PREVENTION STRATEGY AND EARLY WARNING SYSTEM TO REDUCE NATURAL DISASTERS IN VIETNAMESE CROP PRODUCTION:
Systematic Effort and Tools

Speaker: Dr. Pham Quang Ha
(haphamquang@fpt.vn)

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Vietnam Agro-ecological zones

❖ Three of fourth Viet Nam territory is covered by mountains and hills.

❖ The plains concentrate in the down streams of two big rivers, the Red River and Mekong River.

❖ Vietnam has more than 3,200 km coastal lines. Stretching from 8° 30’ to 23° 30’ latitude North, =>Vietnam can be divided into eight agro-ecological
## Eight agro-ecological zones of Vietnam

<table>
<thead>
<tr>
<th>N.</th>
<th>Description</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>North East Mountainous Area</td>
<td>NEM</td>
</tr>
<tr>
<td>2</td>
<td>North West Mountainous Area</td>
<td>NWM</td>
</tr>
<tr>
<td>3</td>
<td>Red River Delta</td>
<td>RRD</td>
</tr>
<tr>
<td>4</td>
<td>North Central Delta</td>
<td>NCC</td>
</tr>
<tr>
<td>5</td>
<td>Sound Central Coast</td>
<td>SCC</td>
</tr>
<tr>
<td>6</td>
<td>Central High Land</td>
<td>CHR</td>
</tr>
<tr>
<td>7</td>
<td>South East Region</td>
<td>SER</td>
</tr>
<tr>
<td>8</td>
<td>Mekong River Delta</td>
<td>MRD</td>
</tr>
</tbody>
</table>
Table 1. Main types of natural disasters according to Vietnamese agro-ecological zone

<table>
<thead>
<tr>
<th>Type</th>
<th>North east and north west</th>
<th>Red river delta</th>
<th>North central coast</th>
<th>South central coast</th>
<th>Central highland s</th>
<th>North east south</th>
<th>Mekong river delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Flooding</td>
<td>-</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>++++</td>
</tr>
<tr>
<td>Flashflood</td>
<td>+++</td>
<td>-</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Drought</td>
<td>+++</td>
<td>+</td>
<td>++</td>
<td>+++</td>
<td>+</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Saline intrusion</td>
<td>-</td>
<td>+</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Landslide</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
<td>+++</td>
</tr>
</tbody>
</table>

Very severe (++++); Severe (+++); Medium (++); Light (+)
### Land use in Vietnam

<table>
<thead>
<tr>
<th>Areas as classified by land used</th>
<th>Area (ha) (2008)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture used land</td>
<td>9,420,300</td>
<td>28.4</td>
</tr>
<tr>
<td>Forestry land</td>
<td>14,816,600</td>
<td>44.7</td>
</tr>
<tr>
<td>Non-Agricultural land</td>
<td>3,385,800</td>
<td>10.2</td>
</tr>
<tr>
<td>Aquaculture land</td>
<td>728,600</td>
<td>2.2</td>
</tr>
<tr>
<td>Others lands</td>
<td>3,666,300</td>
<td>11.1</td>
</tr>
<tr>
<td>Water surface</td>
<td>1,097,400</td>
<td>3.3</td>
</tr>
<tr>
<td><strong>Total of Vietnam Areas</strong></td>
<td><strong>33,115,000</strong></td>
<td><strong>100</strong></td>
</tr>
<tr>
<td>No.</td>
<td>Crops</td>
<td>Planted area</td>
</tr>
<tr>
<td>-----</td>
<td>--------------</td>
<td>--------------</td>
</tr>
<tr>
<td>1</td>
<td>Rice</td>
<td>7,790.4</td>
</tr>
<tr>
<td>2</td>
<td>Maize</td>
<td>1,152.4</td>
</tr>
<tr>
<td>3</td>
<td>Cassava</td>
<td>569.9</td>
</tr>
<tr>
<td>4</td>
<td>Peanut</td>
<td>191.3</td>
</tr>
<tr>
<td>5</td>
<td>Soybean</td>
<td>94.0</td>
</tr>
<tr>
<td>6</td>
<td>Sweet potato</td>
<td>119.0</td>
</tr>
<tr>
<td>7</td>
<td>Rubber</td>
<td>976.4</td>
</tr>
<tr>
<td>8</td>
<td>Coffee</td>
<td>645.4</td>
</tr>
<tr>
<td>9</td>
<td>Cashew nut</td>
<td>293.0</td>
</tr>
<tr>
<td>10</td>
<td>Sugar cane</td>
<td>274.2</td>
</tr>
<tr>
<td>11</td>
<td>Tea</td>
<td>131.5</td>
</tr>
<tr>
<td>12</td>
<td>Pepper</td>
<td>124.5</td>
</tr>
</tbody>
</table>
Table 3. Losses brought about by natural disasters in Vietnam (1995-2009)

<table>
<thead>
<tr>
<th>Year</th>
<th>Agriculture (A)</th>
<th>All sectors</th>
<th>(%) A of All</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VN $ M</td>
<td>US$ M</td>
<td>VN $ M</td>
</tr>
<tr>
<td>1995</td>
<td>58,369.0</td>
<td>4.2</td>
<td>1,129,434.0</td>
</tr>
<tr>
<td>1996</td>
<td>2,463,861.0</td>
<td>178.5</td>
<td>7,798,410.0</td>
</tr>
<tr>
<td>1997</td>
<td>1,729,283.0</td>
<td>124.4</td>
<td>7,730,047.0</td>
</tr>
<tr>
<td>1998</td>
<td>285,216,0</td>
<td>20.4</td>
<td>1,797,249.0</td>
</tr>
<tr>
<td>1999</td>
<td>564,119,0</td>
<td>40.3</td>
<td>5,427,139.0</td>
</tr>
<tr>
<td>2000</td>
<td>468,239.0</td>
<td>32.2</td>
<td>5,098,371.0</td>
</tr>
<tr>
<td>2001</td>
<td>79,485.0</td>
<td>5.5</td>
<td>3,370,222.0</td>
</tr>
<tr>
<td>2006</td>
<td>954,690,0</td>
<td>61.2</td>
<td>18,565,661.0</td>
</tr>
<tr>
<td>2007</td>
<td>432,615,0</td>
<td>27.7</td>
<td>11,513,916.0</td>
</tr>
<tr>
<td>2009</td>
<td>66,000,0</td>
<td>3.2</td>
<td>23,745,000,0</td>
</tr>
<tr>
<td>Annual average</td>
<td>781,764,11</td>
<td>54.9</td>
<td>6,936,716,6</td>
</tr>
<tr>
<td>Lost in GDP (%)</td>
<td>0.67</td>
<td>-</td>
<td>1.24</td>
</tr>
</tbody>
</table>
### Agriculture systems and climate context in Viet Nam: A case study in Commune scale

<table>
<thead>
<tr>
<th>Communes</th>
<th>Climate</th>
<th>Month</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Jan</td>
</tr>
<tr>
<td>Normal year (WG)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal year (MG)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High rainfall year (2011, 2012) (WG)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High rainfall year (1997, Storm No.5) (MG)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry year (2014, 2015) (WG)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry year 2015 (MG)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
- WG: Women Group; MG: Men Group

- **Drought:** Happened extreme drought
- **Lack of water:** Paddy is unable to grow
- **Typhoon No. 5 caused flooding:**
- **Low rainfall, shortage of irrigation water:**
- **Unusual heavy rain, prolonged raining time:**
- **Drought:** Yield of vegetables reduced
- **Unable to sow paddy seeds due to lack of water:**
- **Unusual heavy rains:**
- **Typhoon No. 5 caused flooding:**
- **Flood-Tide:**
- **Rain at wrong season:**
- **High rainfall:**
Table 3. Losses brought about by natural disasters in Vietnam (1995-2009)

Source: MARD, 2017:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Unit</th>
<th>Tindal and heavy rain</th>
<th>Extrem Cold</th>
<th>Drought, Saline</th>
<th>Storm/Inundation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>ha</td>
<td>27,731</td>
<td>60,340</td>
<td>245,496</td>
<td>194,176</td>
<td>527,743</td>
</tr>
<tr>
<td>Vegetable</td>
<td>ha</td>
<td>2,201</td>
<td>25,930</td>
<td>31,904</td>
<td>90,424</td>
<td>150,459</td>
</tr>
<tr>
<td>Perennial crop</td>
<td>ha</td>
<td>58</td>
<td>6,047</td>
<td>38,889</td>
<td>35,434</td>
<td>80,428</td>
</tr>
</tbody>
</table>
Table 5. Estimation of crop yield decreased due to increase of temperature and precipitation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RCP4.5 (medium)</th>
<th>RCP8.5 (high)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2016-2035</td>
<td>2046-2065</td>
</tr>
<tr>
<td>Temperature increase (°C)</td>
<td>0.6-0.7</td>
<td>1.3-1.8</td>
</tr>
<tr>
<td>Crop yield decrease</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Precipitation increase</td>
<td>5-10%</td>
<td>5-15%</td>
</tr>
<tr>
<td>Crop yield decrease</td>
<td>1%</td>
<td>10%</td>
</tr>
</tbody>
</table>
Vietnam’s law on natural disaster and control

• Since 2103, the National Assembly (NA, 2013) promulgates the Law on Natural Disaster Prevention and Control. This Law provides natural disaster prevention and control activities; rights and obligations of agencies, organizations, households and individuals engaged in natural disaster prevention and control activities; and the state management of, and assurance of resources for, natural disaster prevention and control.

• With this Law, Prevention and disaster management in Vietnam is supervised by High authority under the Prime Minister, the Central Steering Committee for National Disasters Prevention and Control (CSCNDPC) through a strong coordination power in all levels (national, provincial, district).

• Specialized functions in Disaster Reduction Management (DRM) with permanent staff and professionals have the capacity to analyze circumstances and give advice on all components of DRM. In disaster prone areas there should be a center for DRM with the role of coordinating all DRM actions within the province and between neighboring provinces.

• Since, 2017, MARD did establish the Vietnam Natural Disaster Management Authority. This authority directly supported the activity of the Central Steering Committee for National Disasters prevention and Control together with its functions to support the Ministry’s work relative with National Disasters Prevention and Mitigation.
Basic principles of natural disaster prevention and control in Vietnam

• Proactive prevention, timely response to, and urgent and effective remediation of consequences of natural disasters.

• Natural disaster prevention and control are the responsibility of the State, organizations and individuals in whom the State plays the key role, organizations and individuals play a proactive role and communities help one another.

• Natural disaster prevention and control are carried out under the ‘four on the-spot motto’ in Vietnamese (4 tại chỗ): command on the spot (chi huy tại chỗ), manpower on the spot (lực lương tại chỗ), means on the spot (vật tư tại chỗ) and logistics supplies on the spot (hậu cần tại chỗ).

• Natural disaster prevention and control contents must be integrated into the national and local socio-economic development master plans and sectoral development master plans.

• Humanity, fairness, transparency and gender equity must be guaranteed in natural disaster prevention and control.

• Natural disaster prevention and control activities must be based on scientific grounds, combining traditional experiences and scientific and technological advances, structural and non-structural solutions; protecting the environment and eco-systems and adapting to climate change.

• Natural disaster prevention and control activities are assigned, decentralized and closely coordinated among involved forces and must conform to the levels of natural disaster risks.
Identification, assessment and zoning of natural disaster risks; monitoring and supervision of natural disasters (Clause 1)

- Observing, collecting, updating, monitoring, supervising, synthesizing and processing information from observation systems, and building databases on natural disasters;
- Assessing and zoning natural disaster risks; making natural disaster warning maps;
- Fully and promptly providing information on natural disasters to the Central Steering Committee for Natural Disaster Prevention and Control, ministries, ministerial-level agencies and localities to serve the direction and implementation of natural disaster prevention and control activities.
- The Ministry of Natural Resources and Environment and Vietnam Academy of Science and Technology shall base themselves on their assigned functions and tasks to implement the provisions of Clause 1 of this Article.
Four on the-spot motto’ = 4 tại chỗ/ “Four actions on site

- For the fight against natural disasters in Vietnam, there have been many lessons learned from generations of Vietnamese. One of the lessons is Four on the-spot motto’ = 4 tại chỗ, with the meaning of "four actions on site". It comes from experience in the collaborative effort to prevent flood and protect the dykes of the northern delta from the early 1970s.

- Experience shows that in order to ensure a safe system of dykes in flood season, it is necessary to take proactive actions in organization, mobilization of all local available (one site) resource from all social and political actors. For this, preparedness and readiness for actions in any stage of flood is very important.

- Four on the-spot motto’ are command on the spot (chủ hủ tại chỗ), manpower on the spot (lực lượng tại chỗ), means on the spot (vật tư tại chỗ) and logistics on the spot (hậu cần tại chỗ). The experiences of Four on the-spot motto’ = “Four actions on site " has been conceptualized and then replicated for implementation in the whole field of prevention and first relief.

- The concept of “four actions on site” is frequently used in disaster prevention can be understood as follows: each household, each location will need to prepare itself fully on what is needed for them to prevent and cope with natural disasters that may occur locally at any time. The concept also requires for preparedness of disaster mitigation for each family and the rest of the community. Nature of the “four actions on site" is self-help, which means the population and local authorities need to be ready for disaster prevention and mitigation, not being passive and relying on the external supports.
Identification of socially vulnerable groups in natural disaster /Collaboration with IAE and NIAPP/

Pragmatic economic valuation of adaptation risk and responses across scales
Case study in Vietnam

Working Paper No. 185

CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

Le Ngoc Lan, Armando Martínez-Valle, Louis Parker, Clement Bourgoïn, Nguyen Thi Than, Nora Guerten, Godefroy Grosjeans, Pham Anh Hung, Vu Cong Lan, Vuong Thuc Tran, Pham Quang Ha, Dao Van Thong, Luong Huu Thanh and Peter Läderach
Elements of Vulnerability to Climate Change

Exposure

Presence of an effect of climate change

Monitoring (historic)
Modelling (future)

Potential impact

Sensitivity

Characteristics that defines different responses to effects of climate change

Adaptive Capacity

Management

Vulnerability


Climate-Risk Vulnerability Assessment (CRVA) Framework

Exposure I: changes in temp. and prec.

- Changes in Temperature
- Changes Precipitation

Sensitivity Index
Changes in climatic suitability to grow crops

“Changes in Climatic Suitability to Grow Crops”
Future Conditions – Baseline Conditions

Exposure II: Biophysical Indicators (climate-related pressures)

- Tropical Cyclones
- Flooding
- Landslide
- Drought
- Erosion
- Salt Water Intrusion
- Sea Level Rise
- Storm Surge

Hazard Index
“Exposure from hazards”

Pot. Impact
“Capacity to Resist and Adapt to Pressures”

Adaptive Capacity
Economic
Natural
Social
Physical
Institutional

Legend:
External Inputs
Derived Data
Spatial Analysis

“Climate-Risk Vulnerability”
Vulnerability = \frac{\text{Exposure II + Sensitivity}}{2} \cdot \frac{\text{Adaptive Capacity}}{2}
Measures taken for socially vulnerable group in disaster management

• **Before disaster**

In the implementation of this guideline, the people involved have to build the plan, anticipate the possibility and likelihood of natural disasters that occur locally and prepare for what is needed to be used for both the response and recovery process when natural disasters occur. Preparation of “four actions on site” will help actively in the practice of preparedness, for example consolidating houses, anchoring boats, cutting pruning trees and especially preparation of evacuation of people.

• **During the disaster**

Preparation of good and adequate facilities, human forces in place, ensuring the evacuation of more timely and proactive; Implementing the searching and rescue, providing first aid and rescue assets, mobilizing all resources for reducing damage to houses and property.

• **After the disaster**

Good preparation for self – help disaster mitigation is very useful for rapid recovery. In fact there have been very expensive lessons of not being prepared of essential necessities to overcome disasters, even in cases where victims suffer from hunger and external support were not able to reach the hit location and food and other necessary things that could only be supplied only by helicopters. In contrast, in other cases, local authorities and people having reserved enough food before the flood can survive even several days of disaster in isolated location due to the traffic cut off.
Role of Media

• Radio and television broadcasting are very effective methods of communicating important information to large groups of people before, during and after emergency situations. Local radio services are particularly effective, as broadcasters have established relationships with local communities and detailed local knowledge that may assist listeners.

• The central body for disaster management in Vietnam is the Central Steering Committee for Natural Disasters Prevention and Control (CSCNDPC) and has representative bodies in provincial, city, district and ward/commune levels. ➔ Provide information to Media

• In general, Vietnam’s media has a well-resourced, advanced approach to disaster management and they play an active role before, during and after disasters.
Hydro-meteorological forecast

- Hydro-meteorological forecast is presently taken by the National Centre for Hydro- meteorological forecast, Ministry of Natural resource and Environment. Its information system is currently including domestic and international network that has been enhanced and applied new achievements from informatics and telecommunication technologies.

- The hydro-meteorological observation network including: 162 surface meteorological stations (63 timing-data receiving and transmitting stations, 4 to 8 times per day); 232 hydrological stations (36 stations of level I, 30 stations of level II, and 166 water gauging stations); 29 agricultural meteorological stations; 15 up-to-air meteorological stations; 21 water meteorological stations; 133 environmental, air, and water monitoring stations; 788 rain gauging stations; 2 weather radar stations; 3 GMS satellite image stations with low resolution; 1 GMS satellite image receiving and processing and NOAA (USA) satellite orbit station with high resolution.
Case study for information tools to monitor and manage rice production to control natural disasters

• This study (Do and Vu, 2017) was carried out by the National Institute of Agricultural Planning and Projection (NIAPP) and some other partners from 2015 to 2017 to provide database by information technology to monitor rice production in Red River (RRD) and in Mekong River Delta (MRD) with the support from via the Swiss Agency for Development and Cooperation (SDC). One of the important objectives of this study is to help the government and assurance company to estimate the loss and damage of rice yield in case natural disasters will happen as well as help farmers to smartly manage their respective rice fields and Prevention loss from national disasters.
Objectives

- Rice extent monitoring
- Start of Season detection
- Estimation of yield & product

- Timely provide crop information to MARD.
- Information delivery to other partners and support crop insurance and prevention disasters
Specific tasks

- Monitoring at commune level.
- Covering a large area (10 provinces).
- Daily weather data collection.
- Monthly crop cultivation progress information collection.
- Online reporting.
- Applications of cutting-edge technologies in surveying and monitoring rice information system.
- Online WebGIS.
- Close connections with MARD, DARDs, Dep. Of Crop Production, Center for Informatics and Statistics, General Statistics Office.
Technologies

- ESA’s free radar imagery (Sentinel-1A/B)
- IRRI’s yield model (ORYZA)
- GISCloud and GeoServer web map services
- Sarmap radar satellite image processing system from Sarmap
- Pocket LAI measurement from Cassandra
- Open-sourced GIS software (QGIS)
Methodology

6/12-day satellite image acquisition

Time-series satellite image analysis

Field surveys

Soil, weather, fertilizers, water, varieties, ...

• Rice extent mapping
• Yield, product estimation
• Damage assessment
Results

Monitoring rice cultivation area; rice mapping by season and forecasting yield and product at commune level:

1. Total number of monitors:

2. Total monitoring area: 860,000 ha (10 pro.)/1 season.
Mekong River delta

Winter Spring

Summer Autumn

Autumn Winter

Bulletin publication
Start of Season detection

MRD

RRD
Yield forecast, product estimation

Total monitoring area: 860,000 ha/1 season, accounting for 30% total national rice extent
Damage assessment

Evaluation and assessment of damaged/affected rice area by the Miranae storm (no. 1) in the Red River delta on 28 Jul. 2016.
Monitoring rice phenological status
Monitoring rice phenological status
Rice monitoring database

http://webgis.riicevn.org/2016/05/webgis.html
Field survey database

45 Surveys

44,000 Geo-tagged photos
Project GIS database

- Land use
- Basemaps
- Weather
- Area, yield summary
- Rice monitoring

GeoDatabase
Results

• On-time delivery of Mid-season and End-season rice monitoring results.

• Expanded connection with stakeholders and concerned users via workshops, bulletin delivery and project’s website.
Update project activities

http://www.riicevn.org

The Red River delta in Winter Season

Two rice crops, An Giang and Dong Thap

Red River Delta, Summer season 2016
Thank you

• Vu Cong Lan, Do Nguyen Phuong (NIAPP) for case study
• FFTC
• IAE
• CIAT
• SCD