Development of a Concept of Operations (CONOPS)

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Presentation Outline

- What is a CONOPS?
- Why is a CONOPS Critical?
- Key Questions a CONOPS Answers (The "Who, What, When, Where, Why, How")
- Core Components of a CONOPS (The Checklist)
- The Strategic Framework (Vision & Goals)
- The Operational Framework (People, Processes, Technology)
- The Path Forward
- Key Takeaways & Conclusion

Goal: To Develop an End-to-End Agrometeorological actionable advisory service and Warning System

What is a CONOPS?

PURPOSE OF CONOPS

- A high-level, user-focused document (typically 15–20 pages) for policymakers
- Describes the desired operation of a future system in simple terminology
- It is the foundational step in the system engineering life cycle
- Forms a key part of the larger, more detailed Roadmap

A **document** describing the likely **operation of a future or existing system** in the **terminology** of its **users**, providing important information for the acquisition and/or development of that system. doi:10.1109/IEEESTD.1998.89424

Brings in Systems Engineering in the design of the "**system-of-systems**"

It's A first step in the process of developing a complex system, such as modernizing a National Meteorological and Hydrological Service (NMHS) to create a MHEWS that links data, models and systems.

Why do we need a CONOPS ?

•**Lowers Risk:** Reduces technical, political, and economic failure.

•**Builds Consensus:** A “system of systems” integrating a large number of stakeholders, and infrastructure to ensures all stakeholders understand and support the proposed system.

•**Guides Implementation:** Conceptualizes the fully integrated, end-to-end system to guide procurement and training.

•**Validates Success:** Provides a methodology to measure the system's performance once operational.

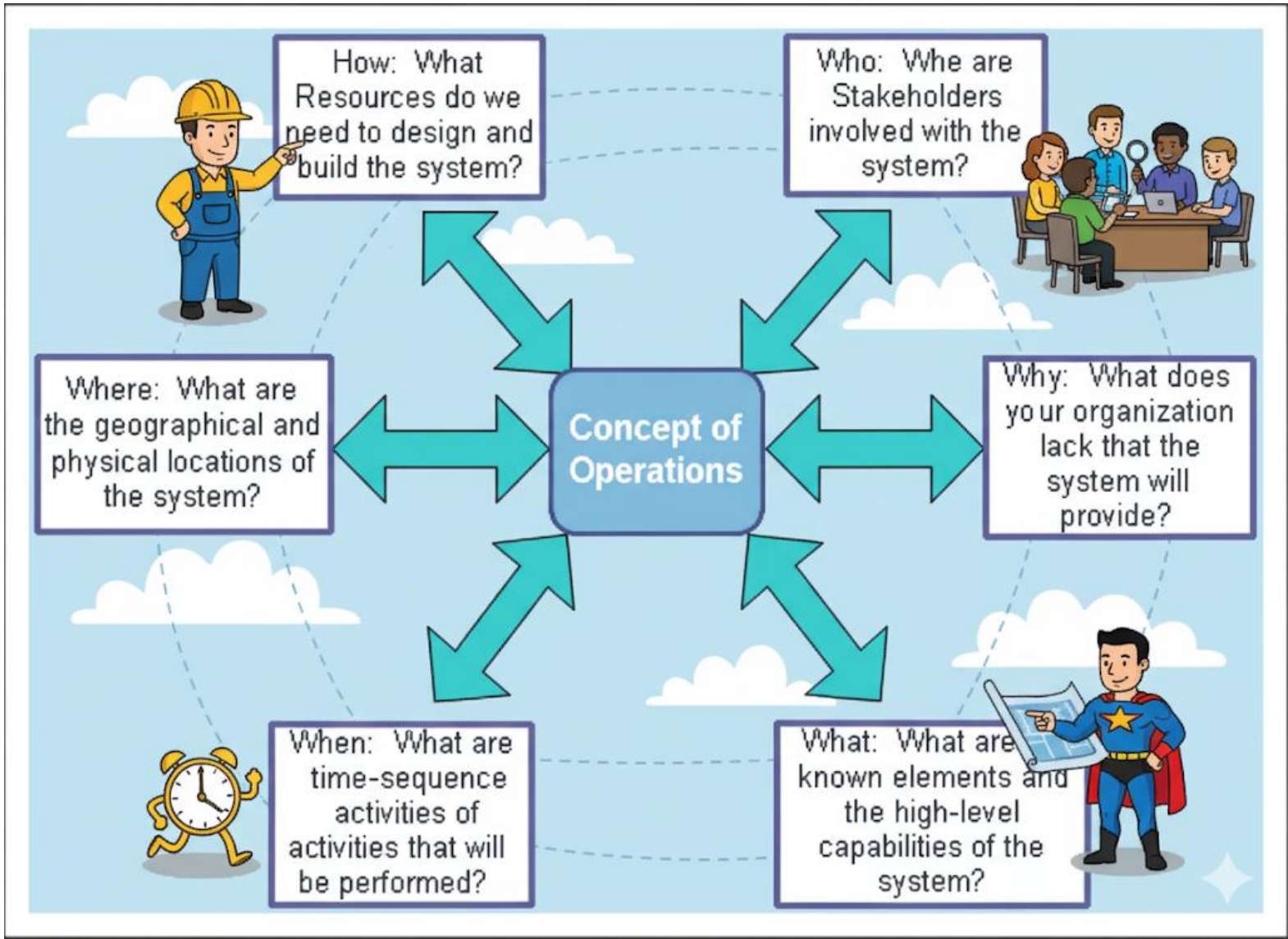
•**Facilitates Collaboration:** Helps different organizations with different procedures work together effectively.

The Core of a CONOPS: Answering the Key Questions

The CONOPS answers the questions:

- Who ?
- When?
- Why?
- What?
- Where?
- How?

for all stakeholders



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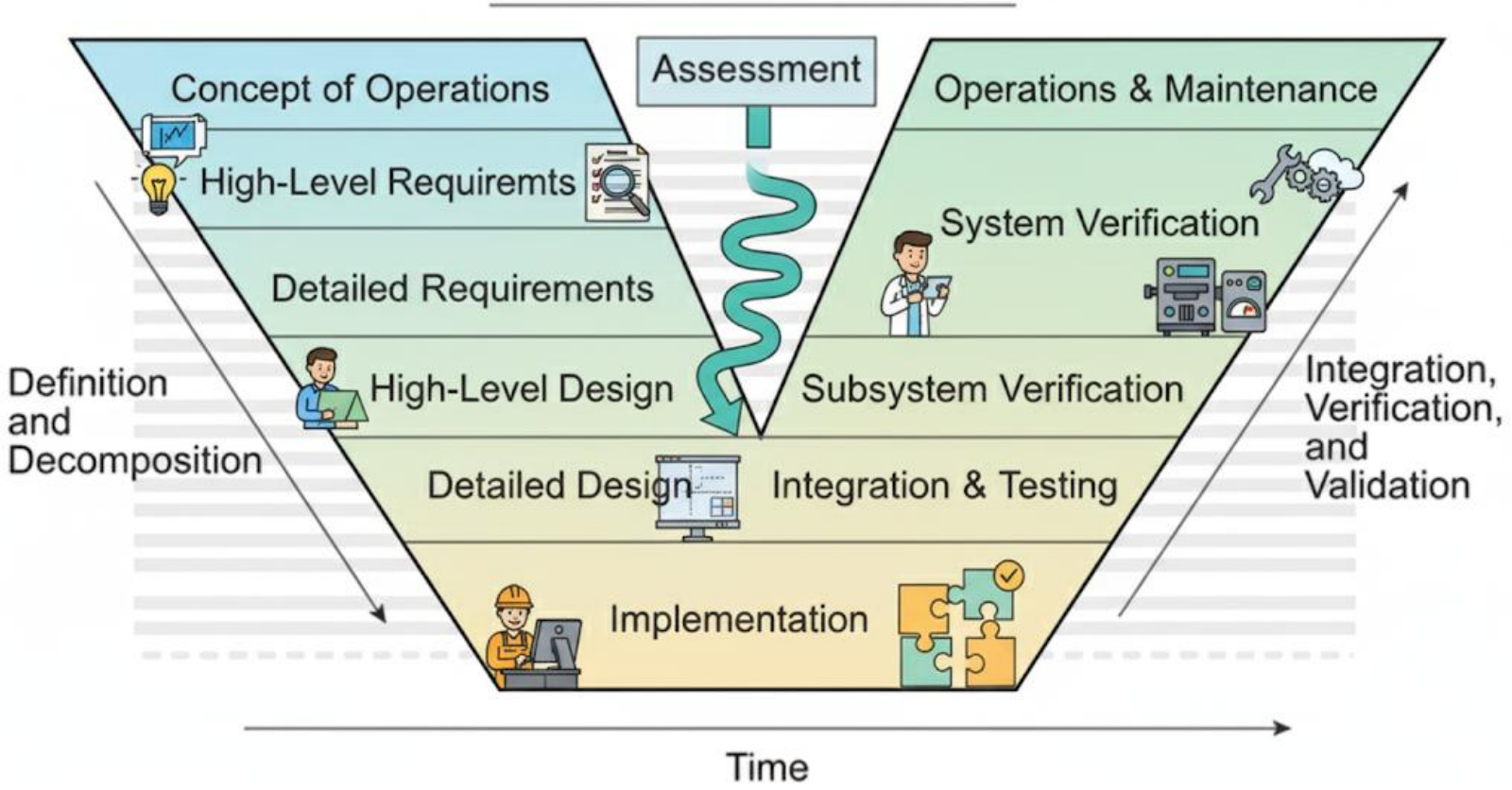
CONOPS viewed as part of the Systems Engineering Life Cycle Process

- CONOPS
- Requirements
- Design
- Implementation
- Integration and Testing
- System Verification
- Operation and Maintenance
- Assessment

CONOPS

Structure technical and interinstitutional linkages based on the requirements



Continue verification and integration of process and elements to improve agromet service

Institutions continue the operation based on the agreed CONOPS for agrometeorological service

It should be aligned to the national legislations

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Establishing the vision ….

During development of the CONOPS, a National CONOPS design Team will need to agree on a vision of the future agrometeorological service capabilities that will be within the capacity of the NMHS and MoA to achieve and that is sustainable.

Actually reaching this end state vision may take a number of years and future phases

Factors to consider when constructing CONOPS

- Why the new system is needed (risk and vulnerability assessments) and a brief overview of the system itself (such as observing systems, forecasting systems (flood, drought, pest and dieses, Impact Based Forecasting);
- The full system-of-systems life cycle (every component of the system) from deployment through disposal or replacement;
- Different aspects of system use including operations (routine and during a hazard event), maintenance, support and disposal;
- The different classes of users, including operators (forecasters), maintainers (technicians), supporters (such as Disaster Managers and the media), and their different skills and limitations;
- The environments (Forecast Workstation at an NMHS) in which the system is used and supported;
- The boundaries of the system and its interfaces and relationships with other systems and its environments;

Factors to consider (continued …)

- When the system will be used, and under what circumstances;
- How and how well the needed capability is currently being met (typically by existing systems);
- How the new system will be used, including operations, maintenance and support;
- What specific products will be provided, when, how and to whom:
    - We will be including IBF
- How forecasts and warnings will be desseminated, when and to whom; and
- Scenarios illustrating specific operational activities involving the use of the system (UCAR, 2010).

The CONOPS Checklist: Strategic Framework

- **Mission Statement:** Ultimate deliverables.
- **Policy Mandate:** Basis for the NMHS to act.
- **Goals & Objectives:** Must be SMART (Specific, Measurable, Attainable, Realistic, Time-bound).
- **System Definition:** Simple, understandable description.

The CONOPS Checklist: Operational Framework (People & Processes)

People/Staff

- Roles & Responsibilities
- Staffing Requirements
- Skills Development & Training

Processes

- Communications Channels
- Data Requirements (historical & real-time)
- Models Used
- Products & Services

The CONOPS Checklist: Operational Framework (Technology)

- **Hardware:** Sensors, gauges, radar, AWS, networks.
- **Software:** Applications and operating packages, models, systems.
- **Maintenance & Replacement:** Predicting longevity and costs.
- **Research & Development:** Framework for future innovation.
- **Outreach & Education:** Strategy for community participation.

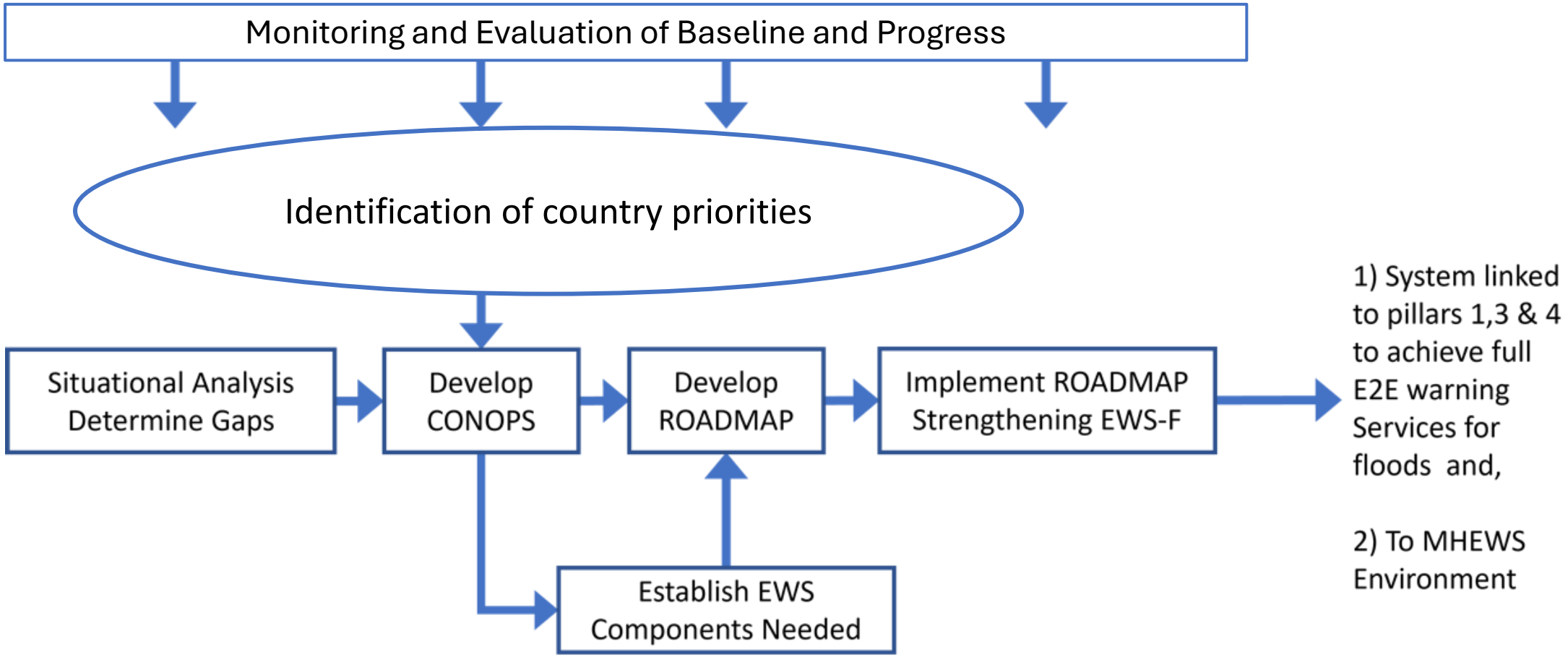
Ensuring Interoperability

Building an Open and Sustainable System

Key Principles for Software/Models:

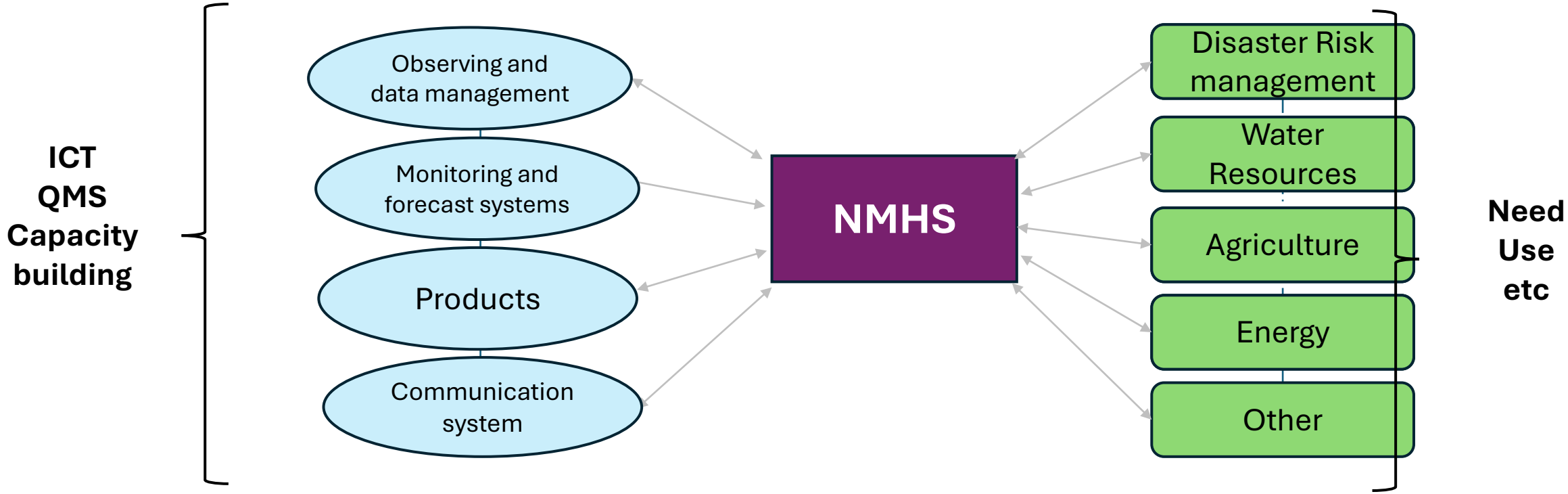
- **Freedom from Vendor Lock-in:** No mandatory commercial contracts.
- **Open/Modular Code:** Allows for in-house or third-party support and modifications.
- **Proven & Available:** Used in operational practice, freely available, with training materials.
- **Reliable & Connected:** Proven stability and interfaces for interaction with other tools.

Example: EWS-F



Conceptual representation of system of system relationship

This illustrate the process related to the operation of hydrometeorological services and contribution to decision making



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who, when, where, why, what, and how

Mistakes to Avoid

- Expecting vendors/contractors/ext. partners to develop ConOps for them

- Postponing ConOps development until after the system is designed and delivered.

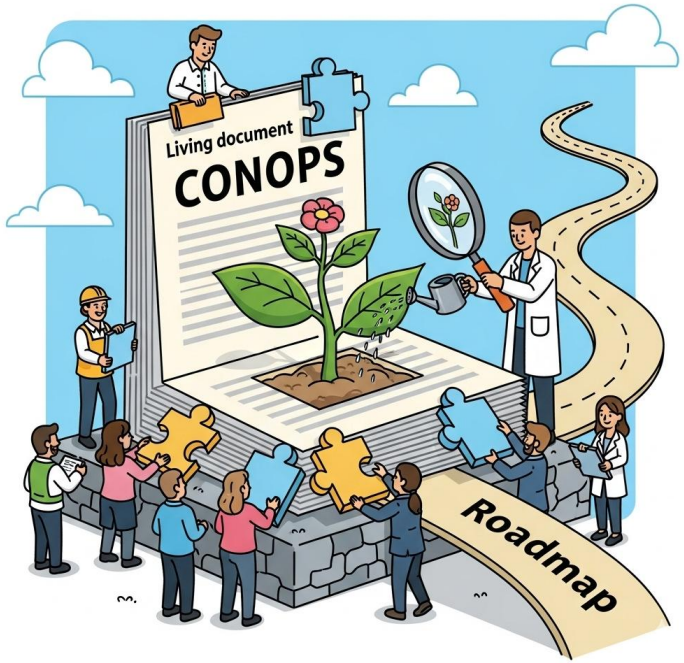
- Allowing inadequate resources fir development

- Cut and paste vs. your own plan

- Neglecting to update

The Living Document and Next Steps

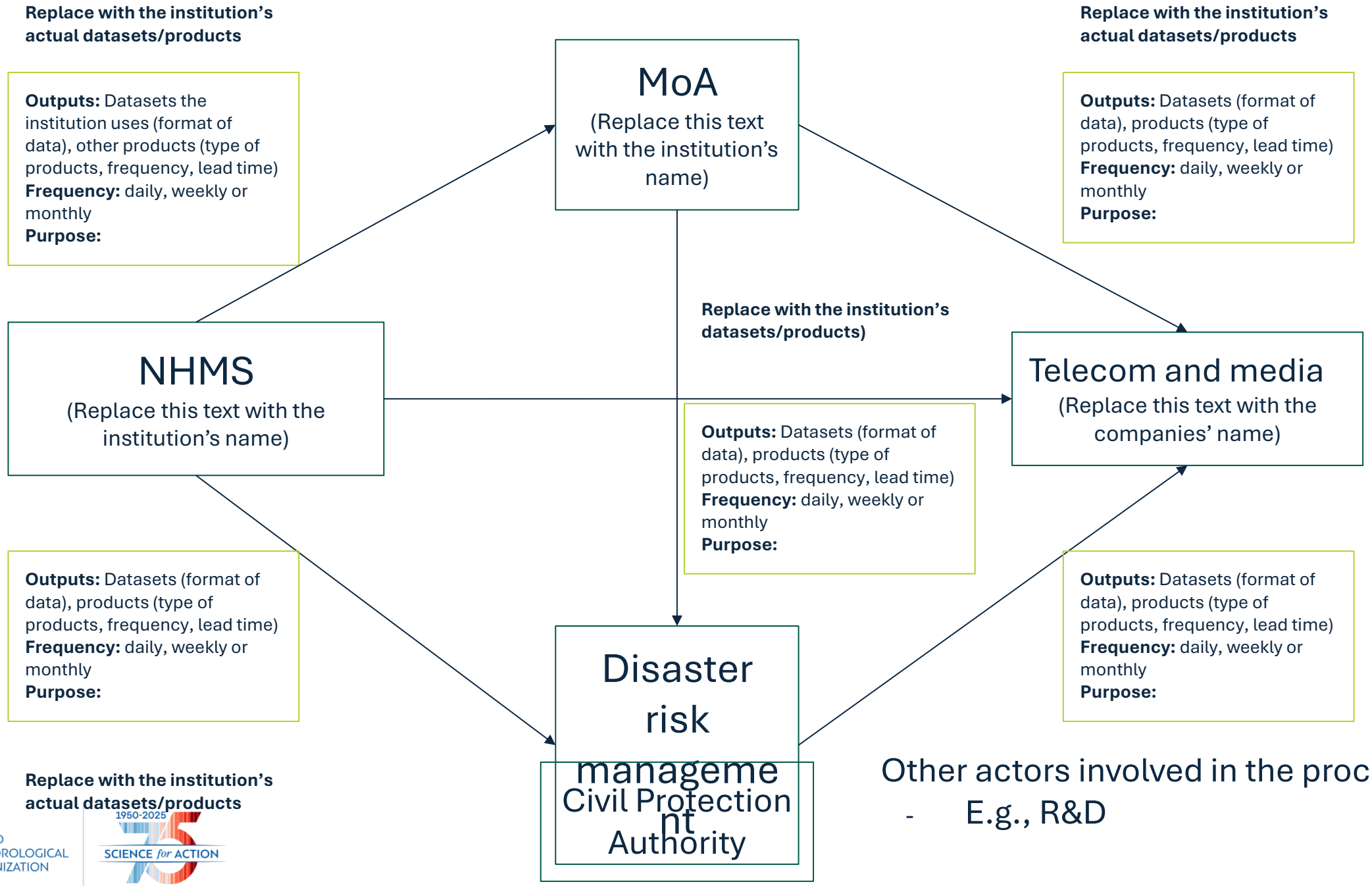
CONOPS is Just the Beginning



- A CONOPS is a **"living document"** requiring regular maintenance and stakeholder input.
- It informs the creation of detailed **Standard Operating Procedures (SOPs)**.
- It becomes the foundation for the comprehensive **Roadmap** and phased implementation plan.
- **Do not take shortcuts** – it requires serious, devoted attention to be effective.

Key Takeaways

- **CONOPS is Strategic:** It's a high-level guide for policymakers, not a technical manual.
- **CONOPS is Essential:** It reduces risk, builds consensus, and guides successful implementation.
- **CONOPS is Comprehensive:** It covers everything from the "why" to the "how" of the entire system.
- **CONOPS is a Foundation:** It is the critical first step that leads to the Roadmap, SOPs, and a functional EWS.


Replace with the institution's actual datasets/products
MoA
(Replace this text with the institution's name)
Replace with the institution's actual datasets/products
Outputs: Datasets the institution uses (format of data), other products (type of products, frequency, lead time)
Frequency: daily, weekly or monthly
Purpose:
Outputs: Datasets (format of data), products (type of products, frequency, lead time)
Frequency: daily, weekly or monthly
Purpose:
Replace with the institution's datasets/products)
NHMS
(Replace this text with the institution's name)
Telecom and media
(Replace this text with the companies' name)
Outputs: Datasets (format of data), products (type of products, frequency, lead time)
Frequency: daily, weekly or monthly
Purpose:
Outputs: Datasets (format of data), products (type of products, frequency, lead time)
Frequency: daily, weekly or monthly
Purpose:
Outputs: Datasets (format of data), products (type of products, frequency, lead time)
Frequency: daily, weekly or monthly
Purpose:
Replace with the institution's actual datasets, products
Disaster risk management
Civil Protection Authority
Replace with the institution's actual datasets/products
Other actors involved in the process:
- E.g., R&D
(Replace this text with the institution's name)

For the National Meteorological Services

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Replace with your country's NMHS

Observation

Roles:
- Total staff
- Educational background
- Routine operation roles

Data management

Roles:
- Total staff,
- Educational background
- Routine operation roles

Quality control

Roles:
- Total staff,
- Educational background
- Routine operation roles

Replace with your country's NMHS

Meteorological forecast

Roles:
- Total staff,
- Educational background
- Routine operation roles

Hydrological forecast

Roles:
- Total staff,
- Educational background
- Routine operation roles

Agromet forecast

Roles:
- Total staff,
- Educational background
- Routine operation roles

Agromet monitoring

Roles:
- Total staff,
- Educational background
- Routine operation roles

Dissemination

Roles:
- Total staff,
- Educational background
- Routine operation roles

Replace with your country's NMHS

Observation

Activities and methods

- Automatic stations for weather, hydrology or Agrometeorology
- Staffed stations
- Maintenance
- Calibration
- Weather radars
- Satellite system ground receiving system

Data management

Activities and methods

- Frequency of observation
- Frequency of data transmission
- Mode de transmission
- Schema for the data collection (local to central level)
- Existence of an automatic message switching system
- Inhouse solution for data collection?
- Stations share data at the international level
- WIS2.0 at the national level
- Climate data management system in place

Quality control

Activities and methods

- Quality control system
- Timing: in real time, in delayed mode
- Type of control applied for each variables

Operation and information flow

Replace with your country's NMHS

Meteorological forecast

Activities and methods

- Type of weather and climate models: name, spatial and temporal resolutions, lead time
- Data format
- Type of product

Hydrological forecast

Activities and methods

- Type of weather and climate models: name, spatial and temporal resolutions, lead time
- Data format
- Type of product

Agromet forecast

Activities and methods

- Type of weather and climate models: name, spatial and temporal resolutions, lead time
- Data format
- Type of product

Agromet monitoring

Activities and methods

- Type of information: name, spatial and temporal resolutions, lead time
- Data format
- Type of product

Dissemination

Activities and methods

- Type of data and products: name, spatial and temporal resolutions, lead time
- Data format

For Agricultural institutions

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Replace with the your country's Ag institution

Observation

Roles:
- Total staff
- Education
- Routine operation roles

Data management

Roles:
- Total staff
- Education
- Routine operation roles

Crops, pest, and disease modeling

Roles:
- Total staff
- Education
- Routine operation roles

IBF

Roles:
- Total staff
- Education
- Routine operation roles

Dissemination

Roles:
- Total staff
- Education
- Routine operation roles

Extension

Roles:
- Total staff
- Education
- Routine operation roles

Operation and information flow

Replace with the your country's Ag institution

Observation

Activities and methods
- If exist RS
- Data using from NHMS
- Others

Data management

Activities and methods
- Management system

Crops, pest, and disease modeling

Activities and methods
- Type of models: name, spatial and temporal resolutions, lead time
- Data format
- Type of product

IBF

Activities and methods
- What kind of data format, type of product

Dissemination

Activities and methods
- Type of data and products: name, spatial and temporal resolutions, lead time
- Data format
- Channels

Extension

Activities and methods
- Type of extension services at the provincial, district, village, farmer level

CONOPS country template (and estimated section length)

1. **Introduction**- (2-3 paragraphs)
    a. Background describing agrometeorological Hazards and impacts on agriculture, livestock and fishery
    b. What is the need for this system? Cite a recent event illustrating the need
    c. Some overview information about the proposed system and about scope
2. **Background** (3-4 paragraphs)
    a. Institutional Responsibilities (Diagram: Institutional landscape map, Show NMHS, MoA, DRM, telecom/media, NGOs — and how they connect in E2E agromet advisory service chain)
    b. Description of current limitations of existing E2E agromet service (summary of GAPS)
    c. Overall description of the capabilities of the proposed system
    d. Financial aspects determine system feasibility
3. **Operation and Information Flow**- current & proposed system: System Architecture Overview (2-3 pages, mostly figures)
    a. Description of Operations (2-3 paragraphs) for:

Diagram 1- Current Workflow (from observations to advisory)
Diagram 2- Proposed E2E Architecture with where potentially Innovations (AI etc) could be applied (with user feedback loop)

4. **Staff Operational Responsibilities**. existing educational background (-2-3 paragraphs)

Diagram: responsibility chart (color-coded), observation, data aquation,QC and management, modelling, forecasting, dissemination, coordination (Contents: Breakdown by ministry, national vs. local actors. Emergency vs. routine operations roles)

CONOPS country template (and estimated section length)

5. Proposed future Responsibilities of Operational Components (2-3 pages)

a. National Meteorological Forecasting Centre (NFC) for Forecasting & Warning

b. National agromet Service Operational agromet responsibilities (Ministry of agriculture or NHMS agromet department??)

c. Role of Regional Forecasting Office(s)

d. Role of National Disaster Management Centre (NDMC)

e. Role of Provincial and Municipal Disaster Management Centres (PDMC's and MDMC's) and Provincial and Municipal Centres of Ministry of Agriculture

Diagram: proposed responsibility chart (color-coded)., observation, data aquation,QC and management, modelling, forecasting, dissemination, coordination (Contents: Breakdown by ministry national vs. local actors. Emergency vs. routine operations roles)

6. Current and proposed future Responsibilities of Support Structures (2-3 paragraphs)

a. IT, communications and Technical Components

b. Research and Development

CONOPS country template (and estimated section length)

6. Current and proposed future Routine Operations (2-3 pages)

a. Hours of Current/Future Operations & any Evaluations

b. National Meteorological Operations – Current and Future

i. Surface Observation Data collected (real time and other), Data Base description, Data products distributed, Maintenance & Operation of data network (architecture)

ii. Radar operations (where available)

iii. Satellite Data Products

iv. Numerical Weather Prediction Models (spatial and temporal resolutions)- Quantitative forecasts

v. S2S forecasting tools and products

vi. Agromet related Product(s) Overview

c. National agromet Operations – current and future

i. Agromet data collected, Data Base description, products distributed, maintenance & operation of system (architecture)

ii. models and or agromet forecasting systems in use and proposed

Diagram 1: current daily/Weekly/monthly forecast/advisory workflow timeline. Agromet related Hazard alert/response cycle (e.g., Alert → Verification → Response → Feedback)

Diagram 2: proposed daily/Weekly/monthly forecast/advisory workflow timeline.Hazard alert/response cycle (e.g., Alert → Verification → Response → Feedback)

Contents:Normal vs. emergency forecasting chain , SOPs

8. **Current and proposed future Service Delivery and Information Dissemination** (1-2 paragraphs)

   a. Dedicated Weather Delivery data system,Mobile Technology,Social Media,Emergency Communications (HF/VHF ham radio), Cell broadcast etc

      Diagram current/proposed: Product suite with user segmentation. What each user group (farmer, MoA, DRM) receives and how.Stakeholder pyramid or ecosystem map (Contents:Routine vs. hazard-specific products. Format (maps, SMS, bulletins, audio, generative AI like agrochatGPT)

9. **Strengthening agromet hazards Warnings through Impact Based Forecasting** (1-2 pages)

   a. Event Reporting requirements (1 paragraph)

   b. Its importance for assessing system performance?

   c. Receipt of ground truth from spotters, the public and NDMAs

      Diagram: Trigger matrix (e.g., hazard level × impact level = action) (Contents:Data used for IBF (soil, crop calendars, vulnerability maps etc), dynamical Threshold setting by using AI, performance evaluation)

10. **Proposed System Training Needs** (1-2 paragraphs)

   a. NMHS Forecaster Training

   b. Ministry of Agriculture Training

   c. Disaster Management Training

Diagram: Training matrix, Staff role × required skill level (forecasting, IT, outreach, etc.) (Contents:Current gaps, priority trainings,Cross-institution learning plans)

11. **Outreach (1-2 paragraphs)**

   a. NMHS's coordination/interaction with Ministry of Agriculture , disaster managers, communities, media and various users

   b. Raising awareness through meeting and public awareness campaigns

12. **System validation, Sustainability, Monitoring 1-2 paragraphs or table**

      Diagram: Monitoring and evaluation loop, Inputs → Process → Outputs → Feedback → Adjustment (Contents:Insitutional ownership,Annual review/refresh cycle, Integration with climate

Q&A / Thank You