production after introduction of ICT based system for the weather forecast information and weather forecast based agro-met advisories. |

| Narrative Summary | Indicators |
|---|---|
| ***Output 3*:** Vulnerable agricultural sector strengthened in response to climate variability and change after using ICT based system for the weather forecast information and weather forecast based agro-met advisories to manage the weather-related events in the agricultural activities. | **Indicator 3.1.1:** Agricultural sector respond to new conditions resulting from climate variability and change due to adoption of ICT based system for the weather forecast information and agro-met advisories to manage the weather-related events in the agricultural activities. |
| | |
| **Outcome 4:** Diversified and strengthened livelihoods and sources of income for climate vulnerable people in targeted areas after introduction of ICT based system for the weather forecast information and weather forecast based agro-met advisories. | **Indicator 4.1:** Increase in targeted population's income ICT based system for the weather forecast information and weather forecast based agro-met advisories. |
| | **Indicator 4.2:** Increase in targeted population's sustained climate-resilient alternative livelihoods such as practice in aquaculture and livestock after introduction of ICT based system for the weather forecast information and weather forecast based agro-met advisories. |
| ***Output 4:*** Targeted population livelihood strategies strengthened in relation to climate variability and change after introduction of ICT based system for the weather forecast information and weather forecast based agro-met advisories. | **Indicator 4.1.1:** Adaptation mechanism strengthened in support of targeted population strategies through implementation of ICT based system for the weather forecast information and agro-met advisories to manage the weather-related events in the agricultural activities. |
| | **Indicator 4.1.2:** Increased income, or avoided decrease in income. |
| | |
| **Outcome 5:** Improved policies and regulations for the use of ICT based system for the weather forecast information and weather forecast based agro-met advisories and promote and enforce climate resilience measures to manage the weather-related events in the agricultural activities. | **Indicator 5:** Climate change priorities are integrated into the targeted population development strategy through introduction of ICT based system for the weather forecast information and agro-met advisories to manage the weather-related events in the agricultural activities. |
| ***Output 5:*** Improved integration of climate-resilience strategies into the targeted population development plans through introduction of ICT based system for the weather forecast information and agro-met | **Indicator 5.1:** Number of policies introduced or adjusted to address climate change risks through introduction of ICT based system for the weather forecast information and agro-met advisories to |

| Narrative Summary | Indicators |
|---|---|
| advisories to manage the weather-related events in the agricultural activities. | manage the weather-related events in the agricultural activities. |

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