FEASIBILITY ASSESSMENT ON FORECAST-BASED ACTION IN THE REPUBLIC OF THE UNION OF MYANMAR

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October 2020

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Funded by European Union Civil Protection and Humanitarian Aid

EXECUTIVE SUMMARY

Introduction

1. Myanmar is exposed and vulnerable to various hydro-meteorological hazards which cause serious humanitarian impacts and consequences. To reduce the loss and damage from the hazards requires a shift from disaster response toward forecast based early actions, including innovative instruments, such as the use of Shock Responsive Social Protection measures to increase the resilience of people and communities.
2. Anticipatory Action, that is Forecast-based Action (FbA), Forecast-based Financing (FbF) and Early Warning Early Action (EWEA) are all initiatives which aim at using weather, climate and impact-based forecasts to trigger actions which reduce the loss and damage from hazards. For clarification, this report uses the term Forecast-based Action to describe the initiatives.
3. In Myanmar, the development of an FbA system is on-going as part of the European Union funded project "Scaling up Forecast based Financing/Early Warning Early Action (FbF/EWEA) and Shock Responsive Social Protection (SRSP) with innovative use of climate risk information for disaster resilience in ASEAN". The project is led by UN FAO, and the consortium includes UNICEF, WFP and the German Red Cross. This project is complemented by various other projects implemented by the project consortium partners.
4. This report presents recommendations for the development of a sustainable FbA system in Myanmar based on a feasibility assessment. The assessment was conducted in February 2020 and the report finalised in October 2020.

Key conclusions

5. To conclude, FbA system in Myanmar is feasible due to the efforts from the UN partners on developing the system, and the related technological advances. However, five main issues need to be considered during the development of the system.
6. First, the institutionalisation and upscaling beyond pilot projects and ad-hoc interventions requires government buy-in and joint system development with the government and consortium members. However, there is uncertainty regarding the buy-in from the government.
7. Second, to make the most out of the experience, tools and expertise of the consortium members, a joint approach is needed especially when approaching the government.
8. Third, plenty of risk information and knowledge exists in Myanmar. Therefore, it is possible to identify the most disaster-prone areas for FbA.
9. Fourth, institutionalisation and scaling up beyond pilot projects and ad-hoc interventions requires improved forecasting capabilities and close collaboration with the Myanmar Department of Meteorology and Hydrology.
10. Fifth, the feasibility of FbA initiatives may vary by state and township due to capacities and security reasons.
11. Overcoming these challenges is not an easy task. However, based on the assessment, the consortium can take various steps to ease the buy-in from the government side, make the approach more coherent and to develop the technical requirements for a sustainable system.
12. The consortium members should systematically identify possible synergies in the technical Early Action Protocol development and in geographic areas for pilot initiatives – it was found that some of the members had plans and ideas for initiatives in the same sectors and areas.

Key recommendations

13. First, the consortium partners should agree on the scale of the joint approach. This implies deciding whether the system aims at a national level, yet flexible FbA system where early actions are implemented in all accessible areas of the country, or smaller scale initiatives in certain, pre-defined locations.
14. Second, the consortium partners are recommended to i) build a common framework for integrated FbA and SRSP; (e.g. identify the minimum requirements for forecast skill, triggers, technical tools, community vulnerability assessments, early actions and potential funding mechanisms for each partner), and ii) agree on terminology with the authorities for a common, translated Myanmar-language term for the approach.
15. Third, the consortium should clarify and agree on the roles, responsibilities and the action plan among the consortium members to enhance synergies. Managing a complex process with multiple stakeholders requires a comprehensive strategic management system with suitable key performance indicators as well as communication and coordination strategies and channels among the consortium members both on the national and regional level.
16. Fourth, each consortium member is encouraged to assess their i) capacity to implement chosen early actions and ii) tolerance for uncertainty and potential consequences for acting in vain, i.e. in locations not affected by the hazard.
17. Fifth, the consortium, most notably WFP as the technical lead, should facilitate an expert assessment of DMH forecasting and warning capacities to deliver credible forecast in a given time for the different identified hazards to have a proper understanding of the forecast skill of DMH.

The following report provides a roadmap for a sustainable FbA system for Myanmar. The roadmap is based on the capacities, engagement and plans of consortium partners and other stakeholders, most notably public authorities at various levels of governance, for FbA, and the identification and analysis of the forecast capabilities and availability of disaster risk information.

CONTENTS

ABBREVIATIONS

AmCross	American Red Cross
AMS	ASEAN Member State
ASEAN	The Association of Southeast Asian Nations
CBT	Cash-based transfers
DDM	Department of Disaster Management
DSW	Department of Social Welfare
DM	Disaster Management
DMH	Department of Meteorology and Hydrology
DRR	Disaster Risk Reduction
EAP	Early Action Protocol
EOC	Emergency Operations Centre
ECHO	European Civil Protection and Humanitarian Aid Operations
EWEA	Early Warning Early Action
EWS	Early Warning System
FAO	United Nations Food and Agriculture Organization
FbA	Forecast-based Action
FbF	Forecast-based Financing
GRC	German Red Cross
ICRC	International Committee of the Red Cross
IFRC	International Federation of the Red Cross and Red Crescent Societies
MCCT	Maternal and Child Cash Transfer Programme
MIMU	Myanmar Information Management Unit
MRCS	Myanmar Red Cross Society
MSWRR	Ministry of Social Welfare, Relief and Resettlement
MUDRA	Myanmar Unified Platform for Disaster Risk Application
MDLD	Myanmar Damage and Loss Database
NDMC	National Disaster Management Committee
PNS	Partner National Society
PRISM	Platform for Real-time Information and Situation Monitoring
RIMES	Regional Integrated Multi-Hazard Early Warning System for Asia Institute
SEADRIF	Southeast Asia Disaster Risk Insurance Facility
SMIS	Social Management Information System
SOP	Standard Operating Procedure
SRSP	Shock Responsive Social Protection
TMDC	Township Disaster Management Committee
UNICEF	The United Nations Children's Fund
WFP	United Nations World Food Programme

1 INTRODUCTION

This national level, multi-hazard feasibility assessment on *Forecast-based Action (FbA)* in Myanmar was conducted in February 2020 and finalised in October 2020. This assessment is a part of the Directorate-General for *European Civil Protection and Humanitarian Aid Operations (ECHO from now on)*[1] funded project "Scaling up *Forecast based Financing/Early Warning Early Action (FbF/EWEA)* and *Shock Responsive Social Protection (SRSP)* with innovative use of climate risk information for disaster resilience in *ASEAN*[2]" ('the project' throughout the report). The project consortium is led by the *United Nations Food and Agriculture Organization (FAO)*, with the *United Nations Children's Fund (UNICEF)*, *United Nations World Food Programme (WFP)* and the *German Red Cross (GRC)* as consortium members. The feasibility assessment process was led by the *Myanmar Red Cross Society (MRCS)* and supported by the Finnish Red Cross, with input from the consortium members.

Two versions of this report have been produced: this report, and an internal version for the Red Cross Red Crescent Movement partners. This report aims to identify the feasibility to develop FbA initiatives and eventually an FbA system in Myanmar, and to understand the compatibility and complementarity between the consortium partners and the government in FbA system development and initiatives. The internal Red Cross Red Crescent report has dedicated sections for developing FbA within MRCS.

Hazard selection in this assessment is based on existing risk assessments in Myanmar and prioritisations of the consortium partners. The hazards in focus are riverine floods, tropical cyclones (combination of strong winds, storm surge and flooding), drought and heatwave.

The assessment and recommendations are based on meetings with the consortium partners, the Red Cross Red Crescent movement partners, government and other stakeholders; listed in appendix 2. Furthermore, an extensive desk study on available material was undertaken; full reference list is provided in the end of the report.

The following limitations should be noted while reading the report: there was i) no access to relevant government departments; most notably the Department of Meteorology and Hydrology during the feasibility study mission ii) limited access to relevant documents and material during the feasibility assessment; and iii) limited amount of time from the MRCS focal point to work on the feasibility assessment due to various other commitments.

Next, this report presents the conclusions of the feasibility assessment, and provides subsequent recommendations for a sustainable FbA system in Myanmar. The conclusions and recommendations are based on analysis presented in sections 4-6. Section 4 focuses on key FbA actors in Myanmar; the government, consortium and academia, Section 5 on the engagement with the consortium and the government, Section 6 on forecast capacity and risk data availability, and Section 7 on the early actions. Extended introduction to the assessment is given in Section 3.

Forecast based Action and Shock Responsive Social Protection

Forecast-based Financing (FbF) enables automatic access to humanitarian funding for early action. FbF and subsequent *Forecast based Actions (FbAs)* are taken based on forecast and risk information to mitigate and prevent the impacts associated with hydro-meteorological events. The forecasts, risk analyses, the related early actions and roles, and responsibilities of the different stakeholders are described in an *Early Action Protocol (EAP),* which will be developed during the system development.

Shock Responsive Social Protection (SRSP) is a social protection system that is designed to better anticipate and respond to shocks.

[1] Throughout the report, concepts used as abbreviations have been spelled out and italicised when introduced for the first time. Abbreviations are used for concepts which appear more than five times in the consortium report or are otherwise widely used (such as the IFRC).

[2] The Association of Southeast Asian Nations

2 CONCLUSIONS AND RECOMMENDATIONS

2.1 Conclusions

2.1.1 Sustainable FbA system in Myanmar

1. The 2-year project, launched in the beginning of May 2019, promotes integrated FbA and SRSP as novel approaches to transform disaster preparedness and response, contributing to building disaster resilience.
2. An FbA system in Myanmar is technically feasible due to the efforts from the UN partners on developing the system, and the related technological advances. However, the institutionalisation and upscaling beyond pilot projects and ad-hoc interventions requires government buy-in and joint system development with the government and consortium members, and the feasibility varies by state and township. *See Section 5.1.*

2.1.2 Institutionalisation and upscaling of FbA

3. One of the main constraints for the development of any FbA initiative is the government's focus on disaster response, not early action. Currently the Disaster Management Law and financial regulations enable the government to assist people only after the disaster strikes, based on needs assessment.
4. The prerequisite of feasible FbA is pre-approved disbursement of funds. Current legislation may not allow government funding to be triggered before the impacts (*See Section 4.1*).
5. The government did not seem to have any existing or planned FbA initiatives, but the situation may change rapidly. For instance, a high-level policy dialogue on drought, held in 2019, considered FbA as an approach to combat drought impacts (See Section 4.1). However, the Department of Disaster Management and regional authorities coordinate traditional early action activities in potential large-scale disasters.
6. WFP has held workshops on weather forecast and warning information with relevant public authorities and consortium members to initiate system development. FAO has organized workshops with the government (Ministry of Agriculture) to advocate FbA-approach, but mostly at provincial level.
7. UNICEF as the lead has initiated the advocacy in the SRSP programme, but the work is still ongoing. It may take major efforts from the consortium until a satisfactory level of government engagement and ownership is achieved.
8. Government buy-in and authorisation is required for implementing most early actions taken by non-government organisations, such as MRCS. It remains unclear how the consortium will succeed in their advocacy toward the government and other stakeholders to i) define financing mechanisms, ii) funding allocation (which hazard, which area in country, which early action) and iii) implement early actions. It remains also unclear whether there is a possibility for other organisations than the government to use funding once the triggers have been agreed and to implement actions. MRCS has strong experience in humanitarian response and assisting the government and communities by implementing early actions, but MRCS is not an official consortium member and its role is therefore more unclear.
9. In Phase I of the ECHO-project, two reports were prepared which are relevant for developing the FbA system: i) Options for Introducing and Developing Risk-Informed & Shock-Responsive Social Protection in Myanmar (from now on "the Options Paper"), and Proposed Way Forward for SRSP. The Options paper provides Policy and Program Options to make selected social protection programmes risk-informed and shock-responsive. The "Options Paper" provides a

review of the existing institutional set-up and coordination structures of Myanmar by identifying policy and operational options that can strengthen the shock-responsiveness of social protection system. Particularly the Glossary and Guidelines provided in the Annex 1 of the Options Paper are particularly relevant for the development of the broader FbA system. In addition, the three components for developing a more shock-responsive social protection system in Myanmar pointed out in the Options paper are also, when slightly modified, relevant for the overall FbA system development:

i) increasing understanding, efficiency and effectiveness (for example familiarizing the concepts and broader policy agenda among the legislative and executive branches of the government);

ii) consolidating approaches and instruments (such as investing in Early Warning Systems (EWS) and livelihoods-based risk and vulnerability framework and analysis, and developing risk-adjusted procedures and processes); and

iii) strengthening the systems (investing in modelling the impacts of hazards and climate change on livelihoods, not just infrastructure and lives).

10. *The Department of Meteorology and Hydrology (DMH)* is the government office with the mandate to issue official forecasts and early warnings in Myanmar. It seems highly unlikely that forecasts/early warnings issued by other agencies, whether public or commercial, can officially be used to trigger action. This implies that the consortium members have to rely first and foremost on DMH forecasts in designing triggers and triggering early actions. This is the case at least for MRCS because of their role as auxiliary to the government. For the UN agencies, the situation may differ. Other forecast and early warning information from global and regional sources could be used for improved preparedness and readiness.

2.1.3 Capacity of FbA stakeholders and their experiences in Myanmar

11. Institutionalised, national level FbA system requires i) a unified approach from the ECHO consortium partners when working with the government as the consortium is currently at the forefront of the system development in Myanmar, ii) improved, tested capacity of the consortium partners (and potentially their partners) to implement pre-agreed early actions in short lead-times in Myanmar, and iii) predefined innovative financing mechanisms.
12. The consortium members use various terms (FbA, FbF, EWEA) to describe a relatively similar approach: i.e. the use of weather, climate and impact-based forecasts and early warning systems to trigger financing and early actions before the forecast hazard hits a community. This may lead to confusion among key stakeholders, most notably the government.
13. Two sets of early action modalities are currently under consideration owing to the consortium member experience and responsibilities: *cash-based transfers (CBT), incl. SRSP* and other modalities, such as evacuation or in-kind distribution.

i) For the UN partners, the main ways to implement FbA are SRSP. For FAO potential early actions include also other activities, such as early harvesting when suitable.

ii) MRCS has experience in CBT in disaster response, so for MRCS, CBT is a potential early action. MRCS, due to their mandate and experience, considers also other modalities: for instance, supporting the authorities in evacuation in various ways, or assisting heat-affected citizens. However, all actions need to be approved by authorities and, in many cases, led as well.

iii) In 2019, a 'Preparedness Data Profiles for Disaster-Prone States in Myanmar' report was compiled to provide practical information related to Cash Transfer Programming. The report notes that "Previous studies have clearly shown that CTP is feasible. This […] does not imply that each new intervention would not require a specific quick-impact context-related feasibility assessment." Even though the report focuses on cash as an early

recovery, not an early action measure, it provides a regional Cash Preparedness Profile for six regions and can be used as preliminary information on the feasibility to use CBT also as an early action. However, the information provided in the report should be updated and a feasibility assessment should be done in the FbA context in the disaster-prone regions. The feasibility of CBT as an early action is still uncertain, as, in principle, state and township authorities must agree with the approach to distribute cash before the hazard has hit the communities. Furthermore, other feasibility aspects, such as the speed of transfers to affected areas in cases where the early actions are beyond community capacity and funds, and distribution to potentially affected people should be assessed before the impacts should be assessed. A key component is also the speed of financial flows. With the current speed cash is not feasible in rapid onset disasters.

iv) The capability to implement other early actions by the government or organisations is unclear, particularly in large-scale disasters, as it would require drills and testing the capacity to implement other than already existing early actions (such as evacuation). MRCS has an existing multi-hazard Standard Operating Procedure (SOP) where the first step is the daily monitoring of early warning information.

v) Table 1 summarises current understanding. *(See also Section 7)*

Table 1. A preliminary capacity assessment of the partners to implement early actions given the current lead times for the hazards. Note, the assessment pertains many uncertainties, most notably due to the lack of testing and drills and verified capacity; and because the government involvement and acceptance is crucial for the feasibility to implement planned actions.

Hazard	Lead time	Technical FbA Potential	Capacity to implement FbA
Riverine flood	3 days	High	Authorities have capacity; UN has capacity. MRCS has experience and capacity for in-kind and evacuation support. Cash unclear.
Cyclone	2 – 3 days, potential maximum 5 days	Medium	Authorities have capacity. UN has capacity. MRCS has experience and capacity. Cash unclear.
Drought	No lead-time as no forecast; however actions can be taken based on monitoring data	Requires improvement in drought forecasting capacity, although actions can be taken based on monitoring data.	Needs capacity enhancement for all stakeholders.
Heat waves / High temperatures	2 to 3 days	Requires improvement in heat wave forecasting	In certain areas authorities have capacity; Potentially of interest for MRCS; capacity may exist.

14. For MRCS, Rakhine, and other conflict-states in Myanmar, are different in terms of the feasibility to implement early actions. In non-conflict states, MRCS can respond directly after informal verbal communication with local authorities. However, in conflict-related areas, a network needs to be established, where some additional steps might be still required, dependent on the area in question. For the UN agencies, the situation may differ but it was not possible to assess this.
15. Some challenges in DMH capacity have to be considered while developing the system (*See Section 6.2 for more details*)

    i) The current capacity of DMH in issuing timely and localised forecasts for the chosen hazards is unclear, because no capacity assessment or forecast verification was possible during the feasibility assessment, and the secondary data sources available had not

verified DMH forecasts, but global and regional level and forecasts. Operational verification at DMH is only done for 24hr temperature, precipitation and water level forecasts, which are not directly useful for FbA.

ii) Based on expert consultation, forecast verification is a challenge because forecast data is not stored in a database. It was not clear whether forecast data is stored in a database, so the possibility for forecast verification in the future is also unclear.

iii) DMH does not issue impact-based forecasts which are generally recommended for trigger development in EAPs.

iv) Stakeholders consulted expressed concern over the capacity of DMH to issue accurate, localised and valuable forecasts; *See Section 6.2*

v) DMH is currently engaged in various capacity enhancement projects, so there is potential for improved weather forecasting capabilities, e.g. impact-based forecasts, and improved verification practices. A World Bank funded project is planning to introduce the topic of impact forecasts to DMH, and potentially initialise the development of qualitative impact-oriented forecasts by March 2021. However, the project has no capability to support the development of data-based impact forecasts for any hazards. Existing risk information could be, however, used in impact-based forecasting. *See Section 6.2*

2.1.4 Technical (Data and Forecast) Feasibility

16. Myanmar has plenty of risk information and knowledge available; therefore, it is technically possible to identify the most disaster-prone areas for FbA. *See Section 6.1 for more detail*

i) *The Myanmar Information Management Unit (MIMU)*[3]*,* offered by the Office of the United Nations Resident and Humanitarian Coordinator, provides information management services to strengthen analysis and decision-making of the humanitarian and development community; MIMU provides maps and other data for risk assessments.

ii) *The Myanmar Unified Platform for Disaster Risk Application (MUDRA)*[4], launched in January 2020, can be used to define return periods (5, 10, 20, 50 and 100 year) for storm surge and wind from tropical cyclones, riverine floods and drought. Heatwaves are not part of MUDRA so no return period analysis is available, nor does MUDRA include livelihoods data. Nevertheless, MUDRA can be a considered a valuable source of data and information in case a national level FbA system, beyond already identified pilot sites, is planned. However, the long-term sustainability and updates remain an open question.

iii) The INFORM risk index and related WFP vulnerability and risk assessment provide detailed township-level risk data on hazards, exposure and vulnerability.

iv) UNICEF has done the Child-Centred Risk Assessment[5] which has plenty of risk maps and show areas of high vulnerability, not only for children. The risk assessment has been approved by the government and available in English and Myanmar language.

v) Historical impact data at the township level is recorded in the Myanmar Damage and Loss Database (MDLD)[6], based on the DesInventar conceptual and methodological tool[7]. Even though the data accuracy is unknown, MDLD can be used to understand the historical impacts of disasters; and potentially in impact-forecast development. The technical possibility to incorporate MDLD on MUDRA exists, but currently there are no plans to undertake this

[3] https://themimu.info/
[4] https://www.mudra-ddm.info/
[5] https://www.unicef.org/myanmar/reports/myanmar-child-centered-risk-assessment-0
[6] http://www.mdld-rrd.gov.mm/DesInventar/main.jsp?countrycode=mmr
[7] https://www.desinventar.net/DesInventar/about.jsp

17. WFP plans to introduce the Platform for Real-time Information and Situation Monitoring (PRISM)[8], a technology solution for measuring climate risk and impact through the lens of socio-economic vulnerability, in Myanmar during 2020. PRISM is a platform owned jointly by the government and, given the open-source nature of the platform, all information in the platform could be used by any agency. The usefulness of PRISM for FbA could not be assessed, considering the launch of MUDRA in early 2020 and the role of DMH as the sole provider of weather forecasts and early warnings in Myanmar. Furthermore, the challenge is, as with all information platforms, that the information provided by the system is only as good as the data fed in. Nevertheless, PRISM can serve as a common data and information platform and enhance cooperation among different actors as everybody will be able to access the same information and in case the authorities approve, PRISM may become a useful tool for FbA.
18. The highest feasibility from a forecasting perspective is for river floods as they have the longest lead-time; river floods is also a priority hazard at national level (See table 1). *See Section 6.1*
19. Tropical cyclones are associated with strong winds, storm surge, and heavy rainfall. The largest damage is usually not caused by the strong winds which are easiest to forecast. Currently, the maximum potential lead-time in the forecasts issued by the Indian Meteorological Department in the Bay of Bengal for cyclone-induced strong winds is 5 days or less; for storm surge 72 hours or less. In general, forecasting cyclone track is easier than cyclone intensity. Noteworthy is that the longer the lead time, the more uncertainty there is about the exact hazard location, but readiness activities, such as securing funding can be taken. *See Section 6.2*
20. DMH issues cyclone forecasts/warnings on their website and disseminates it to its stakeholders in an ad hoc manner, which may reduce the lead time in cases where only DMH information is followed; *See Section 6.2*
21. According to FAO, trigger development is possible for floods and cyclones. Drought is more challenging because currently there is no drought forecasting; only drought monitoring done at the Drought Monitoring Centre in Mandalay. Drought forecasting is currently not under development by DMH. However, WFP is assessing the feasibility of drought triggers anchored in remote sensing.
22. For heatwaves, the trigger should be based on a heat index, which considers temperature and humidity. Currently, DMH issues a heatwave warning if forecast indicates that high temperatures are sustained for three consecutive days, with 7-8°C above normal temperature. No humidity is used for the high temperature alert. The reason for this is unknown.
23. Both FAO and WFP are working on forecast-based triggers with a focus on agriculture and livelihood sectors for cyclones, floods and drought. FAO is working together with the government to identify the triggers. FAO has identified parameters used by DMH in forecasting cyclone and flood and in monitoring drought, filtered potential indicators and sources of information as well as 'danger levels' for early warning used by DMH as potential thresholds. The plan was to pilot the indicators and thresholds at township level in different agro-ecological zones in 2020, drawing on the WFP-led development of a set of indicators and thresholds for these hazards. The plan is to identify and develop the township-level triggers later in 2020, shall the situation allow. WFP's triggers are based on remote sensing data and quantitative information that can be linked to impact on livelihoods and food security. WFP is combining earth observation data (Standardised Precipitation Index, soil moisture, flood extent) and socioeconomic data from WFP's Food Security Monitoring Systems (FSMS) to quantify impact associated with hazards and eventually derive a quantitative threshold for different hazards. Initial triggers for discussions from the WFP side should available and shared with the consortium members.

[8] https://innovation.wfp.org/project/prism

24. Table 2 summarises the available forecast information for the priority hazards

Table 2. Summary of the available forecast information for the priority hazards (modified from the Scoping study published prior this feasibility assessment as part of the ECHO project).

Hazard	Forecast	Lead time	Skill/accuracy	Technical FbA Potential
River flood	Water-level forecasts from Hydrological Monitoring Stations under DMH	3 days	Unknown; but daily water level forecast verified. Skill exists	High
Cyclone	Initially produced by Indian Meteorological Department, disseminated and localised by DMH	2 – 3 days	Unknown for wind, storm surge and rainfall	Medium
Drought	DMH has a dedicated drought **monitoring** centre in Mandalay	No lead-time as no forecast; however, actions can be taken based on monitoring data	Unknown	Requires improvement in drought forecasting capacity but actions can be taken based on monitoring data
Heat waves / High temperatures	Disseminated by DMH	2 to 3 days	24 hour temperature forecast verified: skill score xx	Requires improvement in heat wave forecasting

25. For beneficiary data, UNICEF has suggested piggybacking, i.e. allowing disaster-response agencies (including *Non-governmental organisations - NGOs)* to use the administration systems and beneficiary lists of existing social protection programmes, such as the Maternal and Child Cash Transfer Programme (MCCT), social pensions and Integrated Social Protection Services, in FbA. However, this is most likely not plausible at the moment because most of the governmental processes and delivery systems are still paper-based and stored locally, which means that they can be lost or misplaced easily, especially during disasters. As the individual-level information on beneficiaries is typically stored at township-level or at a facility (school or health clinic) and the Union-level has access only to aggregate indicators, it is challenging to track the beneficiaries (The proposed way forward & the Options Paper; UNICEF et al.). Therefore, data for pre-defining beneficiaries needs to be developed in collaboration with the government. The work of UNICEF on SMIS (Social Management Information System) is aiming at tackling this issue by enabling a comprehensive recipient database.
26. Communities differ in terms of their exposure and vulnerability to different hazards; therefore, the FbA system requires flexibility. The EAP development requires an assessment of the community level disaster impacts, vulnerabilities, capacities and particularly the beneficiary needs to develop effective early actions; this is particularly the case for modalities other than cash. Therefore, a common set of thresholds and indicators for a specific hazard the hazard-prone areas may not be advisable. FAO and WFP are currently identifying thresholds, indicators and triggers for agriculture. Once finalized, these could be used by other stakeholders working in a relatively similar context. In the best case, these thresholds and triggers could be used also by other consortium members as much as possible. However, the FAO work is still at an early stage.

2.1.5 The ECHO project consortium

27. The ECHO project offers the possibility to coordinate and develop a coherent FbA system, technical tools, and joint advocacy with the government and other relevant stakeholders to support the development of an integrated FbA and SRSP system in Myanmar. To achieve this, and to link the various on-going and planned activities of the consortium members, consortium coordination needs to be enhanced from the status observed during the feasibility assessment mission for effective and efficient development of the FbA system. A critical point in the development comes when the ECHO project finishes in March 2021. However, it is expected that the project gets a no-cost extension due to late start and COVID19.
28. The ECHO project benefits also from initiatives implemented outside the project by the consortium partners. UNICEF has an on-going SRSP-initiative in Myanmar and WFP is working on technical solutions such as PRISM. FAO currently has the Technical Cooperation Programme (TCP) aiming at developing thresholds, triggers and indicators for early actions, and the Community-Based Disaster Risk Management Programme (CBDRM) in Myanmar aiming at developing the village development plans (VDP) to ensure that the plans cover all the disaster risk management phases (*See Section 4.2)*. MRCS is potentially a strong partner in the FbA system due to the existing relationship with the government and experience in early actions. However,
    i. SRSP has a lot of potential in becoming one of the early actions, but currently it does not qualify as an FbA in Myanmar as the on-going SRSP initiative in Myanmar does not currently include early actions, i.e. ex-ante cash disbursements. However, the work already done to develop SRSP. (incl. the SRSP Options Paper and Proposed Way Forward reports) has paved the way in making SRSP a truly viable option as an early action in Myanmar.
    ii. to fully engage in an up-scaled FbA system development, MRCS should decide whether FbA is considered a priority and whether MRCS has the resources to commit to the FbA development.
29. On the strategic level, the workplan between the consortium partners is clear, especially when it comes to the UN organizations. Under result 1 of the project, WFP and the consortium plan to establish a Working Group to engage government agencies and other partners to jointly define and agree on risk prioritization, indicators, thresholds and early actions. This will potentially lead to coordinated/complementary actions when the system is activated. On the practical level the consortium members would benefit from crystallizing each other's mandates and actions to avoid fragmentation, overlap, duplication or gaps. There seems to be a lack of knowledge among the consortium members on the roles and responsibilities of other members, at least on the national level.
    i) WFP provides technical support to identify the FbA indicators, thresholds and triggers, UNICEF is working on strengthening the social protection system in Myanmar, including SRSP. FAO is working on identifying the indicators, thresholds and triggers currently used by DMH for cyclone, flood and drought in the agricultural sector through its own projects and has a role in supporting overall institutional coordination and linkages.
    ii) MRCS is not officially a consortium member. The Red Cross partner in the consortium is GRC, and the only task for GRC in Myanmar for the project is this feasibility assessment. This should not, however, prevent the Red Cross, most notably MRCS from being active in the system development due to the existing relationship with the government and experience in early actions.
30. At the national and local level, efficient coordination among the consortium members requires raising awareness of each other's activities, mandates and resources, and developing a good understanding of integrated FbA and SRSP methodologies, before the official launch with the

government. As has been witnessed with FbA initiatives elsewhere, FbA initiatives may experience difficulties in getting local partners and authorities to understand the approach; see for example the feasibility study in the Philippines.

31. None of the consortium members had defined any Key Performance Indicators (KPIs) to measure the progress and success of their FbA-related initiatives, or this project. The Options Paper for SRSP suggests some possible indicators for SRSP, such as monitoring access to and the receipt of shock-responsive or any complementary transfers but based on the discussions during the feasibility assessment mission, KPIs for FbA-related initiatives have not been considered a priority development area so far by the consortium members.

2.2 Roadmap for a Sustainable FbA System in Myanmar: Recommendations for the ECHO project consortium in Myanmar

Recommendation 1: Advocacy

WHAT: The consortium should actively advocate that National Disaster Management Committee (NDMC), and particularly DDM and DMH, include FbA as part of their focal areas, and to use relevant authorities to encourage the government buy-in for a flexible, national level FbA system, jointly developed EAPs and triggers. **The consortium** should work on several fronts through their existing counterparts in the government but develop a joint advocacy strategy to effectively influence governmental interest in FbA and further promote SRSP.
WHY: Joint advocacy to the government is an important first step for the consortium to institutionalise the concept of FbA in the government disaster management policies and initiatives. A clear, unambiguous commitment from the government is required for a sustainable, national level FbA system, and is required, at least for MRCS, to implement early actions. This requires continuous advocacy from the UN agencies and MRCS.
OUTCOME: Government buy-in ensures the long-term sustainability of the initiative and enables effective implementation of early actions.

Recommendation 2: Leveraging networks

WHAT: The consortium should "speak with one voice" when approaching stakeholders, and particularly the government. However, **each consortium partner** should use their existing networks and relationships with the government and other stakeholders to advocate for FbA system, building on the lessons learnt from the SRSP system development. Instead of using only one focal point, the responsibility can be shared between the consortium members. For instance, FAO could be the focal point for the Ministry of Agriculture, Livestock and Irrigation, UNICEF for the Department of Social Welfare at the Ministry of Social Welfare, Relief and Resettlement, WFP for DMH, and MRCS for the *Department of Disaster Management (DDM)*.
WHY: The consortium members have different foci of action and thus different 'natural' focal points in the government and with other stakeholders. The buy-in from the government and other stakeholders may be easier through the existing linkages. Also, it would be more efficient to use the existing relationships instead of trying to build new relationships and trust.
OUTCOME: The process becomes more efficient, and potentially increase the ownership of the project among the consortium members.

Recommendation 3: Scale and financing of FbA

WHAT: The consortium should discuss and agree on the scale of the joint approach. The choice is between a flexible FbA system where early actions are implemented in all accessible areas of the country, or smaller scale initiatives in certain, pre-defined locations. In both cases, local level capacity development, in terms of understanding the FbA concept and implementation capacity, is needed during the system development. **The Consortium partners** need to identify innovative financing mechanisms which can be used to trigger early actions.

WHY: The choice concerning the scale influences many aspects of the FbA system development. Particularly the development of EAPs is influenced as areas and communities differ and thereby, the forecast thresholds and triggers per hazard, the early actions; the funding needs, local level capacities and the funding and capacity needs for the early action protocol development (e.g. how much community-level assessments need to be done) may also differ.
OUTCOME: Common understanding of the scale defines the required resources, capacities and development needs at national, regional and community levels.

Recommendation 4: Framework and terminology

WHAT: The consortium partners need to ensure that the ECHO project goals are achieved. These are to i) build a common framework for FbA; (e.g. identify the minimum requirements for forecast skill, triggers, technical tools, community vulnerability assessments, early actions and potential funding mechanisms for each partner), and ii) agree on terminology with the authorities for a common, translated Myanmar-language term for the approach.
WHY: Different approaches and terminology may be confusing for various stakeholders. Too many overlapping concepts and terms cause confusion and hinder efficient action, cooperation between the consortium partners and legitimacy of the concept with the authorities. During the feasibility assessment mission, the work was still at an early stage.
OUTCOME: A clear understanding of FbA among consortium members and other stakeholders, which will potentially increase fruitful consortium coordination and government engagement and ownership.

Recommendation 5: Forecasting capacity for Trigger and Early Action Protocol development

WHAT: For developing and agreeing on flood, cyclone and drought forecast thresholds and triggers for the EAPs, **the consortium partners** should i) **WFP and FAO** should openly disseminate the work over the development process on triggers with DMH and provide a forecast menu that defines different available forecasts (skill/accuracy, lead times, etc), and **other partners, most notably MRCS,** should check the situation regarding the triggers by the end of 2020; ii) **WFP as the technical lead** engage with the DMH capacity enhancement projects and iii) discuss the possibility to develop triggers based on pure hydro-meteorological forecasts, instead of impact-based forecasts; and iv) to encourage DMH to start their own systematic verification work.
WHY: DMH does not currently issue impact-based or impact forecasts, and realistically, they will not exist in Myanmar in the next few years. There are plans to develop subjective impact-oriented forecasts in a World Bank funded project of DMH. DMH is engaged in various international capacity enhancement projects, and collaboration with the existing projects could potentially avoid duplication of efforts and overlap with existing projects. The consortium should engage with the DMH capacity enhancement projects to avoid overlaps in development efforts and increase efficient use of funds. The consultants working with DMH have expressed their interest to work with the consortium, and their contact details have been shared with the Red Cross. WFP and FAO have been developing triggers, but it was not possible to verify their development stage by September 2020. It was not possible to verify DMH forecast during this feasibility assessment, and the existing material only gave indicative information regarding the skill and accuracy of the relevant DMH forecasts and warnings.
OUTCOME: DMH is not overburdened with collaboration requests and the consortium increases cost-efficient use of funds. Knowing the forecast skill will assist in developing the early action protocols and reduces the chance for acting in vain or missing an opportunity to act.

Recommendation 7: Further needs for Trigger and Early Action Protocol development

WHAT: The consortium is encouraged to further assess the capabilities of the government to engage in the FbA system development and take note on the lessons from the SRSP initiative. Special emphasis should be put on i) assessing the reforms needed in policy and legislation to support the inclusion of FbA in government programmes, financial feasibility and bottlenecks in using government funding for early actions, and on ii) conducting a thorough stakeholder mapping of government and non-government organisations, such as other humanitarian and development partners and academia, that

could contribute to system development.
WHY: Assessing these is crucial for the development of a sustainable FbA system in Myanmar, and was not possible during this feasibility assessment.
OUTCOME: Sustainable, durable **F**bA system which reduces the impacts of natural hazards on vulnerable people and communities in Myanmar in a cost-effective manner.

Recommendation 8: Project Coordination

WHAT: Each consortium member is encouraged to share with each other their current activities and mandates in Myanmar and FbA-relevant initiatives and actions; and especially their current and future programmes for improved harmonization.
WHY: Based on the interviews held, it appears that at least in Myanmar, not all consortium members are familiar with each other's mandates and actions
OUTCOME: The consortium members are aware of each other's actions, mandates and other relevant projects which will further support the planning and implementation of the FbA system development.

Recommendation 9: Roles, responsibilities and the action plan of the project

WHAT The consortium members should discuss and agree on the roles and responsibilities of each member, and create a detailed, concrete action plan with clearly set targets and follow-up measures for each role and responsibility.
WHY: As an example, the role mentioned for FAO in the Project Work Plan (Activity 2.2.a); '*Facilitate institutional linkages and capacity building of concerned agencies (DMH, MSWRR[9], other relevant sector ministries) for shared understanding and consensus on monitoring indicators, EWS, thresholds and triggering mechanism for flood, cyclone and drought*' is a broad and high-level action plan, and requires more tangible and concrete actions that all consortium members are aware of.
OUTCOME: Concrete and actionable roles and responsibilities will enable a coherent coordination between the consortium members and more efficient programme project management as possible overlaps can be identified and avoided.

Recommendation 10: Project Management strategy

WHAT: The consortium should consider creating a strategic management system for the project with strategic (higher-level and longer-term) and operational (actionable) objectives with main activities and key performance indicators (preferable with both lagging and leading measures). The system should follow the progress of the process, not only the outcomes. The management system could include, for example, the development plans for coherent and standardized tools and training packages, increasing access to information and technologies such as relevant geo-spatial information to improve early warnings, and building national and local capacity to implement FbA/EWEA and SRSP.
WHY: A complex process with multiple stakeholders requires a comprehensive action plan to avoid inefficiencies. This may in turn would hinder the currently weak buy-in from the authorities.
OUTCOME: A strategic management system allows for reflexive management and taking corrective actions when needed. Knowledge sharing, developing coherent and standardized tools and training materials and joint advocacy will further improve coordination between the consortium partners, create mutual understanding and provide an opportunity for capacity building for the organizations.

Recommendation 11: Synergies within the project

WHAT: The consortium members should systematically identify possible synergies in the technical EAP development and in geographic areas for pilot initiatives
WHY: Consortium members had plans and ideas for initiatives in the same sectors and areas. For example, FAO is planning some drought activities in Pakokku. MRCS is also interested in drought FbA, and Pakokku was identified as one potential area for MRCS.
OUTCOME: Increased optimisation of the actions utilizing the strengths of each organization.

[9] Ministry of Social Welfare, Relief and Resettlement

Recommendation 12: Communication within the project

WHAT: The consortium members in Myanmar and at the regional level need to develop a communication channel to ensure that information flows from the regional to national level and vice versa, as well as between the consortium members.
WHY: Based on the meetings held during the feasibility assessment, there appeared to be some confusion at the Myanmar level about the project details planned at the UN and Red Cross at the regional (South-East Asia) level. A quarterly communication meeting has been planned but especially in the beginning of the project it may not be enough.
OUTCOME: Efficient programme implementation, enhanced learning and cooperation between consortium members.

Recommendation 13: Sustainability of the project results

WHAT The consortium should start the work to ensure the sustainability of the project outcomes already at this point. Particularly **MRCS (not the PNSs),** even if not officially a member of the consortium, should take an active role in participating in the development of FbA in Myanmar, if MRCS considers FbA a priority and finds the resources to participate in the development;
WHY: Sustainability of the project results and the other initiatives of the UN partners are often jeopardised by lack of after-project strategy, or the fact that the planning starts at the end of project.
OUTCOME: Myanmar has a long-term, sustainable FbA system, considering the resources and other realities in which organisations and authorities in Myanmar operate.

3 BACKGROUND

3.1 Scope of Work

This feasibility assessment analyses FbA system development from an 'innovation systems' perspective. A system can be defined as a set of interrelated components working toward a common objective, in this case developing effective, sustainable FbA initiatives and eventually an FbA system to reduce the impacts of extreme hydro-meteorological events on communities and people. Systems are made up of components, relationships, and attributes. These terms are not repeated in the feasibility assessment, but the idea of system innovation has guided the analysis.

- **Components** are the operating parts of a system, such as actors (most notably consortium partners, government agencies, and beneficiaries); and artefacts (e.g. hydro-meteorological forecasts/warnings, disaster impact data, policy documents).
- **Relationships** are the links between the components. Relationships are important, as the properties and behaviour of each component influences the properties and behaviour of the system as a whole (such as the relationship between MRCS and public authorities, co-operation and collaboration between consortium partners).
- **Attributes** are the properties of the components and their relationships; they characterize the system (such as the accuracy of forecasts, capabilities and resources of the actors).

The feasibility of setting up FbA initiatives and a system and implementing FbA/EWEA interventions in Myanmar was based on assessing the enabling and hindering factors in the components, relationships and attributes. More specifically, the feasibility of FbA in Myanmar was assessed by

- reviewing and analysing the recent experiences and operational activities of the consortium partners in FbA related initiatives to understand the compatibility and complementarity between the partners (Section 4);
- reviewing the synergies and links with the authorities' policies and capacities to understand their engagement and willingness to support FbA initiatives and eventually manage the FbA system; (Section 5)

- reviewing and analysing the availability and usability of hazard, exposure and vulnerability and consolidated risk data as a basis for designing a menu of forecast-based triggers and a prioritization of early actions to (Section 6.1)
- reviewing the forecasting and hydro-meteorological analysis capacities of the Department of Meteorology and Hydrology and in the South-East Asia region to prioritise hazards, and to understand the potential lead-time for the chosen hazards (Section 6.2)
- identifying the potential early actions, the different modalities of delivering assistance, and analysing the critical factors in their implementation within the given lead time to determine the final step in the feasibility of an FbA system in Myanmar (Section 7).

Various limitations, including access to relevant documents and stakeholders, the lack of meteorologist in the assessment team, influenced the scope of this assessment.

3.2 Terminology

FbA refers to the use of weather, climate and particularly impact-based forecasts and early warning systems (EWS) to trigger financing and early actions before the forecast hazard hits a community to reduce the impacts of the hazards on "vulnerable people and their livelihoods, improve the effectiveness of emergency preparedness, response and recovery efforts, and reduce the humanitarian burden" (Wilkinson et al. 2018: 7). In many cases, Early Warning Early Action (EWEA) and Forecast-based Financing (FbF) refer to the same concept, and increasingly, anticipatory action is used. In this report, **we use Forecast-based Action (FbA) throughout the feasibility assessment** to refer to the different concepts. UNICEF focuses on using social protection systems to reduce the impacts of shocks, including natural hazards, and refers to the system as *Shock Responsive Social Protection (SRSP).* SRSP does not currently aim at ex-ante distribution of social protection measures in Myanmar but aims at increased preparedness of the social protection system for various disasters. UNICEF contribution and SRSP is explicitly mentioned when the distinction needs to be clear. The terms (FbA, FbF, EWEA and SRSP) are described in more detail in Appendix 1.

4 KEY FbA ACTORS IN MYANMAR

4.1 Government

The Disaster Management Law was passed in August 2013, and the Disaster Management Rules finalized in April 2015. Following the Disaster Management Law, the Government established the National Disaster Management Committee (NDMC), the highest decision-making body for disaster management. The NDMC is chaired by Vice President II. The Minister of Social Welfare, Relief and Resettlement and the Minister of Home Affairs are the Vice-Chairs. Depending on the emergency, Working Committees and Sub-Committees will be constituted. [10]

The governance system with key government actors from national to ward/village level is described in detail the Myanmar Action Plan on Disaster Risk Reduction, 2017[11]: Some changes have already taken place since the publication, but the main structure remains the same: at national level, the main body is the National Disaster Management Committee, with official disaster management committees also at state/region and township levels. The main department at the national level is the Department of Disaster Management (formerly Relied and Resettlement Department) in the Ministry of Social Welfare, Relief & Resettlement. The operational responsibility to receive early warning information,

[10] https://reliefweb.int/sites/reliefweb.int/files/resources/disaster-mgmt-ref-hdbk-burma_0.pdf, p. 32

[11] https://themimu.info/sites/themimu.info/files/documents/Core_Doc_Myanmar_Action_Plan_on_Disaster_Risk_Reduction_2017.PDF

identify beneficiaries and commence disaster response actions is at the township level with the General Administration Department (GAD). DMH is the sole provider of hydro-meteorological forecasts and early warnings [12]. In Myanmar, the engagement and lead of the government at all levels is crucial for successful FbA initiatives.

The current system for declaring a disaster is ex post. In line with National Disaster Management Law section 11 (Rule 26), only the President can declare a 2-month State of Disaster Affected Areas at the request of the NDMC. To do so, there needs to be "large scale" loss and damage to lives and animals, "serious loss and damage" to infrastructure, properties and livelihoods, "severe damage" to social activities, or "serious damage" to the environment. This Declaration can be extended on a 2-month rolling basis as conditions allow. The NDMC may make the request to the President to make the Declaration once all lower administrative levels have confirmed they have exhausted their capacities in managing the disaster at their level and require additional emergency assistance.

The government does not have any FbA initiatives at the moment. However, the situation may change quickly. In November 2019, a high-level national multi-stakeholder policy dialogue in Myanmar with a focus on 'Building Resilience to Drought in South-East Asia' was held in Nay Pyi Taw. The dialogue was organised by DDM, in coordination with the ASEAN Secretariat and the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). According to FAO representative, anticipatory actions (i.e. FbA) was recognized as one approach to reduce the impacts of drought, particularly drought context.

Two field trips undertaken during the feasibility assessment mission aimed at assessing the feasibility to develop and implement FbA. It is to be noted that both areas visited have either an on-going or just finished MRCS-project, so it is expected that the view is somewhat biased, and these communities are likely to be better prepared for early actions than many other areas in the country.

Based on the discussions with local level authorities during the two field trips, authorities are using weather information in evacuation decisions based on warnings from DMH. Sometimes the evacuation on a local level may take place even before the official warning from DMH, for example, in the case of flood, based on the information on water level from up-river and the local knowledge on when the water level can be expected to reach dangerous level in their village. No specific triggers are used but regular monitoring takes place by the Meteorological Division under DMH that monitors hydro-meteorological hazards and issues flood and cyclone warnings.

In Hinthada Township, the NDMC has directed to develop Township Disaster Management Plans across the country starting at the Village Tract. The development of the Township Disaster Management Plan has been guided by NDMC through national guidelines and the process has been made references of MAPDRR, Regional Development Plans, Township Profile, Township Census, Township information collected by development partners and social organizations. The Township Disaster Management Committee was interested in early actions and seemed to understand the concept of FbA. A flood forecast system is in place. In addition to forecasts received from DMH, Hinthada receives information from upstream and can calculate 14 to 7 days before when the water is expected to reach dangerous levels in their township.

The communities that were identified as very vulnerable are the ones residing between the two dykes. In the rainy season the irrigation department has the responsibility to monitor the water level. There are 30 water level monitoring stations and also the dike situation is under 24-hour monitoring. At the same time, in the district level, they receive information from upstream, and the message is also collated between the offices. Monitoring the dike condition is critically important, because in case the dike breaks, Hinthada and another 7 townships downstream will be in danger. This is financed from the Union level.

[12] https://www.moezala.gov.mm/

On a village-level, the village disaster committees closely follow the information received from upstream, radio and other media. When they receive important messages, will contact the Township DMC to check verify the accuracy of the information. This implies that in some cases the communities can start preparing for the flood even before the official warnings. According to one village disaster management committee, they receive the official warning only 48 hours before the dangerous water level is forecast. The anticipatory actions include for example building extra floors to the house (if not done before) and moving people and belongings and preparing housing for the livestock. There can also be a mark on each house for the critical water level. In some cases, indigenous forecast signs are observed. When the critical water level is reached, people and livestock will be evacuated. The decision to evacuate can be made by the village administration. Once the people arrive in the evacuation centre, TDMC is contacted. TDMC can provide support (food and water, for example) in the evacuation centre after 3-7 days; until then people need to arrange necessities themselves. In both villages these are funded from the village disaster/emergency fund, which is open to all the households by paying the monthly fee (1000 kyat/ household in both villages). In most cases the need and importance of these funds is generally well perceived. After the flood it takes approximately a week to return to normal. Farmers have to wait until the water is down again which takes approximately two months.

In South Dagon Township, located in the south-eastern part of Yangon, where the potential for heat waves FbA was discussed, the erection of tents needs to be negotiated with the township authorities.

4.2 Consortium

4.2.1 Rationale, roles and responsibilities

The "Scaling up Forecast based Financing/Early Warning Early Action (FbF/EWEA) and Shock Responsive Social Protection (SRSP) with innovative use of climate risk information for disaster resilience in ASEAN" project in Myanmar is part of a larger 2 -year ECHO-funded Action of the same name. The project planned termination is in March 2021. The Action will build on the work already done in the South-East Asia by different ECHO-funded activities. The ECHO Action promotes FbF/EWEA and SRSP as novel approaches to transform disaster preparedness and response, contributing to building disaster resilience. It requires an integrated approach between FbA and SRSP, enabling strengthened risk monitoring and identifying the potential early actions across all relevant actors. The aim of the ECHO Action is to reduce disaster impacts and enhance resilience in ASEAN through advancing FbF/EWEA[13] and SRSP, informed by innovative use of climate risk data, resulting in coherent technical approaches, tools, and joint advocacy to support Asean Member States and ASEAN actions on the regional level (Fig. 1)

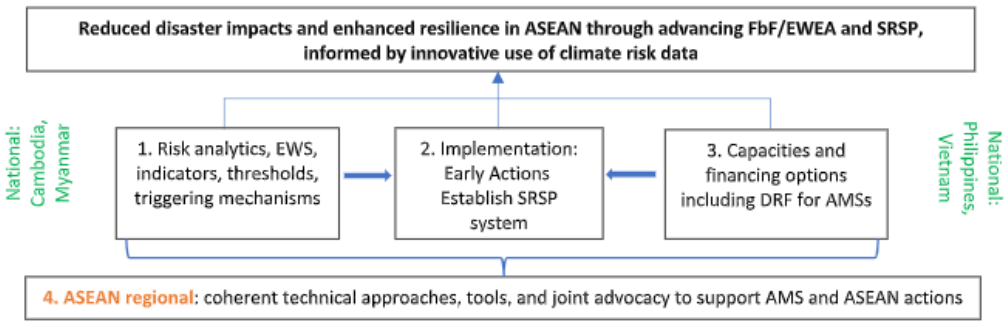

Figure 1. The logic of interventions (Source: Single Form, Annex 3)

[13] This report uses FbA instead of Fbf/EWEA

The rationale behind combining the FbA and SRSP approaches, as noted in the Annex 3 of the project's Single Form[14] is:

- Both FbF/EWEA and SRSP approaches require risk analytics (encompassing use of risk information, monitoring, vulnerability assessment, impact-based forecast), strengthened EWS that include ex-ante agreed indicators, thresholds and triggering mechanism for pre-agreed Early Action and for tweaking/scaling up of social protection for disaster preparedness and response.
- Both would require predefined innovative financing mechanisms, be that fiscal (i.e. contingency budget), other domestic resources for disaster risk management (i.e. national disaster fund), humanitarian aid or disaster risk financing
- ECHO funding would be catalyst for actions to make FbF/EWEA work as part of national preparedness/response system or shock responsiveness elements of social protection rather than developing/strengthening the system itself.

In Myanmar, the project was kicked off at the first coordination meeting in October 2019 in Nay Pyi Taw. This was followed by the launching event at the regional level in Bangkok in September 2019, where the roles and responsibilities of the members were agreed among the Regional Technical Working Group. The Single form further notes that SRSP has been endorsed by the ASEAN through the first phase of a joint UN project, implemented prior to the current project. The UN project assessed the options for making the social protection system in Myanmar more shock-responsive and developed a roadmap for introducing and developing risk-informed and shock-responsive social protection in Myanmar (UNICEF et al. 2019). Because FBA is a new initiative in Myanmar, the ECHO project Single Form emphasizes the strategic importance of introducing FbA in an integrated framework with SRSP for coherent understanding and acceptance, while continuing efforts to establish SRSP systems. Based on the Single form, the ECHO project will align with and contribute to, for example, national policies and programmes in *Disaster Risk Management* and social protection (such as the national social protection/social assistance frameworks, the DRM strategies/plans and major programmes); as well as coordination mechanisms such as Disaster Risk Reduction Working Group and Cash Working Group in Myanmar.

Based on the mandates, missions and previous experience and work already done by each consortium member organization on the national or regional level, the roles and responsibilities have been agreed as follows:

- **FAO** is the lead for the regional project, and on the national level in Myanmar, will facilitate institutional linkages and capacity building of concerned government agencies for shared understanding and consensus on monitoring indicators, EWS, forecast thresholds and trigger mechanisms for flood, cyclone and drought. FAO also contributes to WFP's activities through pilots in the agriculture sector.
- **WFP** is the technical lead and responsible for providing technical support for, for instance, identifying and developing vulnerability indicators, risk and impact assessments, remote sensing methods, and providing training to disaster management officers on the use of remote sensing methods. WFP is also responsible for conducting research on past climate-driven disasters and their impacts on vulnerable populations. WFP and UNICEF are also working on thresholds and triggers for social protection.
- **UNICEF** will continue advocacy on implementation of SRSP policy options and roadmap, the work which started already earlier.

[14] The Single Form is a living document that ECHO partners will use for the submission of proposals, modification requests, interim reports and final reports. By "living document", ECHO means that the same document ("Single") has to be completed/updated during the project's life's cycle. Thus, the Single Form allows a comparison between the planned and actual achievements. https://www.dgecho-partners-helpdesk.eu/action_proposal/what_is_sf/start

- The official **Red Cross partner** in the consortium is the GRC, a Red Cross Partner National Society to MRCS. Before this feasibility assessment, **MRCS, together with the GRC and the American Red Cross**, conducted a scoping study to identify stakeholders working on FbA in Myanmar, high potential areas for this feasibility assessment, and provided initial recommendations. Other than the scoping study and this feasibility study, there are no other actions planned for GRC/MRCS.

For coordination, the organizations established a routine coordination meeting on a quarterly basis to update the progress. The first follow-up meeting was organized in February 2020.

One expected outcome and the logic behind forming a consortium in the ECHO Action is finding coherent technical approaches, tools, and joint. This, however, might prove out to be a challenging task, as even if the initiatives are aiming at the same objective and also following similar broad principles, there are differences in the detailed technical approaches, tools used and results achieved. All the organizations are still speaking in their own terminology which appear to be unclear to the other consortium members.

Based on the discussions during the feasibility assessment, it is also quite clear that the key performance indicators (KPIs) have not even been discussed yet. From a strategic point of view, it would be advisable to start planning on the KPIs as early in the programme development as possible.

4.2.2 Project activities and FbA/EWEA/SRSP initiatives to date

In the ECHO project, the role of **WFP as the technical lead** is to provide technical support. To facilitate this, WFP plans to introduce the Platform for Real-time Information and Situation Monitoring (PRISM)[15], a technology solution for measuring climate risk and impacts through the lens of socio-economic vulnerability. PRISM will 1) use real-time meteorological data and weather forecasts, 2) combine this information with risk, exposure, vulnerability and livelihood profiles to understand place-based resilience to climate hazards and 3) estimate numbers and type of affected population before and just after climate hazards occur. A scoping mission was conducted in November 2019 with DMH, DDM and other stakeholders to review the existing system and areas to improve to generate data on floods and droughts. For example, in Mongolia, where a national FbA system already exists, PRISM has already been implemented as part of the national FbA system.

In addition, WFP, in collaboration with the UN Capital Development Fund (UNCDF), has mapped the presence and capacity of financial service providers, and accessibility of these services during disasters. The report "Cash preparedness profile" in disaster prone states/regions (Ayeyarwady, Bago, Magway, Mandalay, Rakhine and Sagaing) (WFP & USAID 2019) is part of WFP's ongoing commitment as a chair of the UN Cash working group. The report has been shared with the Cash working group members and will be shared with the government once the ECHO project is officially launched with the government. WFP will also support in developing standard operation procedure (SOP) of different types of transfer mechanisms (E-Wallet, Cash Over the Counter and bank transfer etc.), and provide technical assistances in strengthening the existing national social protection system to be shock responsive.

FAO has currently two programmes closely related to the ECHO project:

1) Technical Cooperation Programme (TCP) on DRR and EWEA. The programme aims at identifying thresholds, triggers and indicators, used by DMH, for early actions, developing local level early action plans and early action programmes that, unlike the early action plans, include also financing mechanism and other related parts. Additionally, the objective is to build capacity of the government officials on EWEA.

[15] https://innovation.wfp.org/project/prism,

2) *Community-Based Disaster Risk Management Programme (CBDRM).* The plan is to integrate CBDRM in Village Development Plans (VDP) through series of local level stakeholder consultations and workshops in pilot villages. Depending on whether VDPs already exist or not in the pilot villages, the consultations will either pilot a CBDRM integrated VDP process or facilitate an interim VDP review exercise to ensure that VDP cover all DRM phases (e.g. Preparedness, Mitigation, Response and Recovery). In addition, a guidance document will be developed to integrate CBDRM approaches into existing VDP process.

Thus far, FAO has organized a technical brainstorming and Implementation Planning Workshop in October 2019 to conceptualize the understanding on EWEA. During the workshop, DDM, DMH, and other relevant government departments were consulted on the existing EWS, potential hazards and their impacts. In the discussions with the government departments and other institutions, priority hazards (cyclone, flood and drought) and early warning systems for the hazards were identified for agriculture and livestock sectors. A roadmap including the preparation of a checklist for detailed inventory for EWEA information, a consultation on Development of hazard-specific risk monitoring and early warning thresholds and triggers for piloting of priority hazards Workshop to define forecasting parameters and thresholds at National level as well as EWEA implementation planning workshops has been developed.

For FAO, the next steps will include, as pilot, community level Early Action Planning exercise that will be conducted in Labutta Township, Ayeyarwaddy Region for cyclone and flood hazards, and in Pakkoku Township, Magway Region for drought hazard. In addition, capacity building trainings will be offered to relevant stakeholders from the same townships including implementing partners and sector Ministries. The trainings will cover climate/weather analysis and forecasting and sectorial interpretations and contingency planning, preparedness for response including monitoring indicators, EWS and thresholds and triggers for cyclone, flood and drought.

FAO is also planning to conduct a stakeholder consultation in Sittwe, Rakhine State to review the current Early Warning System and Early Warning dissemination for prioritized hazards such as Cyclone and Flood in Rakhine State. Moreover, local Early Action plan will be developed based on the consultation with relevant stakeholders in pilot four townships in Rakhine to validate on the WFP-lead development of a set of indicators and thresholds for those hazards at national level. Based on the stakeholder consultations, a series of meetings will be organized in order to develop suitable mechanisms to scale-up the Maternal and Child Cash Transfer (MCCT) to be shock responsive in order to ensure pregnant and lactating women and children continue their consumption of nutritious food in case of shocks and disaster, especially during the lean season.

UNICEF, the lead facilitator for social protection, will continue advocacy on implementation of SRSP policy options and roadmap. UNICEF, together with other development partners, has conducted a study aiming at supporting the government by identifying policy and operational options that can strengthen the shock-responsiveness of Myanmar's social protection system (UNICEF et al.: The Options Paper). The focus has especially been on the Maternal and Child Cash Transfer (MCCT) programme, which is one of the two key operational flagship social protection instruments in Myanmar, other one being the Social Pensions programme. As of 4 March 2020, MCCT has reached 236,243 beneficiaries, covered 5 areas (4 States and 1 remote "special zone") with total disbursements accounting to 10,3 MMK billion (7.6 million USD). Based on the study, a roadmap for making the selected social protection programmes more risk-informed and shock-responsive was proposed to the Government of Myanmar. It is yet to be validated (UNICEF et al.**:** Proposed way forward). UNICEF also coordinates and supports DRR actions, for instance in Shan state climate-integrated disaster response plan.

The ECHO project will avoid overlaps with ongoing and foreseen activities led by UN agencies for SRSP with other funding, such as supporting DSW with the development of an integrated web-based Information Management Information System (MIS) for key flagship social programmes (i.e. MCCT,

social pensions, Integrated Social Protection Services). The new MIS will enable creating a unique social protection ID and electronic payment systems.

MRCS has an **'Early Warning Early Action' mechanism** which consists of the mobilization of volunteers and providing assistance with evacuation where appropriate. The capabilities for this are concentrated in townships where there is an on-going DRR project and volunteers have been trained on the evacuation of vulnerable people (elderly, young families, people with disabilities). In these areas, the Emergency Operations Manager, through the MRCS Emergency Operations Centre, disseminates early warning messages to the branches at the township and State/Region level upon receiving a warning from DMH. If evacuations are needed, the Emergency Operations Manager initiates the mobilization of volunteers to assist local authorities. (SEADRIF FS) With the support of AmCross, MRCS has been engaged in EWEA initiatives: EWEA trainings have been held and training material drafted. MRCS Headquarter staff has also been trained by RIMES (Regional Integrated Multi-Hazard Early Warning System for Africa and Asia) experts on hydro-meteorological knowledge; and MRCS HQ staff has further trained township DMC members.

Myanmar was among the first countries to sign an agreement with **SEADRIF**[16]. By increasing pre-disaster planning and post-disaster relief and reconstruction funding, SEADRIF protects people and their livelihoods, and contributes to ongoing economic development and poverty reduction. Regarding the SEADRIF initiative, MRCS decided not to engage with the initiative. However, a feasibility study on MRCS capacity, and a flood and cyclone forecast verification analysis were done. These documents have been used in this FbA feasibility assessment.

4.3 Academia

There are more than 150 universities and colleges in Myanmar, some of which are providing suitable technical and scientific courses or multi-disciplinary courses specifically on disaster management, e.g. the Department of Geography of Dagon University offers a Post Graduate Diploma in Natural Disasters Studies. Due to the time-constraints it was not possible to assess the potential academic partners during this feasibility study. FAO identified academic partners, but no detailed information was available at the time.

From the government side a good focal point for finding out the relevant and potential academic partners could be the Disaster Management Training Centre (DMTC), opened in 2015 in Hinthada, with the mandate for capacity development for disaster management at all levels.

The IFRC Climate Centre[17] is heavily involved in developing FbA initiatives globally. The Climate Centre has substantial technical expertise and experience regarding FbA, particularly from the Red Cross perspective (as being part of the Red Cross Red Crescent Movement). However, engaging the rigorous science-based services of the Climate Centre requires a significant amount of resources.

5 CONSORTIUM ENGAGEMENT WITH THE GOVERNMENT

All the consortium partners are part of the National Disaster Risk Reduction working group; which is a Government-UN-Donor-NGO self-established working group, coordinated by DDM, This provides a chance to increase the visibility and advocate the need for FbA at the national level.

[16] A regional platform that provides participating nations with advisory and financial services to increase preparedness, resilience and cooperation in response to climate and disaster risks https://www.seadrif.org/
[17] https://www.climatecentre.org/

UNICEF is currently collaborating with the government (especially DSW and DDM) to institutionalize SRSP schemes. This includes the development of a Social Management Information System (SMIS) to enable a comprehensive recipient database. The Options Paper for SRSP recognizes the need for collaboration within and with the Ministry of Social Welfare, Relief and Resettlement (MSWRR). As identified in the Options Paper, the ministry was already doing cash distributions in Rakhine so the programme will have to be aligned with the approach of the ministry.

According to work done by UNICEF, one of the main constraints for the development of any FbA initiative is the government's focus on disaster response, not early action. Currently the Disaster Management law and financial regulations enable the government to assist people only after the disaster strikes, based on needs assessment.

Also, the concept of 'no-regret actions' does not sit well in the current working environment – it appears that the government is hesitant to take any no-regret SRSP measures, such as additional cash distribution for the MCCT programme when there are heavy rains forecast. This additional grant would enable the beneficiaries to prepare for the disaster. If the disaster does not strike, instead of paying back the money the beneficiaries are expected to attend nutrition sessions. Therefore, for FbA to become a truly viable option, a significant shift in the mindset, together with the legislative changes, will be needed to shift the focus from response to anticipatory action. UNICEF is working to get the government acceptance for the Cash Transfer Programming plans. The aim is to use the existing MCCT mechanisms and procedures; therefore, UNICEF is not necessarily distributing additional cash on top of the government distribution. Instead, the aim is to gradually adapt the MCCT mechanism toward SRSP by focusing on specifically on disaster preparedness within the mechanism, but it will not include actual ex-ante disbursements. UNICEF could consider topping up the government MCCT distribution, *if and when* a disaster hits an area where MCCT operates, given that the MCCT is gradually expanded to the whole country. Many other aspects, choices and options are still open.

WFP, together with UNICEF, is supporting the government with the MCCT. This support includes implementing the programme, distributing the cash, as well as monitoring and evaluation. The policy Options (UNICEF, 2019 paper detailed the policy options and roadmap for MCCT at the regional level; currently, some of the recommendations are implemented. WFP is planning on achieving two results: 1) accelerate the use of primary risk data, and 2) strengthen the early action system to bridge early action and SRSP and the use of impact-based forecasting. The plan is to achieve these results by implementing PRISM by June 2020. Most of these initiatives are still in an early stage, and the short timeframe for the implementation in Myanmar poses a risk to government buy-in.

Similar to UNICEF, **FAO** is considering options to possibly top-up to the government payment on the MCCT in case of a disaster. This work is still in an early stage and subject to the approval from the government. As became evident from the 'Options Paper for SRSP', the prerequisite of FbA to be feasible is the process of automatically disbursing the funds, which needs to be defined and discussed with the local partners and the government to ensure feasibility.

MRCS as an auxiliary to the government by the national Disaster Management Law from 2013 and the Disaster Management Rules from 2015 (mandated also by the Red Cross Acts from 2015 and 2018), has the closest connection with the government among the consortium members. MRCS has a representative in the NDMC and participates in the DDM EOC. MRCS local branches and the MRCS EOC do not have to wait for NDMC emergency declaration on the ground to respond, and they can report to National government EOC directly. All UN agencies also engage with the government departments on a regular basis.

6 RISK DATA AVAILABILITY AND FORECAST CAPACITY

6.1 Prioritisation of hazards

Myanmar is exposed and vulnerable to many natural hazards. The hazard selection is based on the relevance to FbA, the Scoping study results, past disaster impact data, the prioritisation done at the FAO workshop; and for MRCS, the prioritisation of MRCS.

The Hazard Profile of Myanmar report from 2009 gives an overall description of nine hazards: tropical cyclones, storm surge, floods, drought, earthquake, forest fire, landslide, tsunami and fire. However, the report does not place the hazards in any order based on severity or impacts. The Myanmar Action Plan on Disaster Risk Reduction, 2017 also notes that riverbank erosion, strong winds and lightning have caused localised damage and casualties. None of the existing material cover heat waves as a potentially risky hazard, but the Scoping study notes that "[a]t the township level, authorities mentioned that about 8-10 people die every year from heatstroke." A further complicating factor is "the authorities were not disseminating the correct advice to protect against heatwaves, cautioning people against drinking cold water or taking showers."

Fire as a pure man-made hazard is ignored. Earthquakes cannot be forecast, and based on the scoping study the lead time for tsunamis is currently less than three hours, so are also ignored. Based on the scoping study assessment on forecast capabilities, feasibility for riverine flood is high, tropical cyclones medium, flash floods and strong winds low, and heat waves and drought require further study.

In the FAO workshops focusing on FbA for agriculture and livestock sectors, participants consisting of government representatives and other stakeholders (incl. MRCS) highlighted cyclones, floods, drought as priority hazards in the pilot areas. For MRCS, FbA for floods are considered a priority, and MRCS has experience in flood response activities. Interest toward drought and heatwaves were also raised.

6.2 Forecasting capacity

6.2.1 General forecast capacity

The value and benefit creation of hydro-meteorological forecasts, early warnings based on forecasts, and observation-based warnings can be boiled down to three broad components: the quality of the forecast, the dissemination of the forecast, and the actions taken based on the forecast. For FbA, of particular importance is the spatial accuracy of the forecast/warning: does the event hit the actual location as forecast (forecast skill), and how much in advance can the warning be given to implement actions (lead time). FbA triggers can be developed by model-based hydro-meteorological forecasts and early warnings and observation-based forecasts and warnings. Forecast verification is the process of assessing the quality of a forecast. In principle, the forecast is compared, or *verified*, against a corresponding observation of what actually occurred, or some good estimate of the true outcome. The verification can be qualitative ("does it look right?") or quantitative ("how accurate was it?"). In either case it should give information about the nature of the forecast errors.[18] Forecast skill and lead time to implement forecast-based actions is central to assessing the feasibility for FbA. This provides an indication of how frequently a trigger, based on a given forecast, might have a false alarm (type 1 error) or miss an upcoming event (type 2 error).

In Myanmar, the responsible government department to create and disseminate forecasts and early warnings for FbA is the Department of Meteorology and Hydrology (DMH). The availability of hydro-meteorological forecasts was assessed by compiling existing information from the SEADRIF initiative (extreme rainfall, tropical cyclones, river flooding and storm surge) and the scoping study on the

[18] https://www.cawcr.gov.au/projects/verification/#Introduction

available forecasts, and consulting national and international experts on the availability and skill of forecasts issued by DMH.

Table 3 shows the hydro-meteorological forecasts and lead times available for the chosen hazards based on the scoping study.

Table 3. The forecast information, responsible agency, lead time and preliminary assessment of FbA potential for chosen hazards (Modified from the scoping study)

Hazard	Forecasting Information	Responsible agency	Lead time	FbA Potential
Riverine flood	Water-level forecasts from Hydrological Monitoring Stations	DMH	3 days or less	High
Flash flood	Guidance being developed	USAID project Follows WMO guidance	>1 day	Low
Heat waves / High temperatures	Temperature outlook, such as "Situation of increasing day temperature". or "forecast to continuously increase day temperature in these Regions and States during next (3) days".	DMH	A few days prior (~2/3)	Heat wave assessment provided in a separate annex
Cyclone	Forecasts and early warnings	DMH	2 – 3 days	Medium
Strong winds	General strong wind warnings, including hail, thunder and lightning due to convective cloud during summer period and pre monsoon period issued.	DMH	Unclear	Low
Drought	Drought monitoring centre	DMH in Mandalay	Unclear	Requires further study

Currently, there is no systematic forecast verification undertaken at DMH, so it was not possible to obtain information on the forecast skill. Most importantly, it is not clear whether forecast data is stored in a database, so the possibility for forecast verification in the future is also unclear.

Most likely, DMH will be the main responsible agency providing the forecasts and early warnings for the FbA system, and it is highly unlikely that any other forecast information, provided by another agency, can be used. Therefore, DMH forecast skill, and the DMH willingness to be part of the trigger development and the human resource capacity need to be assessed before engaging in larger scale FbA activities. FAO has collaborated with DMH to identify the parameters used by DMH in foresting assess the status of defining the triggers and thresholds. Based on preliminary findings, DMH has well defined forecasting parameters and thresholds for cyclone and flood. However, there are limited forecasting parameter and threshold for drought with purpose for drought report for monsoon season annually from National Drought Monitoring Centre from DMH, located in Upper Myanmar to the Head Office in Nay Pyi Taw. (FAO)

Furthermore, DMH is currently engaged in various international projects funded, for instance, by the Japan International Cooperation Agency (JICA), South Korea on automatic weather stations and the World Bank. The World Bank-funded project develops the general capacity of DMH and has a component on impact-based forecasts. However, based on the consultant interview, the project will not develop actual impact-based forecasts but will introduce the topic with DMH and potentially initialise the development.

The Early Warning Information and Dissemination System in Myanmar is depicted in figure 4.

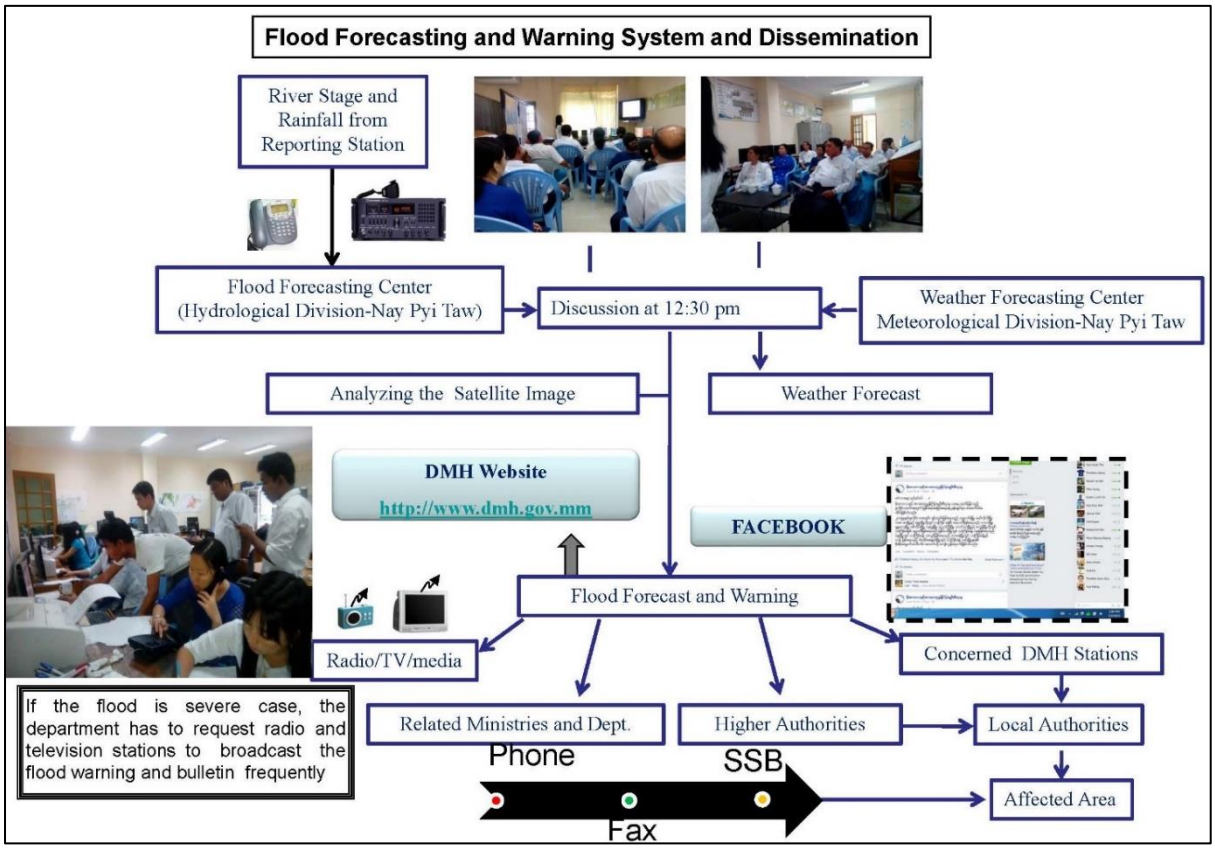

Figure 2. Early Warning Information and Dissemination System in Myanmar

Figure 5 shows the DMH early warning dissemination system.

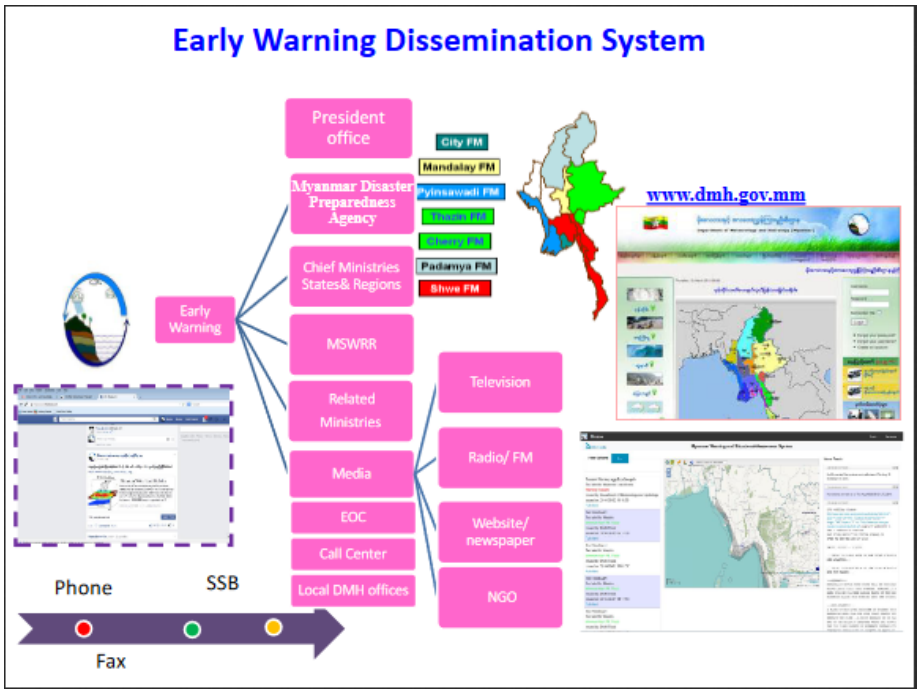

Figure 2. DMH early warning dissemination system. Screen shot, slide 15 from https://www.unescap.org/sites/default/files/2b_Myo%20Myo%20Aye%20_Myanmar%20Meteorology%20and%20Hydrology%20System%20Overview.pdf

Figure 6 provides another description of the early warning dissemination process.

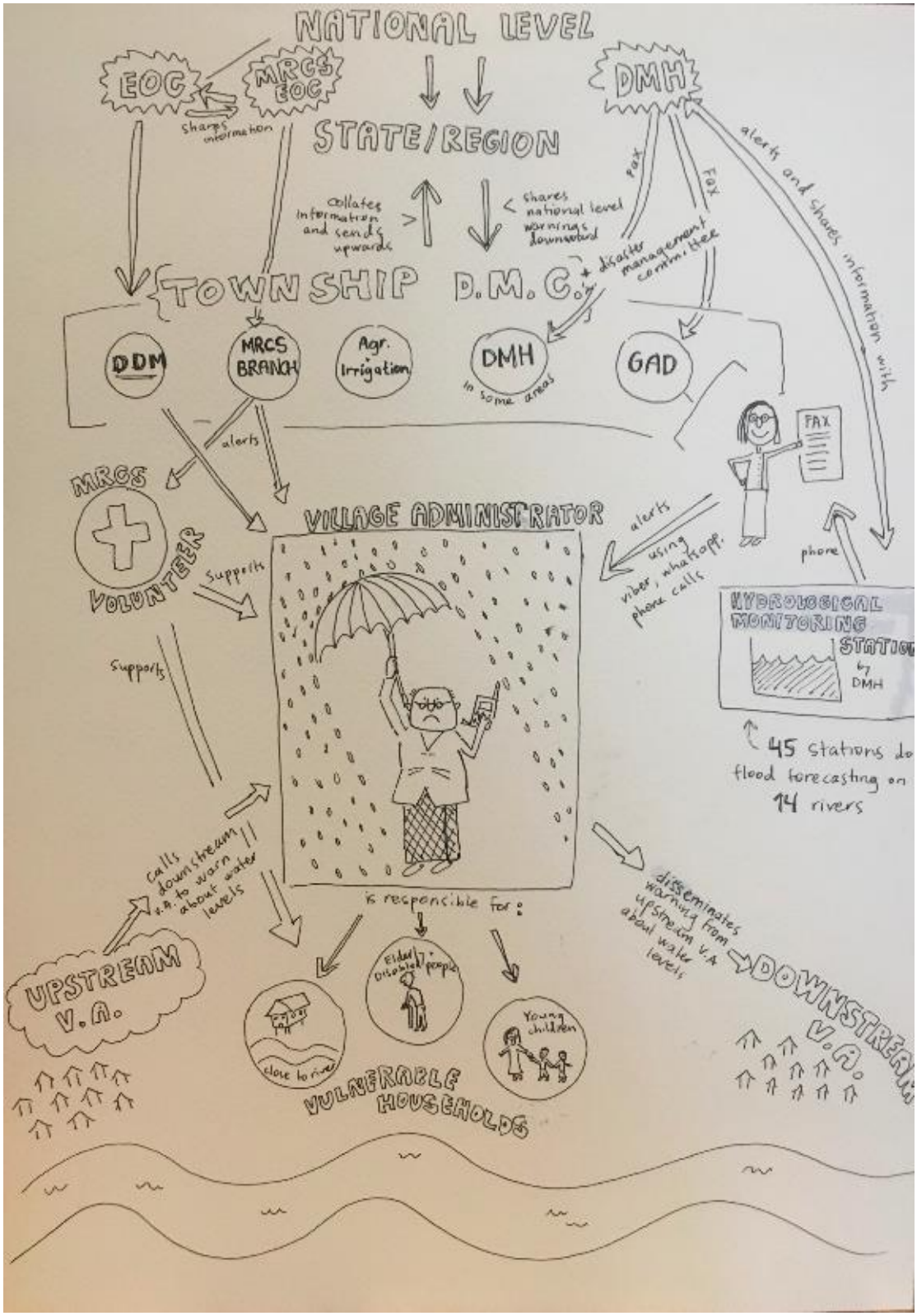

Figure 3. Schema of early warning dissemination (Source: Scoping study, p. 8). *Corrigendum: DMH also reports to National Disaster Management Committee (NDMC).*

According to a Red Cross representative, DMH cyclone forecasts allow normally for ample warning; however, the exact location to be hit and the strength of the storm are uncertainties, which need to be taken into account. Once the Meteorological Division predicts a cyclone of minimum category 2 to approach a determined geographical area within 8-36 hours should be enough warning for the MRCS EOC to alert MRCS branches. The triggers presented in table 4 have been established in MRCS the contingency plan.

Table 4. MRCS alert levels, notifications and triggers for river floods and cyclones according contingency plan.

Alert Level	EOC Position	Notification and Trigger	
		Flood	Storm/Cyclone
Level 1	Normal	Flood warning received with potential widespread area, may reach danger level in next (1) day	Cyclone alert: cyclonic storm with category 2 conditions approach Myanmar possible within 48 hours
Level 2	Stand-by	Reach danger level with over 50,000 potential affected population	- Cyclone warning: cyclonic storm conditions possible within 48 hours. - Category: 4 or 5m (Colour code: **Orange**)
Level 3	Activate	Flood in low land area with over 50,000 potential affected population	- Landfall outlook: category cyclonic storm conditions expected within 12 hours. - Category: 4 or 5 (Colour code: **Red**)
Level 4	Operate	impact of the flood is at the level of Large-scale disaster.	- Storm surge and torrential rain brought by hit flush flood at large-scale disaster.

6.2.2 River flood

Based on the scoping study, river flood has high feasibility for FbA; and it has the longest lead-time, and MRCS sees it as priority hazard. DMH issues several forecasts relevant for river floods, as shown in Table 5. DMH uses the ECMWF flood forecast model, River Stage Correlation Method, HBV Model, Hydrologic Modelling System (HEC-HMS) and has 20 water level stations across Myanmar. Flood forecasts and warnings are not verified. During the feasibility assessment, it was not possible to further analyse the status of river monitoring stations or forecasts.

Table 5. Relevant flood forecasts issued by DMH (Source: Scoping study)

Type of forecast	Time of issuance	Lead time
General long-range water level forecast	April 28	Monsoon season
Seasonal water-level forecast	April 28, June 28, August 28, October 28	Early, Mid, Late Monsoon, Winter Monsoon
Monthly water-level forecast	April 28, May 28, June 28, July 28, August 28, September 28, October 28	1 month
10 days water-level forecast	8th, 18th, 28th of every month	10 days
Daily forecast	Daily	1 day
Flood warning	When water levels at hydrological observation stations reach within one meter of danger level	3-1 day

The SEADRIF study contains a comparison of river flood forecasts from the Global Flood Awareness System (GloFAS) produced by the ECMWF are and the Global Flood Forecasting Information System (GLOFFIS) produced by Deltares, A Dutch independent research institute with a focus on water and subsurface. The study concludes that

> *"lack of data precludes a full robust analysis of forecast skill, however the analysis carried out leads to the following conclusions:*

- *Both GloFAS and GLOFFIS have difficulty simulating 1 in 2 year return period flows or higher, although GloFAS performance is better than GLOFFIS*
- *Where discharge data is available for direct verification in Myanmar, GloFAS reforecasts achieve a false alarm ratio of 40% for 1 in 2 year return period events over select stations. The forecast skill is lower for 1 in 5 year events.*
- *[…] there is a large variation in discharge forecast skill across the […], indicating that the potential for forecast-based action depends highly on the location within the country."*

Figure 7 shows the discharge observation stations, as provided in the SEADRIF report.

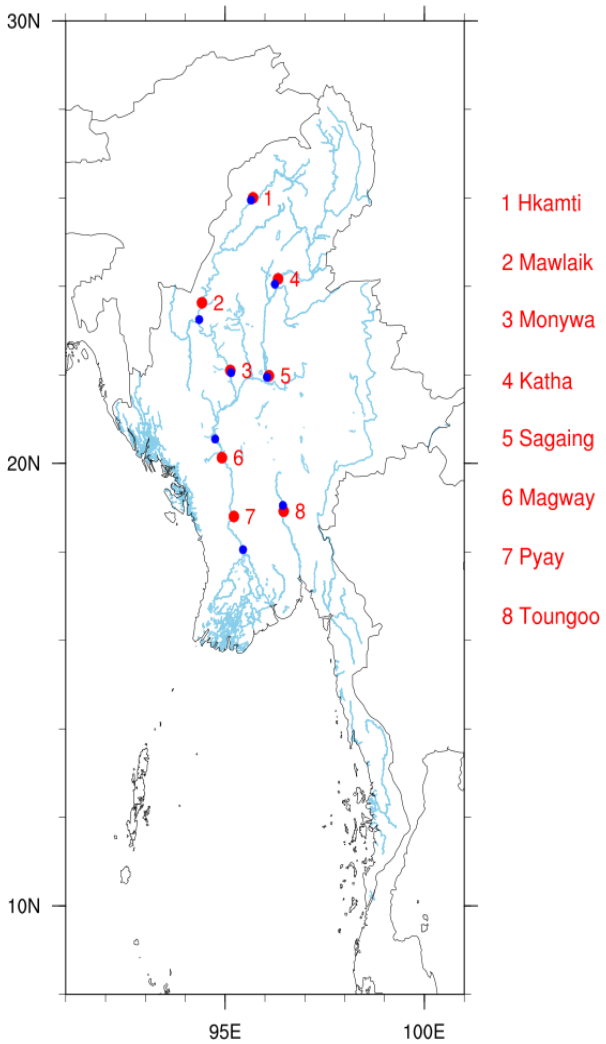

Figure 4. Stations providing discharge observation records to GRDC (red). Blue dots indicate the nearest GloFAS reporting point to each station and light blue shows the major river network of Myanmar.

6.2.3 Tropical Cyclone forecasting

DMH issues tropic cyclone (TC) forecasts and early warnings based on the forecast information issued by the Tropical Cyclone Regional Specialized Meteorological Centre (RSMC) of the Indian Meteorological Department based in New Delhi. Regional Specialized Meteorological Centres are responsible for detecting tropical cyclones in their designated area of responsibility, and for providing basic information about the systems present and their forecast position, movement and intensity. The RSMC New Delhi is responsible for tracking tropical cyclones in the North Indian basin. As already noted, it is not possible to assess the tropical cyclone forecast skill issued by DMH. However, currently, DMH warnings are not place-based, do not overlay local vulnerability or exposure data, and do not suggest early actions. According to DM staff, because this information does not suggest preventative actions or forecast *where* impacts will manifest, it is challenging to use and disseminate this information at branch level for effective early action (SEADRIF study).

However, All RSMC use a range of internal and external TC forecasts, including products from the European Centre for Medium Range Weather Forecasts (ECMWF) to produce their advisories. In the SEADRIF initiative, the Red Cross Red Crescent Climate Centre undertook a study to verify extreme rainfall, tropical cyclones, flood and storm surge forecasts over Myanmar from the ECMWF. Regarding TC forecasts, the study concludes that

> *"Whilst errors in cyclone position are relatively small, forecasting intensity is more difficult. Models in particular have difficulty capturing rapid intensification events. When a tropical cyclone has formed, the probabilities provided in the ECMWF track forecast are highly reliable and only slightly overconfident. For example, once a cyclone has formed, to act only in the region of 90% strike probability from a track forecast would result in a 20% hit rate and a 16% chance of action in vain. In addition to the track forecast a tropical cyclone activity product is also available, which attempts to forecast the probability of formation of tropical cyclones as well as the future position of existing cyclones. This product is relatively reliable for forecasts less than a week ahead for North Indian Ocean cyclones affecting Myanmar, but becomes quite overconfident beyond this.*
>
> *The action window between cyclone formation and landfall depends on the precise region of genesis of each cyclone. […] generally North Indian Ocean cyclones make landfall no more than three days after formation."*

6.2.4 Drought

On drought, the scoping study concludes that

> *"drought is rising on the agenda of hazards in Myanmar. During the El Nino period of 2014 and 2015, the dry zone of Central Myanmar (which represents about 10% of Myanmar's landmass) experienced the driest years on record.*[19]
>
> *The DMH has a special centre dedicated to drought monitoring which is based in Mandalay, which we were not able to speak with during this scoping study. According to KIIs [key informant interviews] based in Naypyidaw, the drought center issues seasonal forecasts but does not issue warnings for drought management. The Ministry of Agriculture and Irrigation also takes a role in monitoring drought, though we were not able to establish how responsibilities are divided between DMH and the Ministry of Agriculture and Irrigation because our KIIs were restricted to Yangon and Naypyidaw. In the DMH in Naypyidaw, the water level monitoring system used for floods is also applied for droughts: the DMH issues Minimum Alert Water Levels and Bulletins for seven stations in the dry zone area during low flow periods."*

[19] ESCAP (2019) Ready for the Dry Years: Building Resilience to drought in South-East Asia. Bangkok: United Nations ESCAP.

During the feasibility assessment, it was not possible to further assess the feasibility for drought FbA, but the ECHO project has preliminary assessed the forecast feasibility for drought and concludes it to be weak. According to FAO, "*there is no drought forecast and warning yet, [but] DMH is monitoring meteorological drought based on rainfall, temperature and [provides an] agro-meteorological bulletin. […] There is a need for DMH to improve the accuracy of the forecast especially.* "

The National Drought Monitoring Centre in Mandalay is analysing drought by using Satellite based (MODIS) Normalized Difference Vegetation Index[20]. The centre currently issues the ''Monsoon season (May- Oct) Meteorological Drought Report" based on the rainfall conditions to head office at Nay Pyi Taw. There are totally 50 drought monitoring stations and the centre analyses drought conditions within the period of monsoon season annually. (FAO)

Although not currently in use by DMH or other government partners, remote sensing products like the Standardized Precipitation Index, soil moisture and Normalized Difference Vegetation Index are potentially useful for drought monitoring. These are some of the potential products that could be used for drought assessment in Myanmar (WFP).

6.2.5 Heat Wave

Based on a quick assessment for heatwave FbA and EAP, DMH forecasts heatwave three days ahead. In addition, they forecast temperatures up to 10 days before. This enables a good lead time (up to 10 days) to carry out actions, in addition to establish a stop mechanism. With a lead time from 1 to 3 days, the accuracy of heatwave forecasting should be around 70 %, since in the country the activity of low-pressure systems is quite predictable. More detailed information regarding heatwave FbA is given in a separate annex.

6.3 General risk data

The availability of disaster risk data has been assessed by consolidating available disaster risk, exposure and vulnerability information, and by identifying gaps in the available information. Plenty of hazard and risk data and information has been produced for Myanmar to be potentially used in a national FbA system. In January 2020, The Myanmar Unified Platform for Disaster Risk Application (MUDRA)[21] was launched. The MUDRA platform offers a possibility to overlay various hazard, exposure and vulnerability data on maps. Currently, data cover riverine floods, cyclone winds and storm surge based on historical climate information and based on three climate scenarios. More hazards are planned to be included in the future. Population exposure and vulnerability data have been collected from 2014 census, and the agriculture and critical infrastructure data from various sources. Data are presented at State/Region, District and Township levels. In 2019, UN OCHA led the development of the Myanmar sub-national INFORM Index working with multiple stakeholders who validated the index at a workshop in Nay Pyi Taw on 9 October 2018. The INFORM model is presented at township level (Adm. 3). The data can be freely downloaded from the INFORM website [22]. Based on the Inform Index methodology (See website[23]), WFP compiled Vulnerability and risk analysis in June 2020 (draft form during the finalisation of this report).

UNICEF has also done the Child-Centred Risk Assessment[24] which has plenty of risk maps and show areas of high vulnerability, not only for children. The risk assessment has been approved by the government and available in English and Myanmar language. The analysis explicitly places children at the centre of a national risk assessment to understand where children experience the greatest risk.

[20] https://earthdata.nasa.gov/earth-observation-data/near-real-time/hazards-and-disasters/vegetation
[21] https://www.mudra-ddm.info/
[22] https://drmkc.jrc.ec.europa.eu/inform-index/INFORM-Subnational-Risk/Myanmar
[23] https://drmkc.jrc.ec.europa.eu/inform-index/INFORM-Risk/Methodology
[24] https://www.unicef.org/myanmar/sites/unicef.org.myanmar/files/2020-02/Myanmar%20Child-Centered%20Risk%20Assessment_English%20.pdf

The assessment integrates various data sources into a single metric. The assessment overlays hazard, risk information, population exposure, climate change vulnerability, socio-economic vulnerability, and local capacity to absorb, and recover from, disaster. The assessment demonstrates the utility of using indicators related to children's development and welfare as the key measures of vulnerability in the larger population. The outcome of the analysis is a child-centred risk index ranking the 325 townships of Myanmar compiled using 32 indicators.

Disaster impacts (loss and damage) data is stored at the Myanmar Disaster Loss and Damage Database (MDLD)[25]. The database is based on the UN Desinventar global database and DDM is responsible for uploading the data in Myanmar. Hazards recorded in the database relevant for the feasibility study are wind, flood, storm, landslide, flash flood, river flood, cyclone, drought and heatwaves. The first recorded event dates back to 1952. Data are presented at the township level, and potentially includes a more precise location, the number of deaths, injured, missing, victims, affected, relocated and evacuated people, houses destroyed and damaged, monetary losses in USD and Kyat, Education centres and hospitals (but does not clarify the extent of damage/loss), crop damage in hectares and lost cattle, and damages in roads. As of now the impact data is not disaggregated based on sex, age or other demographic factor, but plans exist to collect data at a more disaggregated level in the future. MDLD and MUDRA do not communicate at the moment, but technically, the possibility to incorporate MDLD data in MUDRA exists (interview with DDM).

The Myanmar Information Management Unit (MIMU)[26] provides information management services to strengthen analysis and decision-making of the humanitarian and development community in Myanmar. It maintains a common data and information repository with data from various sources on all sectors, countrywide, at the lowest administrative unit for which it is available. Data available in MIMU includes, for instance, "the "Who does What, Where" database, or 3W, which maintains updated information on WHO (which organizations) are doing WHAT (which activities), WHERE (in which locations) to enable organizations and donors to improve the targeting of beneficiaries to ensure that humanitarian, development and peace-focused needs are met.[27]

Based on the EM-DAT International Disaster Database, tropical cyclones are the most damaging hazard measured in terms of the number of casualties, other affected people (injured, affected, homeless), and economic damage. However, the result is heavily affected by the 2008 Cyclone Nargis. When Nargis is removed from the data, the combination of riverine floods and less specific hydrological hazard becomes the deadliest, affecting and economically damaging hazard. Tropical cyclones are next, followed by landslide, convective storm and flash flood measured in number of people affected; although flash floods kill more people than convective storms. Economic damage has not been recorded for the three smaller scale hazards. The INFORM Index for Risk Management[28] assesses that out of the hazards mentioned, Myanmar is exposed, in the order of importance, to floods, tropical cyclones, epidemics and drought. Forest fires and landslides are not included.

Based on the MUDRA data and analysis, one-third of the population exposed to riverine floods and storm surge from tropical cyclones live in the Ayeyarwady region. More than two-thirds of the monetary damage occur in Ayeyarwady, Rakhine and Yangon. The scoping study identified river floods with highest feasibility for FbA, tropical cyclones with medium feasibility, and drought was mentioned to require further study.

6.3.1 Floods

The hazard profile of 2009 identifies four types of floods occurring: i) Riverine floods in the river delta; ii) flash floods in the upper reaches of the river systems, normally the mountainous areas, caused by

[25] http://www.mdld-rrd.gov.mm/DesInventar/main.jsp?countrycode=mmr
[26] https://themimu.info/
[27] https://themimu.info/3w-maps-and-reports
[28] https://drmkc.jrc.ec.europa.eu/inform-index/Countries/Country-Profile-Map#

the heavy rainfall striking at head water region for considerable period of 1-3 days; iii) localized floods in urban area due to a combination of factors such as cloudburst, saturated soil, poor infiltration rates and inadequate or poorly built infrastructure (such as blocked drains) and in rural areas due to the breakage of water resistance structures as dams, dykes and levees; and iv) flooding due to cyclone and storm surge in the coastal areas.

The majority of big cities and towns, economically strategic places in the country, are usually situated along four major rivers, namely Ayeyarwady/Irrawaddy, Chindwin, Sittaung and Thanlwin. Though water retaining and flood control structures are being built in areas considered vulnerable to floods, with the increased population in the big cities, development of living quarters and settlement lands has been encroaching upon natural catchment areas. Flooding leads to loss of lives and properties, damage to critical infrastructure, economic loss and health related problems such as outbreak of water borne diseases when the lakes, ponds and reservoirs get contaminated. (Hazard profile 2009).

Different types of floods can be seen in different areas of Myanmar:

- Riverine floods are the most common among all and occur when the monsoon troughs or low-pressure waves superimpose on the general monsoon pattern resulting in intense rainfall over strategic areas of the river catchments.
- In Ayeyarwady/Irrawaddy and Chindwin rivers, the flooding occurs when intense rain persists for at least 3 days over northern Myanmar, the headwaters of the rivers. Most of the flooding in the lower Ayeyarwady and the delta is by Chindwin, when its flood coincides with upper Ayeyarwady floods.
- In the Sittaung and Thanlwin rivers, floods are caused by rainfall associated with low-pressure waves (the remnants of typhoons and tropical storms of South China Sea) moving from east to west across the country.
- In addition, other rivers such as the Bago and Dokethawady (tributary of Ayeyarwady) also set off major floods.

MUDRA provides riverine flood hazard maps for estimated 5, 10, 20, 50 and 100-year return periods (see Fig 2 as an example). For instance, FbA by the DREF approves EAPs with approximately 5-year hazard return periods. The challenge with using MUDRA directly for selecting the hazard return period is that the exposure maps are provided for yearly riverine flood exposure (see Fig 3) and potential annual impact, not showing the exposure and potential damage for the different return periods. Therefore, the selection of the return period for EAP requires collecting detailed historical impact data.

Figure 5. Screenshot from the MUDRA platform showing river flood locations based on 5-year return period historical data. Flood maps for MUDRA were produced by DMH. The models used were 1D2D SOBEK hydraulic model Ayeyarwady delta + National scale flood model: Distributed hydrological model based on WFLOW-SMB (Simple Bucket Model, CSIRO). The limitations Accuracy of the modelled coastal flood maps, in terms of water depth is estimated to be between 1 and 2m.[29]

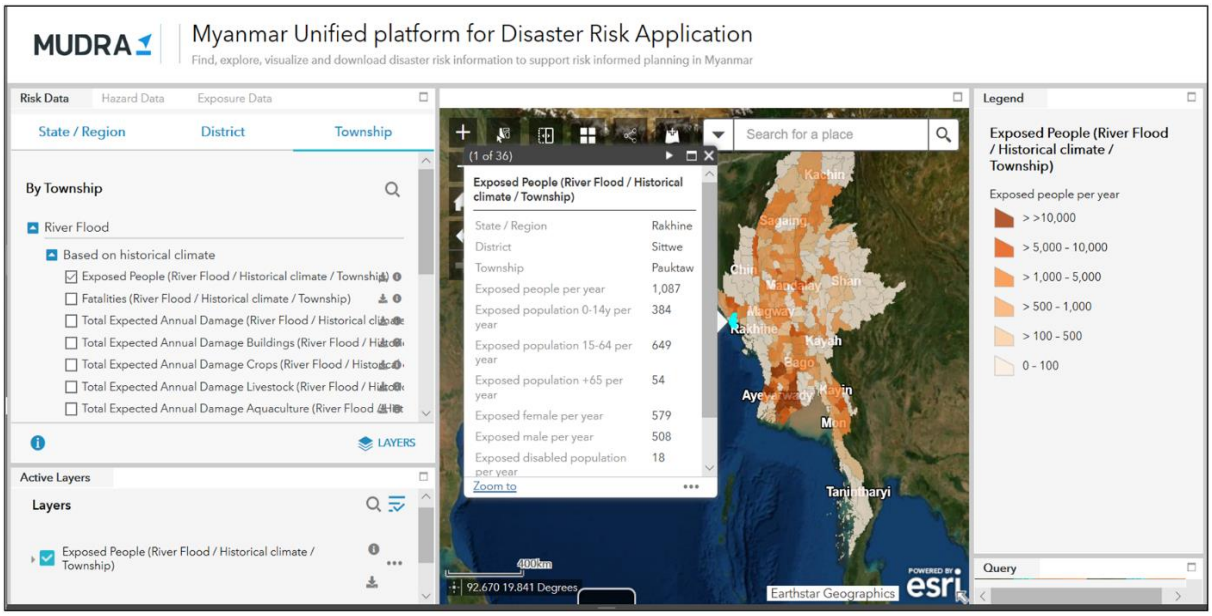

Figure 6. Screenshot from the MUDRA platform showing yearly amount of people exposed to riverine floods at township level based on historical data. The results are Risk calculations with FIAT; Deltares open source toolset for flood risk assessments[30]

6.3.2 Tropical cyclones

Myanmar is exposed to tropical cyclones. The cyclone is accompanied by three destructive forces: strong winds (as high as 120 mph), heavy rains (more than 5 inches in 24 hours) and storm surges (depends on topography.). Storm surge is the main cause of damage, which depends on the vulnerability of the place of landfall. Previous frequency of cyclones that made landfall on the Myanmar coast was once in approximately three years, but since 2000, cyclones crossed the Myanmar coast every year. (Hazard profile 2009.) For cyclones, MUDRA provides similar return period estimates as for riverine floods; strong winds and storm surge are given separately. Also, yearly exposure and total expected annual monetary damage, and building and agriculture damage data is provided based on the Deltares FIAT-model.

Severe cyclones occur during the pre-monsoon period of April to May and post-monsoon period of October to December. The tropical storms that form during the monsoon period June to September are weak and have a short life span. In the post-monsoon period, remnants of typhoons in the South China Sea regenerate into storms in the Bay of Bengal. Hence, the Bay of Bengal has two cyclone seasons annually, approximately a month before and three months after the South-West monsoon. May can be considered to have the highest probability for a cyclone to cross the Myanmar coast. However, the post-monsoon period is also important, considering the fact that the cyclone in November 1970 in Bangladesh claimed 300,000 lives. (Hazard Profile of Myanmar, 2009)

[29] *https://app.mudra-ddm.info/*

[30] https://publicwiki.deltares.nl/display/DFIAT/Delft-FIAT+Home Pauktaw township has been chosen only for illustrative purposes and does not imply any preference or priority in the feasibility study.

For FbA, the cyclone track is very important as even for the same intensity of cyclones, the damage varies depending on the exposure (e.g. topography) vulnerability (e.g. population density) and capacity (such as knowledge and experience of cyclones) of the areas falling under the cyclone. Furthermore, the duration of landfall (for instance in Cyclone Mala 10 hours and Cyclone Nargis 24 hours), greatly affects the level of impacts. (Hazard report 2009)

As noted in the Hazard report 2009, cyclone damage is heavily affected by exposure and vulnerability: "The significant differences between the two cases are: the high population density, poor knowledge of storm surge in the community, the topography i.e. flat land, and almost no place which can act as cyclone and storm surge shelter and the evacuation route.".

6.3.3 Drought

The Dry zone of Myanmar is located in the central part of the the country in Magway, Mandalay and Sagaing (lower) Divisions and covers approximately 10 percent of the total area. Fifty-four Townships spread across 13 Districts in 3 Divisions fall under the Dry zone as per the Dry Zone Greening department. Some other reports have identified 60 Townships in the dry zone. (Hazard report 2009).

Table: 6 Divisions and Townships, and extent of dry zone

Division	Total Townships	Townships in Dry zone	Percentage of Division in dry zone	Are of Township in Dry zone (sq. mile)
Sagaing	38	19	20.22	7,388.5
Mandalay	39	23	68.00	8,872.0
Magway	25	18	56.47	9,819.5
Total	**102**	**60**	**-**	**26,080**

Approximately 35 percent of the cultivable land is in the Dry zone. Rice being the main crop is cultivated on approximately 60 percent of the cultivable land. Other gain crops like millet and maize cover 5 percent, oil crops account for 15 percent, legumes for 7 percent and rest include fruits, rubber, tea, etc. The dry zone is the most important vegetable oil production region, which includes sesame and sunflower. Other important crops include rice, millet, cotton and tobacco. All suitable land is cultivated and there is minimal scope for expansion. The farmers of this zone are mainly commercial, cultivating a variety of crops in a double cropping and rotational system. Intercropping is widely practiced in Chaung U, Sagaing and Kyaukpandaung, Mandalay while less in Magway. (Hazard report 2009)

For the FbA system, MUDRA offers the possibility to identify the most hazard exposed locations with various return levels at township-level based on population, critical infrastructure, housing, crops, livestock and aquaculture. Population data includes certain factors that can be used to identify vulnerabilities. Some uncertainty and inaccuracy in the data exist: Population data is from 2014 census so there is a possibility that it is out-dated; some of the identified inaccuracies have been stated in MUDRA metadata. From risk information perspective, MUDRA can be a considered a valuable source of data and information in case a national level FbA system is planned. Follow-up of MUDRA development is highly recommended.

Drought frequency/return period assessment has not been done, so it would require further analysis.

6.3.4 Heat Wave

The DMH issues a heatwave warning if high temperatures are sustained for three consecutive days, with 7-8°C above normal temperature No humidity is used. In order to follow the FbA approach, the calculation of a specific trigger is needed. If possible, it should be based on impacts, preferably added mortality or added morbidity (i.e. hospitalization rate) correlated with heatwave intensity (or duration). If this is not possible, it should be based on percentile of historical data to indicate the most extreme events. It is possible to get the historical data since the DMH data on temperatures is available in electronic database since 1987. Rapid urbanization, climate change, and their effect on recent sharp increases of temperature, should be considered when using historical data. More information on heatwaves is given in a separate annex.

7 EARLY ACTIONS PER HAZARD - IDENTIFICATION AND FEASIBILITY

In practice, two sets of early action modalities are currently under consideration owing to the consortium partner experience and responsibilities. For the UN partners, social protection measures in the form of SRSP (already covered in the report), is the main early action identified.

At MRCS, national HQ takes proactive action on level-1 of storm/cyclone alert level based on set triggers: prepare emergency plan of action with FbA and submit donors for imminent DREF with aims to enable MRCS accesses to humanitarian funding for early action based on in-depth forecast information and risk analysis. At the stage of level-4 alert for storm/cyclone, MRCS prepares comprehensive emergency plan of action and submits to donors for response.

For MRCS, due to their mandate and experience, the two key early actions identified are disseminating early warning information at the village/ward level and supporting the authorities in evacuation in various ways. However, MRCS has experience in cash distributions in disaster response, which makes it a potential early action as well, but requires a case-by-case feasibility assessment at the township and state levels. Furthermore, some experience from other, already accepted EAPs from other countries is given. Secondary knowledge on the feasibility regarding CBT is also used.

It was not possible to further assess the feasibility to implement the planned early actions due to 1) the lack of verification information from DMH forecasts so the accurate lead time for the chosen hazards was unknown; and 2) the lack of information on the government willingness and capabilities, and on the capacity of the consortium organisations to implement effective early actions given the uncertain lead-time.

7.1 Feasibility of Cash-based Transfers as Early Action

The WFP Cash Transfer Programming - Preparedness Data Profiles Disaster-Prone States - Myanmar report from June 2019 concludes the following regarding the feasibility of CTP in Myanmar: " ... [S]tudies have clearly shown that CTP is feasible in Myanmar, in principle. This general observation does not imply that each new intervention would not require a specific quick-impact context-related feasibility assessment. However, the baseline is: CTP is clearly an option. An important point, emerging from the numerous meetings held with stakeholders in each of the States[31] covered by this "CTP Preparedness Profiles" document, is that local communities, grass-root organizations, private sector and Authorities form a resilient network that would be at the forefront of relief operations in the immediate aftermath of a catastrophic event. In such a context most of the emergency relief would

[31] Ayeyarwady, Bago, Magway, Mandalay, Rakhine & Sagaing

be provided in-kind. Operations implemented by or through non-local stakeholders using CTP as a delivery mechanism could henceforth meaningfully be launched in an early recovery phase."

As noted in the WFP CTP report, MRCS has experience in CBT, but according to the SEADRIF feasibility study, "previous flood responses have used cash, but this is still a slow modality. MRCS is looking into developing agreements with financial service providers in 2019. MRCS believes this will enable a much faster response to more beneficiaries in the future. [...] Currently cash assistance arrives 2 – 3 months after disaster event due to lengthy assessment periods and lack of agreements with supplier". Furthermore, for MRCS all cash distributions, whether in complex or stable contexts, need to be approved by the township or state/region level. Furthermore, there was reticence around using cash; Village Administrators were concerned that people would use money for food, although it was not clear why this might be problematic (the scoping study). In 2020, MRCS established a service agreement with AYA Bank for mobile cash grants distributions.

7.2 Other modalities as Early Actions

The scoping study confirmed that "although most stakeholders' conception of early action to floods/cyclones was confined to **evacuation** of vulnerable people, a few ideas for early actions were suggested at the Township Administrator and Village Administrator level." The scoping study listed the following potential early actions:

1. **"Help secure homes from thieves by distributing locks in order to encourage people to evacuate"** as some people do not want to evacuate because they are concerned that their houses would not be safe while they are away." To comment, distributing locks as an early action is possible with MRCS volunteers, but this would require further assessment if this is the case in all communities.
2. "**Fortify homes or evacuation centres** (though unclear how this could be done within short lead times)". To comment, fortifying homes and/or evacuation centres is a measure that should be done prior to any forecast as a disaster risk reduction measure.
3. **"Early harvesting for rice in rural areas**, if the hazard falls within a window when this makes sense in the crop cycle. New machinery has enabled farmers to harvest within a day, but when early harvesting still produces a viable crop requires further study." To comment, however, as was discussed during the field visits during the feasibility study mission, for example floods in Myanmar often happen during such a time of the cultivation cycle that early harvesting is not a viable option. Therefore, the feasibility for early harvesting should be carefully examined within each community. The timing of the cyclone is crucial if early harvesting is considered as early action. The post-monsoon season with a high TC probability coincides with the paddy harvesting, so MRCS supporting paddy harvesting in rural areas would require development in MRCS capacity in supporting this, as the capacity of MRCS and the volunteers is low. For river floods, the feasibility of early harvesting needs to be further analysed.
4. **"**For heat waves and floods, a potential early action could be **to provide factory employers and vulnerable street workers with information about protecting themselves / their employees**." Heat Waves are discussed in a separate annex to this feasibility study.

The scoping study concludes that "generally, ideas about early action were relatively narrow. With more trainings and consultations, the breadth of potential early actions is likely to expand"

Discussions held in Hinthada township and Gaung Zay Kyun and Auk Ywas Lay villages during the feasibility study concluded that evacuation was considered the most important early action by the MRCS.

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APPENDIX 1: DEFINITIONS FOR FBA / EWEA /SRSP

Different terms have been and are used by the consortium members to describe the aim of FbA. *Early Warning Early Action (EWEA)* has been used by FAO, and the *International Federation of Red Cross and Red Crescent Societies (IFRC*) to refer to the use of weather and climate forecasts to trigger action before the hazard hits a community. More recently, all these approaches have been bundled under the concept of Anticipatory Action.

Regardless of the name and form, what is common to these approaches is the use of impact-based hydro-meteorological and climate forecasts to trigger funding and action prior to a disaster to reduce the impacts of natural hazards on "vulnerable people and their livelihoods, improve the effectiveness of emergency preparedness, response and recovery efforts, and reduce the humanitarian burden" (Wilkinson et al. 2018: 7). FbF and FbA can be considered a more structured, upscaled form of EWEA, as it includes defining forecast thresholds to trigger financing and pre-defined early actions. More precisely, *Forecast-based Financing (FbF)* allows access to ex-ante funds to be released by a trigger to implement early actions. FbF and subsequent Forecast based Actions (FbAs), or early actions, are taken based on risk information and impact-based forecasts to determine when and where the impact of a forecasted hazard is highest to mitigate and prevent the impacts associated with hydro-meteorological events. The goal of FbA is to anticipate disasters, prevent their impacts, and reduce human suffering and losses. The forecasts, risk analyses, the related early actions and roles, and responsibilities of the different stakeholders are described in an *Early Action Protocol (EAP),* which will be developed during the system development.

Early Warning Early Action (EWEA) term has been used by three organisations participating in the consortium: WFP, FAO and the Red Cross Red Crescent movement. Recommendation 2 suggests defining a common term when working in Myanmar and together with the government. The consortium members have their own concepts when talking about the topic internally and e.g. to their donors. Recommendation 2 does not mean to change this vocabulary, but to encourage finding a common term in Myanmar. *(Recommendation 2)*

Early Warning Early Action (EWEA) is defined by the International Federation of Red Cross and Red Crescent Societies (IFRC) as regularly taking action, prior to a disaster, utilizing scientific information of all timescales. This context exemplifies a dynamic process of short-, medium-, and long-term preparedness and puts into perspective the paradigm shift from responding to a disaster to responding to forecast/warning/risk information, for enhanced preparedness and for avoidance of recurrent losses. (MRCS EWEA manual). FAO, with a focus on agriculture and food security, uses EWEA to describe n approach which consists of early warnings, early actions, and financing mechanism[32]. The Red Cross Red Crescent movement calls the approach including the financing mechanism as Forecast-based Financing.

Forecast-based Financing (FbF) is a programme that enables access to humanitarian funding for early action based on in-depth forecast information and risk analysis. The goal of FbF is to anticipate disasters, prevent their impact, if possible, and reduce human suffering and losses.

A key element of FbF is that the allocation of financial resources is agreed in advance, together with the specific forecast threshold that triggers the release of those resources for the implementation of early actions. The roles and responsibilities of everyone involved in implementing these actions are defined in the Early Action Protocol (EAP). This ensures the full commitment of implementation among the involved stakeholders.[33]

[32] https://reliefweb.int/sites/reliefweb.int/files/resources/ca3127en.pdf
[33] https://www.forecast-based-financing.org/about/

Forecast-based (Early) Action (FbA) is a system, or initiatives, that link the triggers to subsequent early actions taken based on forecast and risk information to mitigate and prevent the impacts associated with hydro-meteorological events. They are either funded through the automatically triggered *Forecast-based Financing (FbF)* mechanism or are actions that do not incur any cost. The goal of FbA is to anticipate disasters, prevent their impacts on vulnerable people and their livelihoods, and reduce human suffering and losses. The forecasts, risk analyses, budget and funding, the related early actions and roles, and responsibilities of the different stakeholders are described in an *Early Action Protocol (EAP),* which will be developed during the system development.

Shock-Responsive Social Protection is a social protection system that 'can respond flexibly in the event of an emergency' (OPM 2018), implicitly referring to covariate shocks –whether natural, economic or political - affecting large numbers of people and/or communities at once. Strategies for scaling up the social protection system include for example Design tweaks—making small adjustments to the design of the core programme; 'Piggybacking'—borrowing elements of an existing programme or system while delivering a separate emergency response; 'Vertical expansion'—topping up support to beneficiaries; 'Horizontal expansion'—temporarily extending support to new households; and Alignment of social protection and/or humanitarian interventions with one another (O'Brien et al. 2018). Sometimes a sixth option, 'refocusing'—retargeting an intervention without expanding it – is included in the strategy options but for example O'Brien et al. (Ibid.) are not considering it anymore as, rather than being an adaption of the social protection systems, it is perceived to be a resourcing strategy. As to the study at hand, UNICEF et al. (2018a) are also considering only the first five options.

APPENDIX 2 MEETINGS AND INTERVIEWS

Date 2020	Contact	Position	Location
Feb 4	Thin Thin Aung	Director, Finance Department (MRCS)	Yangon
Feb 4	Daw Ei Ei Htwe	Director, Logistics Department (MRCS)	Yangon
Feb 5	Daw Moe Thida Win	Deputy director, Disaster Management Department (MRCS)	Yangon
Feb 6	Rita Petralba	Disaster Risk Management Delegate (IFRC)	Yangon
Feb 6	Township Disaster Management Committee		Hinthada
Feb 7	Village Disaster Management Committee		Gaung Zay Kyun
Feb 7	Village Disaster Management Committee		Auk Ywas Lay
Feb 9	U Aung Naing Lwin	EOC Manager (MRCS)	Yangon
Feb 10	U Maung Maung Khin	DM technical person of NDMC	Yangon
Feb 10	Daw Ma Nandar Aung	Social Protection Specialist at SPCRM (Social Policy and Child Rights Monitoring)	Skype
Feb 11	Daw Myat Moe Thwe	Director, Coordination and Research Division, Department of Disaster Management, Ministry of Social Welfare, Relief and Resettlement	Nay Pyi Taw
Feb 13	Daw Swe Swe Win	Deputy Head of Programme (WFP)	Nay Pyi Taw
Feb 13	Paul Keen	Cooperation Coordinator Myanmar (ICRC)	Nay Pyi Taw
Feb 17	Daw Moe Thida Win	Deputy director, Disaster Management department (MRCS)	Yangon
Feb 17	Joy Singhal	Head of Delegation (IFRC)	Yangon
Feb 18	Reda Lebdahi	Emergency and Rehabilitation Coordinator (FAO)	Yangon
Feb 18	U Chit Kyaw	Technical Person of NDMC	Yangon
Feb 18	Thinn Hlaing Oo	National Disaster Risk Reduction Specialist (FAO)	Yangon
Feb 19	Dr. (Daw) Amaya Maw-Naing	Vice president (MRCS)	Yangon
Feb 19	Dr. U Nay Htet Lin	Deputy director, Health department (MRCS)	Yangon
Feb 19	Finbarr Sweeney	DRR Livelihood Delegate (American Red Cross)	Yangon
Feb 19	Manish Tewani	Country Representative (American Red Cross)	Yangon
Feb 19	Emilio Teijeira	Country Representative (German Red Cross)	Yangon
Feb 20	Daw San San Maw	Director, Disaster Management (MRCS)	Yangon
Feb 20	Viviane Fluck	CEA regional representative (IFRC)	Yangon
Feb 21	Daw Aye Aye Nyein	Head of Operations in Rakhine (MRCS)	Nay Pyi Taw
Feb 24	Andreas Fabricius	Country Manager (Danish Red Cross)	Yangon
Feb 24	Daniel Becker	UDRR Delegate (German Red Cross)	Yangon
Feb 26	Ei Thandar Bol	Community Based Disaster Risk Reduction and Early Action Planning Specialist (FAO)	Skype
Feb 26	Thet Htar Su Hlaing	National Meteorologist (FAO)	Skype
Feb 27	Amit Wadhwa	PRISM demonstration (WFP)	Skype