ESCAP

Multi-donor Voluntary Trust Fund on Tsunami Early Warning Arrangements in the Indian Ocean and Southeast Asia

(2013-2018)

TERMINAL REPORT

PROJECT TITLE	Strengthening of Myanmar's Multi-Hazard Early Warning System
ORGANIZATION	Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES)

Total project budget	US$ 705,291	Funding received to date	US$ 621,296
Percentage of total project budget spent	86.0%	Percentage of funding received to date that has been spent	97.6%
Interest earned on funding received from ESCAP	US$ 0		
Date of signature of Letter of Agreement	21 Jun 2013	Date of project completion	31 December 2015

ANNEXES

1 DMH annual capacity self-assessment for strengthening multi-hazard early warning system in Myanmar
2 Site survey report for Myaungmya
3 ES&S-DMH communication on Kelunji plug-in and station integration into SeisComP3
4 Myanmar seismic network
5 SeisComP3 upgrading and training
6 SOP Exercise report, 15 Oct 2015
7 Final NEDC SOP
8 Report on geospatial database development
9 ShakeCast development – final report
10 Report on ShakeCast testing
11 Report on agro-ecological zoning
12 Report on updating of crop-weather calendars
13 Upgraded agromet network
14 Report on agro-advisory expert system development
15 Report on external end-of-project evaluation
16 Financial audit report
17 Project closeout workshop report

I certify the accuracy of the substantive and financial information contained in this report.

A.R. Subbiah
Director, RIMES Program Unit
21 March 2016

This terminal report is accepted.

Mr. Alf Blikberg, Programme Officer
Trust Fund for Tsunami, Disaster
and Climate Preparedness

OVERALL ASSESSMENT

Briefly state the main results of the project so far. These could include key activities and, more importantly, should include any evidence of capacities the project has built. Is there any evidence that the project has reduced gender inequalities?

Longer-term goal: Strengthened and integrated multi-hazard early warning system in Myanmar

Expected Outcome 1: Synergy in donor assistance for DMH capacity building

Performance indicators:

- DMH capacity building program document, identifying gaps and priority actions to address gaps
- Warning system design, with specifications

Progress against performance indicators:

- Capacity building program document prepared, identifying gaps and priority actions to address gaps, owned by DMH

Expected Outcome 2: NEDC meets UNESCO/IOTWS standards for national tsunami warning centers

Performance indicators:

- Real-time data availability from 2 remote seismic stations
- SeisComP3 automatically locates earthquakes from real-time detections at Myitkyina, Namsang, Pathein, Hpa-an, and Naypyitaw stations
- At least 3 of these stations share data globally through IRIS
- NEDC access to seismic data from at least one other network
- Dedicated GTS client server at NEDC operational
- At least 5 NEDC staffs trained in SeisComP3 and Tide Tool configuration, operation, and maintenance, and apply skills in tsunami generation evaluation
- At least 4 drills conducted at NEDC on earthquake and tsunami evaluations at different earthquake scenarios and SOP-based generation and dissemination of warning information
- Tested SOP for generation and dissemination of tsunami warnings and cancellation bulletins, printed and displayed at the NEDC

Progress against performance indicators:

- Data from Hpa-an is now available in real-time, with improvement of Internet services; Pathein station shall be relocated as agreed with DMH for better detections, and shall be equipped with GSM/ VSat telemetry. RIMES shall pursue this in synergy with ongoing project funded by INCOIS.
- Integration of Nay Pyi Taw and Hpa-an stations into SeisComP3 is ongoing, in coordination with data acquisition system supplier for these stations. The 3rd station shall be integrated after relocation.
- IRIS registration shall follow on completion of station integration into SeisComP3, as SeisComP3 data format meets IRIS data format requirement (SEED/ miniSEED).

- NEDC is now able to access data from the California Integrated Seismic Network (CISN) with installation of CISN software, and from the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO). NEDC staffs have practiced on CISN data access for comparing and supplementing detections from SeisComP3.
- GTS client server has been established at NEDC. Operation manual has been handed over to NEDC and DMH IT Section
- 13 NEDC staffs were trained on SeisComP3 from 11-12 November 2013, using lectures and hands-on exercises on seismic data processing and analysis, including SeisComP3 configuration, troubleshooting, and maintenance
- 14 NEDC staffs trained in November 2013 on Tide Tool software application, installation, configuration, and maintenance, using lectures and hands-on exercises
- 4 drills conducted at NEDC (November 2013, December 2014, May 2015, and October 2015), and evaluated current NEDC practice in generating warning information. Exercise conducted in October 2015 involved DMH, RRD, and GAD offices from national to township levels, as well as MRCS.
- Revised draft SOP prepared and practiced in the exercise conducted in October 2015. Final SOP, which integrates feedback from October 2015 exercise, readied for printing.

Expected Outcome 3: Reduced disaster risks through users' increased uptake of warning information

Performance indicators:

- 1 tsunami warning drill that involves tsunami evaluation and warning generation at NEDC, dissemination through the Relief and Resettlement and General Administration Departments, and evacuation at 1 pilot site
- Availability of geospatial database for multi-hazard risk assessments
- Availability of potential earthquake damage information to guide emergency response
- Updated agro-ecological zone map for the country
- At least 6 updated crop-weather calendars for major crops
- DMH agro-meteorological bulletin that integrates crop development stage
- At least 17 agro-meteorological stations that automatically transmit data to the data center for forecast generation and verification and to support research
- A web-based agro-advisory expert system operationalized and maintained by DMH and linked to the MOAI website
- At least 20 personnel from MOAI and GAD at the pilot sites trained on the use of agro-advisory expert system
- Climate Risk Management Field Schools established in at least 2 of the pilot sites to introduce farmers to the use of science-based information for decision-making
- At least 60 farmers report benefits on the use of forecast-based agro-advisories

Progress against performance indicators:

- 1 full-scale tsunami exercise conducted on 26 December 2014, involving DMH-NEDC, GAD, RRD, MRCS, Action Aid, and 714 residents of Aunghlaing township
- Geospatial database developed with township level administration boundaries and population, and rainfall as static data layers, and 3-day weather forecast as dynamic data layer. Web-based tool could be used for preliminary identification of risk hotspots based on rainfall thresholds. Other township level data layers could be added once available.
- ShakeCast customized for Myanmar and transferred to DMH. RIMES upgraded the tool in October 2015 to version 3.0 platform, which has more customizable features. Tool could be further improved with addition of building survey data, particularly for high-risk areas, and integration of building vulnerability thresholds that are specific for Myanmar. Ongoing UN-Habitat initiative could contribute in this regard.

- Township level agro-ecological zoning, using land use and elevation and meteorological data, prepared. The tool could be further improved with addition of township level soil, crop, irrigation, and allied datasets.
- Crop-weather calendars for paddy, sesame, pigeon pea, cotton, chili, and groundnut developed for Monywa and Nyaung-Oo, and integrated into the agro-advisory system
- Agro-meteorological bulletin with crop development stage developed and integrated into the agro-advisory expert system
- 17 agromet stations upgraded and automatically transmits data to data receiving hub
- Web-based agro-advisory expert system developed and transferred to DMH, with functionalities for provision of 3-day forecasts by SMS, 10-day agro-met bulletin by email, and agro-advisories by email.
- 11 personnel from national level DMH, DOA, Irrigation Department, and Water Resources Utilization Department trained on functionalities and operation of agro-advisory expert system
- 53 local level DMH personnel, agriculture extension officers (DOA), local administrators (GAD), and progressive farmers trained on functionalities of and products from the agro-advisory expert system
- Climate risk management field schools (named FARM School) established in Monywa and Nyaung-Oo, with tested curriculum and pool of 27 trainers at national level and 75 trainers at township level
- 80 participants trained in FARM Schools in Monywa and Nyaung-Oo
- Limited experimental operation of agro-advisory expert system, involving extension specialists and progressive farmers. Experimental operation over at least 2 seasons would be required for demonstrating economic benefits.

ACTIVITY WORK PLAN

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
Project initiation					
	Project initiation meeting	Jun 2013 – Jul 2013	*Personnel* Lead Scientist, EQ and Tsunami Evaluation: US$ 900 System Developer: US$ 900 Capacity Building Specialist: US$ 450 *Travel* Airfare: US$ 2,500 Local travel, visa fees, etc.: US$ 500 DSA: US$ 2,055 *Meeting costs:* US$ 850 **Total for activity: US$ 8,155**	*Personnel* Lead Scientist, EQ and Tsunami Evaluation: US$ 900 System Developer: US$ 900 Capacity Building Specialist: US$ 450 *Travel* Airfare: US$ 2,613 Local travel, visa fees, etc.: US$ 532 DSA: US$ 2,157 *Meeting costs:* US$ 898 **Total for activity: US$ 8,450**	The Department of Meteorology and Hydrology (DMH) convened the project inception workshop on 25 July 2013 in Naypyitaw, with 34 participants from DMH, Ministry of Agriculture and Irrigation's Department of Agriculture (MOAI/DOA), General Administration Department (GAD), and Relief and Resettlement Department (RRD). The workshop: ○ Discussed and received feedback on the project framework ○ Received baseline information ○ Detailed the project implementation arrangement ○ Agreed on roles and responsibilities of partners ○ Agreed on project time line and milestones ○ Finalized the work plan ○ Identified sites for local activities – Nyaung Oo (in Mandalay) and Monywa (in Sagaing)
1. Coordinated external support for DMH capacity building and system development					
1.1	Preparation of DMH capacity building program document, and system design and specifications	Jul 2013 – Oct 2015	*Personnel* Project Coordinator: US$ 9,600 Lead Scientist, EQ and Tsunami Evaluation: US$ 1,500 System Developer: US$ 1,500 Instrumentation Specialist: US$ 1,150 Admin and Financial Assistant: US$ 255 *Travel* Airfare: US$ 2,000 Local travel, visa fees, etc.: US$	*Personnel* Project Coordinator: US$ 9,600 Lead Scientist, EQ and Tsunami Evaluation: US$ 1,500 System Developer: US$ 1,500 Instrumentation Specialist: US$ 1,150 Admin and Financial Assistant: US$ 255 *Travel* Airfare: US$ 760 Local travel, visa fees, etc.:	This project component aimed at developing a document that DMH could refer to in building its capacity for providing user-relevant warning information products and services. The process involved: ○ DMH self-assessment, guided by RIMES, of current capacities in observation and monitoring; data communication, processing, and management; prediction and forecasting; bulletin development; and dissemination system for its meteorological, agro-meteorological, hydrological, and seismological/tsunami divisions. Feedback was received in October 2013. ○ Review of WMO and IOC requirements and standards

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
			400 DSA: US$ 1,644 *Meeting costs:* US$ 700 *Layout and printing costs:* US$ 1,000 **Total for activity 1.1: US$ 19,749**	US$ 321 DSA: US$ 1,143 *Meeting costs:* US$ 708 **Total for activity 1.1: US$ 16,937**	relevant to above areas ○ Evaluation of minimum requirements for provision of warning information products and services, considering WMO and IOC requirements and standards. These shall guide immediate and short-term capacity building investments. ○ Evaluation of optimum requirements to guide medium- to long-term capacity building investments ○ Technical visit to DMH in February 2015 to confirm evaluation outcomes ○ Preparation of first draft document ○ Consultation for draft finalization in a RIMES-facilitated workshop ○ Preparation of final document (Annex 1) The document generated interest from donors that plan to invest in early warning and disaster preparedness in Myanmar. The World Bank-initiated donor coordination conference in Nay Pyi Taw in October 2015 appreciated the inputs from this ESCAP-supported project. The conference aimed at facilitating dialogue among donors and development partners for supporting DMH capacity building, to enhance its delivery of weather, climate, and hydrological services. Owning the document, DMH plans to hand copies of the document to interested donors, as reference to engage with them for DMH capacity building.
2. Increased availability of real-time seismic and near real-time sea level data					
2.1-2.4	Remote station telemetry, integration of remote stations into SeisComP3, registration of at least 3 stations with IRIS, facilitating access to other	Jul 2013 – Oct 2015	*Personnel* System Analyst: US$ 6,000 Lead Scientist, EQ and Tsunami Evaluation: US$ 1,500 Instrumentation Specialist: US$ 4,600 Country Coordinator: US$ 750 Admin and Financial Assistant:	*Personnel* System Analyst: US$ 6,000 Lead Scientist, EQ and Tsunami Evaluation: US$ 1,500 Instrumentation Specialist: US$ 4,600 Country Coordinator: US$ 750 Admin and Financial Assistant:	***Remote seismic station telemetry.*** The project aimed to improve reliability of data receipt from broadband seismic stations in Hpa-an and Pathein, stations that were then newly acquired by DMH, with government funding. The stations were established by Australia-based commercial provider, ES&S, with Internet-based telemetry – ADSL in Hpa-an station, and iPStar in Pathein station.

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
	seismic networks, establishment of GTS client server, and NEDC training in SeisComP3, Tide Tool and GTS		US$ 255 *Travel (RIMES)* Airfare: US$ 3,000 Local travel, visa fees, etc.: US$ 600 DSA: US$ 4,110 *Travel (DMH):* Local travel: US$ 400 DSA: US$ 972 *Equipment (DMH and remote stations)* Server: US$ 7,000 Workstations: US$ 2,000 VSat system (antenna, codan BUC, LNB, modem) 2 sets: US$ 30,000 Materials and consumables: US$ 400 Spare codan BUC, LNB, modem: US$ 9,780 Solar power- 2sites: US$ 10,000 Export packing, air freight, customs clearance, delivery to site: US$ 5,000 Concrete base for VSat antenna -2 stations: US$ 4,000 VSat receiver/ transmitter at NEDC (4 channels): US$ 8,500 *Training costs:* US$ 1,500 **Total for activity:** **US$ 100,367**	US$ 255 *Travel (RIMES)* Airfare: US$ 2,700 Local travel, visa fees, etc.: US$ 603 DSA: US$ 3,968 *Travel (DMH):* Local travel: US$ 418 DSA: US$ 794 *Equipment (DMH and remote stations)* Server: US$ 7,299 Workstations: US$ 2,071 Materials and consumables: US$ 361 Export packing, air freight, customs clearance, delivery to site: US$ 79 *Training costs:* US$ 222 **Total for activity:** **US$ 31,620**	The project's plan was to upgrade telemetry to VSat, taking advantage of the JICA-supported project with DMH, which includes establishment of VSat receiving facility at DMH in Nay Pyi Taw. This JICA-supported project, however, started much later than expected, with establishment of the VSat receiving station programmed beyond the life of this ESCAP-supported project. Options were then explored, which include the use of telemetry system planned for the INCOIS-supported RIMES project, which will establish 8 stations using VSat system through INCOIS, or the USAID-supported USGS project, which planned to establish 5 stations, with mobile telecommunications-based telemetry. DMH Director General, in discussions at RIMES in late 2014, conveyed her preference for VSat telemetry with INCOIS, noting that the system would be operating at no recurring cost to DMH. RIMES pursued this with INCOIS. Delay in equipment acquisition by INCOIS has delayed the INCOIS-supported project. Meanwhile, ADSL Internet in Hpa-an has become stable, with data streaming in to NEDC reliably. For Pathein, there was request from NEDC to relocate the station due to environmental noise. Proposed new location is Myaungmya, a neighboring township in Ayeyarwady Division. The site was included in the survey for potential sites under the INCOIS-supported project, and was found suitable (Annex 2). The site, however, does not have Internet facility. In this regard, DMH suggested Dawei broadband station, which was also established by ES&S. USGS seismic installations in 5 locations, wherein RIMES was involved, used GSM-based telemetry, which has minimal recurring costs, although not the telemetry system that DMH preferred. Performance during 2016 is crucial for DMH acceptance of this telemetry system. In this regard, RIMES shall pursue Pathein station relocation and telemetry along with implementation of INCOIS-supported activities. Both GSM-

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
					based and VSat telemetry through INCOIS are being considered. Final choice would depend on performance of the GSM-based telemetry in the USGS-supported stations during the first few months in 2016. ***Integration of remote seismic stations into SeisComP3.*** The project aimed at integrating remote broadband seismic stations into one data acquisition platform (SeisComP3) that NEDC mainly uses in its operations. These include the 3 stations (Pathein, Hpa-an, and Nay Pyi Taw) established by ES&S, 2 stations (Myitkyina and Namsang) established by China Earthquake Administration (CEA), and 1 station (Sittwe) established by RIMES, with ESCAP support. RIMES coordination with ES&S for plugin to convert data format into SEED/ miniSEED, required by SeisComP3, was initiated in July 2013. In November 2013, ES&S agreed to assist, and required a public IP address for remote work on the system. IP address from Myanmar Posts and Telecommunications was received early 2015. Work by ES&S to link the 3 stations to SeisComP3 was initiated only in November 2015 and is still ongoing (refer to Annex 3). Stations established by CEA could not be integrated into SeisComP3. DMH has decided to keep the 2 stations independent. Stations established by USGS in Yangon, Mandalay, Kengtaung, Hakha, and Tamu have been integrated into SeisComP3. Stations to be established/upgraded in Gwa, Taungoo, Nay Pyi Taw, Taunggyi, Nyaung Oo, Shwebo, Hsipaw, and Katha, with INCOIS support, shall also be integrated into SeisComP3. Annex 4 shows the locations of these stations. ***Registration with at least 3 stations with IRIS.*** Registration with IRIS of Nay Pyi Taw, Hpa-an, and Pathein/Myaungmya/Dawei stations shall be pursued on completion of integration of these

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
					stations into SeisComP3. ***Facilitating access to other seismic networks.*** Software to enable NEDC access to the California Integrated Seismic Network (CISN) was installed in November 2013. Acquisition of CISN seismic data has been integrated into NEDC SOP. CTBTO approved in late 2014 DMH request for access to CTBTO seismic network. Efforts are ongoing to integrate these stations into SeisComP3. Access to these networks increased the number of seismic data available to NEDC for evaluating monitoring inland and tsunamigenic earthquakes. ***Establishment of GTS client server at NEDC.*** GTS client server was established at NEDC in November 2013. Sea level data acquisition from GTS has been incorporated into NEDC SOP. ***NEDC training on SeisComP3 and Tide Tool.*** Training sessions were held to build NEDC capacity on data acquisition from and maintenance of SeisComP3, Tide Tool, and GTS systems, including data analysis: o 13 NEDC staffs trained in November 2013 on basic seismology, interpretation of ground motion data from different earthquake events, determination of earthquake magnitude using SeisComP, hands-on exercises on seismic data processing using SeisComP, and SeisComP configuration, troubleshooting, and maintenance o 14 NEDC staffs trained in November 2013 on sea level sensor types and methods of measurement, technique for sea level reading and interpretation, extraction of tsunami parameters from sea level records, introduction on Tide Tool, hands-on exercises on Tide Tool functions, and Tide Tool installation, configuration, and server maintenance o Refresher trainings in December 2014, May 2015, and October 2015 during preparations for tsunami warning drills

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
					RIMES scheduled to assist DMH in January 2016 in upgrading SeisComP3 to the latest version (Jakarta 2016.062) and train NEDC personnel on the operation and maintenance of this upgraded version (Annex 5).
3. More efficient and effective generation and dissemination of warning information					
3.1	NEDC drills and SOP testing and finalization	Jul 2013 – Oct 2015	*Personnel* Lead Scientist, EQ and Tsunami Evaluation: US$ 6,000 System Analyst: US$ 3,000 Country Coordinator: US$ 1,200 Admin and Financial Assistant: US$ 680 *Travel* Airfare: US$ 4,000 Local travel, visa fees, etc.: US$ 800 DSA: US$ 3,288 *Meeting costs:* US$ 2,400 **Total for activity 3.1: US$ 21,368**	*Personnel* Lead Scientist, EQ and Tsunami Evaluation: US$ 6,000 System Analyst: US$ 3,000 Country Coordinator: US$ 1,200 Admin and Financial Assistant: US$ 680 *Travel* Airfare: US$ 3,744 Local travel, visa fees, etc.: US$ 813 DSA: US$ 3,416 *Meeting costs:* US$ 1,297 **Total for activity 3.1: US$ 20,150**	Four exercises were facilitated to practice NEDC personnel on SOP for inland and tsunamigenic earthquakes: ○ Drill in November 2013, involving 11 NEDC personnel, evaluated performance against SOP and performance indicators ○ Full-scale exercise in December 2014, linked to TTF-17, evaluated performance against SOP and performance indicators, warning communication from NEDC down to village level, and warning receipt and response at village level. The exercise involved 19 NEDC staffs; personnel from GAD (Nay Pyi Taw, Labutta, and Aunghlaing), Aunghlaing Village Disaster Management Committee, MRCS, and Action Aid; and 714 residents from Aunghlaing. ○ Drill on 4 May 2015, involving 19 NEDC officers, evaluated performance against SOP and performance indicators ○ Drill on 15 October 2015, involving 20 NEDC officers, and personnel from RRD and GAD at national to township levels and local DMH offices in Sagaing, Shwebo, Thabbekyin, Labutta, and Sittwe, including MRCS, evaluated performance against SOP, performance indicators, and warning communication from national to township levels. The exercise used SOP that integrated the recommendations from the May 2015 drill. Following are the findings from the exercise evaluation: – NEDC watch standers were able to process seismic detections in 2 minutes – Warning communication from NEDC to national

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
					down to township level RRD and GAD offices took about 20-30 minutes – SMS is the fastest dissemination mode, but has associated costs related to the number of recipients, compared to fax – A dissemination support system would be required to automate bulletin generation and dissemination Annex 6 provides the report of the exercise. Based on outcomes of the exercise, NEDC SOP for tsunami and inland earthquakes was finalized, as provided in Annex 7. RIMES committed to assist NEDC in developing the dissemination support system.
3.2	Development and transfer to DMH of geospatial database	Jul 2013 – Dec 2015	*Personnel* GIS Specialist: US$ 12,000 Programmer: US$ 6,000 Country Coordinator: US$ 750 Admin and Financial Assistant: US$ 425 *Travel (RIMES)* Airfare: US$ 2,000 Local travel, visa fees, etc.: US$ 400 DSA: US$ 2,740 *Travel (DMH)* Airfare: US$ 500 Local travel, visa fees, etc.: US$ 100 DSA: US$ 3,000 *Equipment* Workstations: US$ 2,000 Software: US$1,500	*Personnel* GIS Specialist: US$ 12,000 Programmer: US$ 6,000 Country Coordinator: US$ 750 Admin and Financial Assistant: US$ 425 *Travel (RIMES)* Airfare: US$ 2,090 Local travel, visa fees, etc.: US$ 430 DSA: US$ 1,993 *Travel (DMH)* Airfare: US$ 550 Local travel, visa fees, etc.: US$ 37 DSA: US$ 2,317 *Equipment* Workstations: US$ 2,200 Software: US$1,520	Development of the geospatial database involved: ○ Identification of data available from various institutions and organizations ○ Data collection ○ Data quality check, processing, metadata generation, and creation of geo-referenced database ○ Training and technology transfer to DMH To be relevant for disaster risk management applications, the database was developed with aim for township scale resolution. It was found, however, that not many datasets in digital form are available for all townships. The database was, hence, developed having administrative boundaries, rainfall, and population datasets. Datasets used in development of other tools under this project are still to be integrated. These include buildings, critical facilities, and land use and elevation. With these three datasets (static database layers), along with gridded 3-day weather forecast from WRF model (dynamic layer), a GIS-based tool was developed that uses rainfall thresholds for identifying risk hotspots at township level. This could be an introductory resource for disaster risk management

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
			Workshop costs: US$ 600 **Total for activity 3.2:** **US$ 32,015**	**Total for activity 3.2:** **US$ 30,312**	practitioners. Risk is determined by evaluating rainfall forecast against rainfall thresholds to assess weather-related hazard, and population density as proxy for vulnerability. Rainfall threshold maps for each day of the year were created, based on extremes of deviations from normal, using rainfall data from 68 stations for the period 2000-2014. Population density map was developed using population data. Annex 8 provides sample outputs. DMH professionals were trained on basic concepts of GIS, data preparation techniques, data analysis, archiving, and management, and geospatial development, as part of the participatory tool development program from May to July 2014. RIMES shall continue its engagement with DMH to further develop the database as and when additional data become available.
3.3	ShakeCast customization and transfer to DMH	Jul 2013 – Apr 2015	*Personnel* Earthquake Risk Evaluation Scientist: US$ 10,000 Programmer: US$ 6,000 Admin and Financial Assistant: US$ 425 *Travel (RIMES)* Airfare: US$ 1,500 Local travel, visa fees, etc.: US$ 400 DSA: US$ 1,937 *Equipment* Workstation: US$ 1,000 *Workshop costs:* US$ 600 **Total for activity 3.3:**	*Personnel* Earthquake Risk Evaluation Scientist: US$ 10,000 Programmer: US$ 6,000 Admin and Financial Assistant: US$ 425 *Travel (RIMES)* Airfare: US$ 830 Local travel, visa fees, etc.: US$ 194 DSA: US$ 1,213 *Equipment* Workstation: US$ 1,039 *Workshop costs:* US$ 538 **Total for activity 3.3:**	ShakeCast is an online tool for rapid assessment of real-time earthquake risk to populations and structures. ShakeCast@DMH was first developed using USGS' ShakeCast version 2.0 platform. Development involved: ○ Integration of township level population data from geospatial database developed under this project ○ Integration of building survey data for 6 cities, received from UN-Habitat under their ongoing project. In other areas, building location, name, and usage was sourced from Google Earth; this source, however, does not provide details on building material/ type of structure. ○ Development of user interface ○ ShakeCast@DMH transfer to DMH and training of DMH-NEDC personnel and users In the absence of building vulnerability thresholds (to earthquakes), specific to Myanmar, ShakeCast default settings were used.

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
			US$ 21,862	**US$ 20,239**	With USGS release in October 2015 of ShakeCast version 3.0, the ShakeCast@DMH was migrated to the version 3.0 platform. This version has more customizable features. Annex 9 provides the final report on ShakeCast@DMH customization, including sample information products from the tool. NEDC staff, seconded to RIMES tsunami unit, was trained on ShakeCast@DMH version 3.0 installation, customization, and troubleshooting, and has initiated further system development with integration of village level population data, which was shown to increase reliability of ShakeCast@DMH information products (refer to outcomes of ShakeCast@DMH testing in Annex 10). With RIMES continuous support to DMH even after project end, RIMES is pursuing the training of NEDC personnel and of RRD, GAD, and MRCS on ShakeCast@DMH version 3.0. This shall cover: ○ Introduction of ShakeCast@DMH version 3.0 ○ Interpretation of ShakeCast@DMH products ○ Understanding and managing uncertainty ○ Injection of ShakeCast@DMH information into users' decision systems Further development of the tool could focus on: *In the short-term:* ○ Integration of higher-resolution data. Integration of village level population data has been initiated by DMH-NEDC personnel. Data from ongoing building survey under the UN-Habitat project shall be integrated once available. ○ Integration of building vulnerability thresholds once these become available from the UN-Habitat project *In the medium-term:* ○ Development of mobile application to enable users to access information products through Android phones

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
					○ Integration of NEDC strong motion detections Other recommendations include replication of UN-Habitat building survey initiative, with focus on seismically active areas that have high population densities, to increase resolution of building data currently available in ShakeCast@DMH.
3.4	Preparation of agro-ecological map: data collection and digitization, mapping	Jul 2013 – Dec 2015	*Personnel* Agriculture Specialist: US$ 5,000 System Developer: US$ 6,000 GIS Specialist: US$ 12,000 Country Coordinator: US$ 1,500 Data Encoders: US$ 1,600 Admin and Financial Assistant: US$ 850 *Travel (RIMES)* Airfare: US$ 2,000 Local travel, visa fees, etc.: US$ 400 DSA: US$ 2,740 *Travel (DMH and MOAI)* Airfare: US$ 1,000 Local travel, visa fees, etc.: US$ 200 DSA: US$ 6,000 *Equipment (RIMES)* Server: US$ 7,000 Workstations: US$ 3,000 **Total for activity 3.4: US$ 49,290**	*Personnel* Agriculture Specialist: US$ 5,000 System Developer: US$ 6,000 GIS Specialist: US$ 12,000 Country Coordinator: US$ 1,500 Data Encoders: US$ 1,227 Admin and Financial Assistant: US$ 850 *Travel (RIMES)* Airfare: US$ 1,086 Local travel, visa fees, etc.: US$ 421 DSA: US$ 1,269 *Travel (DMH and MOAI)* Airfare: US$ 1,100 Local travel, visa fees, etc.: US$ 61 DSA: US$ 5,411 *Equipment (RIMES)* Server: US$ 7,700 Workstations: US$ 2,581 **Total for activity 3.4: US$ 46,206**	DMH demand for updated agro-ecological zone maps at the 9th Monsoon Forum in October 2012 is for the purpose of guiding agro-meteorological forecasting. Agro-ecological zone maps available for the country are of coarse resolution, at state level of data integration. The project aimed at increasing the resolution to township level. Methodology used is the multi-criteria evaluation technique, which uses length of growing period, soil moisture availability during the growing period, and temperature regime of the growing period for analysis of crop suitability. Paucity in township level crop data and quality meteorological observation data for the whole country constrained the analysis to the use of administration boundary, land use, and remotely sensed land elevation and meteorological data. Meteorological parameters considered were rainfall and evapotranspiration only, which were used for evaluation of soil moisture availability, for guiding cropping decisions. The analysis was done in 3 stages: a) Identification of agro-edaphic zones based on land use and land elevation b) Agro-climatic zoning based on soil water availability in contiguous months c) Agro-ecological zoning, which combines the agro-edaphic and agro-climatic zones Results and outputs are provided in Annex 11. Although product from this initiative is useful for DMH for the

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
					purpose of guiding agro-meteorological forecasting, further refinement of the agro-ecological zone map would be required to make it relevant for agricultural planning. This would involve: o Verification against rainfall observations o Integration of township level soil, crop, irrigation, and allied datasets. Most datasets are not in digital format and are yet to be collated at national level. o Integration of quality township level meteorological observation dataset for at least the past 30 years RIMES, in its continuous engagement with DMH (Myanmar being RIMES Member State, and DMH a member of the RIMES Council), shall assist in this area even after project end.
3.5	Updating of crop-weather calendars	Jul 2013 – Dec 2015	*Personnel* Agriculture Specialist: US$ 5,000 Country Coordinator: US$ 750 Admin and Financial Assistant: US$ 255 *Travel (RIMES)* Airfare: US$ 2,000 Local travel, visa fees, etc.: US$ 400 DSA: US$ 1,644 *Meeting costs:* US$ 600 **Total for activity 3.5: US$ 10,649**	*Personnel* Agriculture Specialist: US$ 5,000 Country Coordinator: US$ 750 Admin and Financial Assistant: US$ 255 *Travel (RIMES)* Airfare: US$ 1,038 Local travel, visa fees, etc.: US$ 423 DSA: US$ 1,729 *Meeting costs:* US$ 517 **Total for activity 3.5: US$ 9,712**	At the 9th Monsoon Forum in October 2012, DMH articulated the need to update crop-weather calendars in view of observed climate trends. Crop-weather calendars guide DMH in providing agro-meteorological forecasts, in terms of what forecast parameters are required by farmers for particular crop and crop growth stage, and when these forecasts are needed. The project aimed to develop crop-weather calendars that consider local climatology. Efforts focused on the pilot sites in the Dry Zone – Nyaung Oo and Monywa. Activities undertaken include: o Establishment of local climatology using 30-year (1983-2013) quality meteorological observations from 14 stations o Consultations with DOA and farmers on 6 major crops at the pilot sites, important cropping stages for each crop, and optimum weather conditions required at each crop stage. Major crops identified are paddy, sesame, pigeon pea, cotton, chili, and groundnut. o Preparation of first draft crop-weather calendar for each crop o Consultations for refining crop-weather calendars o Finalization of crop-weather calendars o Integration of crop-weather calendars into the agro-advisory expert system

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
					The agro-advisory expert system displays the forecast information required by farmers at the stage of crop growth for each crop, for each 10-day forecast period (dekad). This period also matches with the periodicity of visits by agriculture extension specialists to farmers. Refer to Annex 12 for sample outputs.
3.6	Integration of crop growth stage into agro-meteorological bulletin	Jan 2014 – Dec 2015	*Personnel* Agriculture Specialist: US$ 5,000 System Developer: US$ 1,500 Admin and Financial Assistant: US$ 255 *Travel (RIMES)* Airfare: US$ 2,000 Local travel, visa fees, etc.: US$ 400 DSA: US$ 1,644 **Total for activity 3.6: US$ 10,799**	*Personnel* Agriculture Specialist: US$ 5,000 System Developer: US$ 1,500 Admin and Financial Assistant: US$ 255 *Travel (RIMES)* Airfare: US$ 794 Local travel, visa fees, etc.: US$ 419 DSA: US$ 1,643 **Total for activity 3.6: US$ 9,611**	Demand for integration of crop growth stage into agro-meteorological bulletin was also articulated by DMH at the 9th Monsoon Forum. The web-based agro-advisory system that was developed for DMH has incorporated crop growth stage into agro-meteorological bulletin for each of the 6 major crops in Nyaung Oo and Monywa (refer to reports under Activities 3.5 and 3.8)
3.7	Upgrading of agro-meteorological stations: Equipment acquisition, station upgrading, integration into data center, documentation, and maintenance training	Jul 2013 – Oct 2015	*Personnel* Instrumentation Specialist: US$ 13,800 Country Coordinator: US$ 750 Admin and Financial Assistant: US$ 850 *Travel (RIMES)* Airfare: US$ 3,500 Local travel, visa fees, etc.: US$ 2,400 DSA: US$ 6,885 *Travel (DMH)* Local travel: US$ 3,400 DSA: US$ 5,508	*Personnel* Instrumentation Specialist: US$ 13,800 Country Coordinator: US$ 750 Admin and Financial Assistant: US$ 850 *Travel (RIMES)* Airfare: US$ 3,670 Local travel, visa fees, etc.: US$ 2,610 DSA: US$ 7,506 *Travel (DMH)* Local travel: US$ 3,374 DSA: US$ 4,739	17 agro-meteorological stations were upgraded from manual to automatic stations. Upgrading involved: ○ Equipment acquisition and importation. Sensors acquired and telemetry settings meet WMO specifications. ○ Site preparation, which included construction of concrete platforms and perimeter fencing. In locations where obstructions to wind observation could not be cleared (e.g. DMH office building, tall trees, etc.), site relocation was undertaken. ○ Equipment installation, telemetry, and testing ○ On-site training of DMH staff on installation, operation, troubleshooting, and maintenance ○ Testing of data acquisition system Annex 13 provides the location map for these stations.

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
			Equipment Upgrades: US$ 42,500 Telemetry: US$ 122,400 Hardware and consumables: US$ 3,400 **Total for activity 3.7: US$ 205,393**	*Equipment* Upgrades: US$ 45,913 Telemetry: US$ 128,268 Hardware and consumables: US$ 3,154 **Total for activity 3.7: US$ 214,634**	RIMES is continuously engaged with DMH in addressing data transmission delay issues, which were observed from July 2015. This involved firmware upgrades and replacement of affected sensors as necessary. Transfer of the data server, integration into DMH operations, and commissioning shall be undertaken once data receipt becomes stable over a period of at least 3 months. A back-up data acquisition system was set up at RIMES to support DMH as long as they require.
3.8	Development of agro-advisory expert system: system development, transfer, testing, evaluation and adjustment, integration into DMH operations	Jul 2013 – Dec 2015	*Personnel* System Developer: US$ 27,000 Data Visualization Specialist: US$ 4,500 Data Encoders: US$ 1,600 Agriculture Specialist: US$ 7,500 Admin and Financial Assistant: US$ 1,700 *Travel (RIMES)* Airfare: US$ 2,000 Local travel, visa fees, etc.: US$ 400 DSA: US$ 5,480 *Travel (DMH and MOAI)* Airfare: US$ 2,000 Local travel, visa fees, etc.: US$ 400 DSA: US$ 12,000 *Equipment (DMH)* Server: US$ 7,000 Workstations: US$ 2,000 *Layout and printing of users manual:* US$ 200	*Personnel* System Developer: US$ 27,000 Data Visualization Specialist: US$ 4,500 Data Encoders: US$ 1,004 Agriculture Specialist: US$ 7,500 Admin and Financial Assistant: US$ 1,700 *Travel (RIMES)* Airfare: US$ 1,719 Local travel, visa fees, etc.: US$ 440 DSA: US$ 5,398 *Travel (DMH and MOAI)* Airfare: US$ 833 Local travel, visa fees, etc.: US$ 419 DSA: US$ 2,517 *Equipment (DMH)* Server: US$ 7,700 Workstations: US$ 2,010 *Layout and printing of users manual:* US$ 12 *Training costs:* US$ 706	The Specialized Expert System for Agro-Meteorological Early Warning (SESAME) was developed, in collaboration with and with participation by DMH and the Department of Agriculture (DOA). The system's agro-climatic database consists of static layers of monthly normal climate, soil, terrain, land use, and population density data; and dynamic layers of weather observation and forecast data. Due to data limitations, system development focused on the pilot sites – Nyaung Oo and Monywa at the Dry Zone. Thus, crop-weather calendars used are for major crops in the sites – paddy, sesame, pigeon pea, cotton, chili, and ground nut. The system provides: ○ 3-day forecasts of wind speed, rainfall, number of rainy days, and spells, disseminated via SMS ○ Dekadal agro-meteorological bulletins – daily observations for the past 10 days and daily forecast for the next 10 days of rainfall, temperature, and potential evapotranspiration – disseminated by email ○ Agro-advisories, disseminated by email. Admin users (DOA) could edit advisories, for providing information on suitable farm practices based on weather forecasts The system is web-based, with user interface for data inputs, visualization and analysis of weather and climate data, and generation and dissemination of forecast, bulletins, and advisories to users. Being an expert system, the system is able to associate

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
			Training costs: US$ 720 *Communications (SMS advisories)*: US$ 1,200 **Total for activity 3.8: US$ 75,700**	*Communications (SMS advisories)*: US$ 678 **Total for activity 3.8: US$ 64,136**	advisories with climate patterns, on continuous use. Workshops in May 2015 trained admin users at DMH and DOA on the system's functionalities and information products, and familiarized DOA agriculture extension specialists in Nyaung Oo and Monywa on the system's outputs. SESAME User Guide was prepared and shared with DMH and DOA. The system was deployed in May 2015 for experimental use. In September 2015, towards the end of the monsoon season, feedback from extension specialists and farmers in Nyaung Oo and Monywa were received for system evaluation. Based on user feedback, the following improvements were made: ○ Bulletins were simplified and presented in local language (refer to Annex 14); forecasts of daily rainfall amounts in inches for next 5 days have been integrated ○ Daily forecasts were provided in the mornings to inform decision-making Also, latest version of crop calendars has been integrated. Transfer of the system has been scheduled. RIMES support to DMH operation of the system shall continue even after project end. This shall include: ○ Assistance to DMH on verification of forecasts, to guide system adjustment to improve forecast reliability ○ Integration of high-resolution sub-seasonal and seasonal forecasts for seamless forecast application ○ Ensuring that products meet user demands, ascertained from periodic user feedback The system is currently hosted at http://agro.rimes.int It shall be migrated to DMH domain on completion of experimental operation after the 2016 monsoon season.

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
3.9	Agro-advisory expert system training of MOAI and GAD at pilot sites	Sep 2014 – Oct 2015	*Personnel* System Developer: US$ 1,500 Capacity Building Specialist: US$ 750 Admin and Financial Assistant: US$ 255 *Travel (RIMES)* Airfare: US$ 1,000 Local travel, visa fees, etc.: US$ 600 DSA: US$ 1,620 *Travel (DMH, MOAI)* Local travel: US$ 400 DSA: US$ 648 *Workshop costs:* US$ 600 **Total for activity 3.9: US$ 7,373**	*Personnel* System Developer: US$ 1,500 Capacity Building Specialist: US$ 750 Admin and Financial Assistant: US$ 255 *Travel (RIMES)* Airfare: US$ 900 Local travel, visa fees, etc.: US$ 653 DSA: US$ 1,744 *Travel (DMH, MOAI)* Local travel: US$ 419 DSA: US$ 301 *Workshop costs:* US$ 579 **Total for activity 3.9: US$ 7,101**	Training on the agro-advisory expert system was undertaken in May 2015 at national and local levels. The national training from 7-8 May 2015 in Nay Pyi Taw trained 11 participants from DMH, DOA, Department of Agricultural Planning, Water Resources Utilization Department, and Irrigation Department. The hands-on workshop introduced participants to the functionalities of and information products from the system. Training workshops in Nyaung-Oo (11 May 2015) and Monywa (12 May 2015) trained 27 and 26 participants, respectively, from DMH, DOA (agriculture extension specialists), GAD, and progressive farmers. They were introduced to the system's functionalities and products. Table-top exercises simulated the receipt of advisories by extension specialists, understanding its content in context, and communicating the climate information and related agro-advisory to farmer participants.
3.10	Establishing Climate Risk Management Field Schools: curriculum adaptation, implementation	Jul 2013 – Apr 2015	*Personnel* Agriculture Specialist: US$ 2,500 Capacity Building Specialist: US$ 9,000 Admin and Financial Assistant: US$ 850 *Travel (RIMES)* Airfare: US$ 3,000 Local travel, visa fees, etc.: US$ 1,800 DSA: US$ 4,860 *Travel (DMH and MOAI)* Local travel: US$ 4,800	*Personnel* Agriculture Specialist: US$ 2,500 Capacity Building Specialist: US$ 9,000 Admin and Financial Assistant: US$ 850 *Travel (RIMES)* Airfare: US$ 2,598 Local travel, visa fees, etc.: US$ 1,802 DSA: US$ 5,196 *Travel (DMH and MOAI)* Local travel: US$ 4,327 DSA: US$ 8,363	The climate risk management field school in Myanmar, named Forecast Application for Risk Management (FARM) in agriculture school, was established involving the following process: o Curriculum adaptation, using RIMES generic modular curriculum, through a write-shop from 14-15 November 2013 in Nay Pyi Taw, with 18 participants from DMH, DAS/DOA, Irrigation Department, Yezin Agriculture University, Department of Agricultural Research, and Department of Agricultural Planning o Curriculum run-through for national trainers, for curriculum familiarization, in a workshop held from 22-26 September 2014 in Nay Pyi Taw, with participation from DMH, DOA, Department of Agricultural Planning, Department of

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
			DSA: US$ 7,776 *Curriculum adaptation workshop:* US$ 900 *Manual layout and printing:* US$ 1,000 *Training of trainers cost:* US$ 1,500 *Farmers training costs*: US$ 7,200 **Total for activity 3.10: US$ 45,186**	*Curriculum adaptation workshop:* US$ 990 *Manual layout and printing:* US$ 1,050 *Training of trainers cost:* US$ 1,638 *Farmers training costs*: US$ 7,908 **Total for activity 3.10: US$ 46,222**	Agricultural Research, Department of Agricultural Service, Water Resources Utilization Department, and select agricultural extension workers from Monywa and Nyaung Oo. The workshop also received feedback for curriculum refinement, identified national trainers for the Training of Trainers, prepared the training schedule, and identified and agreed on roles and responsibilities on preparatory activities. o Training of Trainers, conducted in Nyaung Oo from 13-17 October 2014 and in Monywa from 20-24 October 2014. The training produced a pool of trainers – 32 from Nyaung Oo and 43 from Monywa – from DMH, DOA district and township offices, GAD district office, including lead farmers. The training also received feedback on training curriculum and methods of delivery, and identified the villages for piloting the training of farmers. Participants demanded for yearly training delivery, timed during the growing season. o Training of farmers in Nyaung Oo, with 30 participants from 10 villages; and in Monywa, with 50 participants from 9 villages. Training commenced on 17 March 2015, and went on for 12 weeks, with 2 to 3 hour sessions per week. o Mid-course evaluation in April/May 2015, which found: – Improved understanding of forecast terminology – Demand for forecast that is specific to their locality – Participants' appreciation of climate information application in crop management – Participants' keen interest to participate in rainfall monitoring, using calibrated plastic bottles – Participants' keen interest to practice related technologies, such as agro-forestry for improving water availability (the sites being located in Myanmar's Dry Zone) – 25 regular participants in Nyaung Oo and 40 in Monywa o Culminating activity in June 2015

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
3.11	Agro-advisory expert system demonstration	Nov 2014 – Dec 2015	*Personnel* Capacity Building Specialist: US$ 6,000 Admin and Financial Assistant: US$ 850 *Travel (RIMES)* Airfare: US$ 2,000 Local travel, visa fees, etc.: US$ 1,200 DSA: US$ 3,240 *Travel (DMH and MOAI)* Local travel: US$ 2,400 DSA: US$ 3,888 **Total for activity 3.11: US$ 19,578**	*Personnel* Capacity Building Specialist: US$ 6,000 Admin and Financial Assistant: US$ 850 *Travel (RIMES)* Airfare: US$ 362 Local travel, visa fees, etc.: US$ 842 DSA: US$ 3,185 *Travel (DMH and MOAI)* Local travel: US$ 683 DSA: US$ 3,755 **Total for activity 3.11: US$ 15,677**	Visit to the pilot sites from 7-9 February 2015 was made to engage agriculture extension specialists and progressive farmers for application demonstration of the agro-advisory expert system. The visit was timed before the FARM School training of farmers. The visit also confirmed the climate risks that farmers face in the Dry Zone, in particular: o Rainfall supports one cropping season per year only o Lack of rains during the pre-monsoon shifts the cropping season from early March-May to end July-November o Lack of rain during crops' flowering stage is very damaging o High temperatures and prolonged dry periods also cause damage o Sudden squalls and thunderstorms, particularly during May, damage crops Current practices to manage these risks include shifting of the cropping season, mixed cropping, and inter-cropping. DOA extension services are available through agriculture specialists that visit at most twice a week. The agro-advisory system is a valuable tool for receiving forecasts and advisories, with 3 days and 10 days lead times, for guiding crop management decisions. The system was deployed in May 2015 for experimental use, involving DMH Agro-met Division in Yangon and DOA extension specialists and progressive farmers at the pilot sites. Feedback was received towards the end of the monsoon, through consultations at the pilot sites from 5-7 September 2015. These include: o Farmers find forecasts of daily rainfall, number of rainy days, and wind direction as more useful than 10-day forecasts of rainfall, minimum and maximum temperature, wind speed, and potential evapotranspiration o Farmers prefer simpler bulletin in local language o Forecasts should be delivered in the mornings before farmers head out for their daily tasks, to inform their planning and

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
					decision-making Above recommendations were considered in improving the agro-advisory system (refer to report under Activity 3.8). In addition, farmers requested the following to support climate information application: o Simple calibrated rain gauges to monitor rainfall, for forecast validation o Assistance to implement agro-forestry technology for improving water availability The project responded to these requests in collaboration with DMH for provision of calibrated rain gauges, and DOA for provision of plant varieties for agro-forestry.
4. Project management					
4.1	Progress monitoring and reporting	Jun 2013 – Dec 2015	*Personnel* Project Coordinator: US$ 15,360 *Travel* Airfare: US$ 500 Local travel, visa fees, etc.: US$ 100 DSA: US$ 411 *Communications, consumables, etc:* US$ 7,200 **Total for activity 4.1: US$ 23,571**	*Personnel* Project Coordinator: US$ 15,360 *Communications, consumables, etc:* US$ 7,509 **Total for activity 4.1: US$ 22,869**	
4.2	Documentation	Jun 2013 – Dec 2015	*Personnel* ICKM Specialist: US$ 6,240	*Personnel* ICKM Specialist: US$ 6,240	

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
			Travel Airfare: US$ 500 Local travel, visa fees, etc.: US$ 100 DSA: US$ 411 *Layout and printing costs:* US$ 1,500 **Total for activity 4.2:** **US$ 8,751**	*Layout and printing costs:* US$ 83 **Total for activity 4.2:** **US$ 6,323**	
4.3	External evaluation and audit	Nov 2015 – Dec 2015	*Consultants* External Evaluator: US$ 5,250 Auditor: US$ 2,000 *Travel* Airfare: US$ 2,500 Local travel, visa fees, etc.: US$ 200 DSA: US$ 1,370 **Total for activity 4.3:** **US$ 11,320**	*Consultants* External Evaluator: US$ 3,536 Auditor: US$ 1,537 *Travel* Airfare: US$ 1,022 Local travel, visa fees, etc.: US$ 216 DSA: US$ 907 **Total for activity 4.3:** **US$ 7,218**	External end-of-project evaluation was undertaken from 4 January to 12 February 2016, alongside the evaluation for TTF-16. The report is provided in Annex 15. Financial audit was completed on 11 March 2016. Expenditures were on accrual basis. The scanned, signed auditor's report is provided in Annex 16. The original signed report is provided to ESCAP with the hard copy of this report.
4.4	End of project workshop	Nov 2015 – Dec 2015	*Personnel* Project Lead: US$ 1,500 Lead Scientist, EQ and Tsunami Evaluation: US$ 900 Capacity Building Specialist: US$ 450 Admin and Financial Assistant: US$ 255 *Travel* Airfare: US$ 1,500 Local travel, visa fees, etc.: US$ 300 DSA: US$ 1,233	*Personnel* Project Lead: US$ 1,500 Lead Scientist, EQ and Tsunami Evaluation: US$ 900 Capacity Building Specialist: US$ 450 Admin and Financial Assistant: US$ 255 *Travel* Airfare: US$ 859 Local travel, visa fees, etc.: US$ 219 DSA: US$ 731	Final workshop was held on 19 February 2016 in Nay Pyi Taw. The workshop reviewed the status of project completion, identified residual gaps, and charted a way forward to address these gaps. Annex 17 provides the workshop report.

	Activity	Time Frame	Trust Fund Contribution	Trust Fund Contribution Spent	Description of Results
			Meeting costs: US$ 900 **Total for activity 4.4: US$ 7,038**	*Meeting costs:* US$ 758 **Total for activity 4.4: US$ 5,672**	
Total for all activities:			**US$ 678,164**	**US$ 583,089**	
Indirect Cost:			**US$ 27,127**	**US$ 23,324**	
TOTAL COST			**US$ 705,291**	**US$ 606,413**	

LESSONS LEARNED

Capacity building of low capacity countries is a process over time, and one that requires coordinated and sustained investment of resources. The capacity building process facilitated by RIMES:

a) Increased DMH personnel's stake in DMH capacity building for meeting user needs. DMH has seen the value of its own assessment of capacity gaps and needs, and identification of priority actions to address these in view of ongoing and planned capacity building projects with various donors and partners. Thus, DMH resolved to make such review an annual exercise.
b) Advocated for DMH to take a more proactive engagement with development partners, in terms of directing where assistance would matter most, guided by the capacity building document that was prepared under this project
c) Raised DMH awareness on the need for ICT and field/ instrumentation personnel to support modernization of its systems and infrastructure
d) Demonstrated the value of participatory, mentoring, and handholding approach in tool development and training, over passive recipients of technology and one-time training, for more effective technology transfer and knowledge diffusion.

In RIMES' aim to coordinate efforts under this project with other ongoing projects in Myanmar to achieve synergy, delivery of the Hpa-an and Pathein station telemetry was affected by delay of the INCOIS-supported seismic monitoring project, which shall establish the VSat system for seismic data communication. The project also depended on the cooperation of the private company that installed broadband stations in Nay Pyi Taw, Hpa-an and Pathein, for providing necessary technical support to integrate these stations into SeisComP3; as well as of UN-Habitat for sharing building survey and vulnerability thresholds data for ShakeCast customization. (The UN-Habitat project is still ongoing, and building vulnerability thresholds and additional survey data are yet to be received.)

Tool development required data of higher resolution than those used in existing tools/ products (e.g. agro-ecological zone map). However, availability of data at township resolution from a central location was limited and constrained the development of geospatial database for multi-hazard risk assessment, agro-ecological zone map, and agro-advisory expert system. Nonetheless, these tools were developed, with trained DMH staff, to accommodate input of additional high-resolution data once these become available.

The Monsoon Forum provided a mechanism for reporting back to users, who demanded these planning/ decision support tools, on progress made on tool development, fostering accountability to users. By presenting the methodology used in tool development and the products generated through these tools, feedbacks were received, which were useful for tool improvement and product refinement.

ESCAP's mechanism for LOA amendment gave flexibility to the project, in terms of adjustments in activity timeframes and budgets, to respond to partner demand for more in-depth capacity building approach, particularly in establishing an institutionalized system for forecast application for reducing disaster risks (FARM School). Thus, it was possible to accommodate DMH and the Department of Agriculture's (DOA) request for a curriculum run-through for national trainers, in addition to the initially programmed curriculum adaptation write-shop, training of trainers, and farmers' training.

Capacities built within DMH under this project need to be complemented by government investment in communication infrastructure (e.g. high-speed/ bandwidth internet for operational use) and relevant personnel (e.g. ICT and field instrumentation specialists, agro-meteorologists).

SUSTAINABILITY

Please elaborate on any progress towards ensuring that this project results in a long-term benefit to the project stakeholders.

DMH adoption of the capacity building document, and commitment for its annual review, is a step towards ensuring coordinated donor engagement and coherent and effective investment for building the country's early warning system.

The participatory, mentoring, and handholding capacity building approach, taken by the project, developed capacities within DMH to further develop tools created under the project. This also deepened DMH-RIMES relations, and fully integrated DMH into RIMES. Along with Myanmar's formal joining in RIMES, with DMH signing of the RIMES Cooperation Agreement on 15 July 2015, this positions RIMES to provide continued support to systems developed under the project (e.g. software upgrades), and address residual capacity gaps (e.g. staff re-training).

Involvement of relevant stakeholders in tool development is a step towards sustained tool application. For example, the FARM School was anchored with the Department of Agriculture (DOA), for adoption and integration into DOA programs. DMH-DOA interactions and involvement in project activities also deepened DMH-DOA cooperation, allowing for easier access between institutions.

Presentation of tools developed under this project in the Monsoon Forum generated interest in wider tool application and further tool development. UNDP has expressed interest to scale up the agro-advisory expert system to cover more areas in the country, and the Irrigation Department has requested for further development of the system for reservoir management application.