FMMP C 5 & FLOOD INFORMATION BASED LAND MANAGEMENT (FIBLM)

by

Dr. Martin Falke

Team Leader (GFA-Consulting Group)
MRC Flood Management and Mitigation Programme (FMMP)
Land Management Component (C 5)
Regional Flood Management & Mitigation Centre (RFMMC)
Phnom Penh/ Cambodia
Email: falke@mrcmekong.org

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2. PROJECT OBJECTIVE

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MRC-FMMP Overview

- **The ultimate objective of the Flood Management and Mitigation Programme (FMMP) of the MRC, established in 2002, was to contribute to a reduction of civil and socio-economic losses due to floods while preserving the environmental benefits of floods.**

The MRC-FMMP Programme covered 5 components:

1. Establishment of a Regional Flood Centre
2. Structural Measures and Flood Proofing
3. Mediation of Transboundary Flood Issues
4. Flood Emergency Management Strengthening
5. Land Management

The immediate objective of component 4 and 5 (supported by GIZ) was:

- **To improve the capacities of authorities and organisations at various levels of the riparian countries to apply more efficiently appropriate disaster preparedness, emergency management and land management policies and tools in the field of flood management.**

The Objective of FMMP- Component 5 (Land Management) was:

Land Management in the Mekong floodplains is more effective, using reliable flood-related information.

Relevant authorities and organisations at various levels of the four riparian countries use reliable flood-related information in land management.

- **Current land management practices are an important factor contributing to a situation where the regular floods of the Mekong cause substantial damage to agriculture and infrastructure**

- **More effective decision making requires the provision of more relevant and accurate flood related information**

- **FMMP C 5 produced flood probability maps (FPM) in a scale of 1: 10 000 or larger. The project intended to supply the decision making authorities (particularly provincial and district offices) in the four participating countries with this urgently required planning tool of the right scale, which will contribute to avoid or at least minimize flood risks and damages for communities living along the Mekong River**

FMMP C 5 in the context of CLIMATE CHANGE

- **Global Warming induces rising temperature, changing in precipitation and wind**
- **Resulting in flooding, drought and storm in terms of an increased frequency, intensity and duration, also within the Mekong River Basin**
- **Causing disruption & damages to many development sectors such as land management, agriculture, infrastructure, ecology, hydrology, fisheries, tourism, etc.**
- **The FMMP- C5 – Approach and its Maps can serve as an ADAPTATION & MITIGATION TOOL for Planning Authorities and Communities as a response to Climate Change Effects (e.g. intensified flooding)**

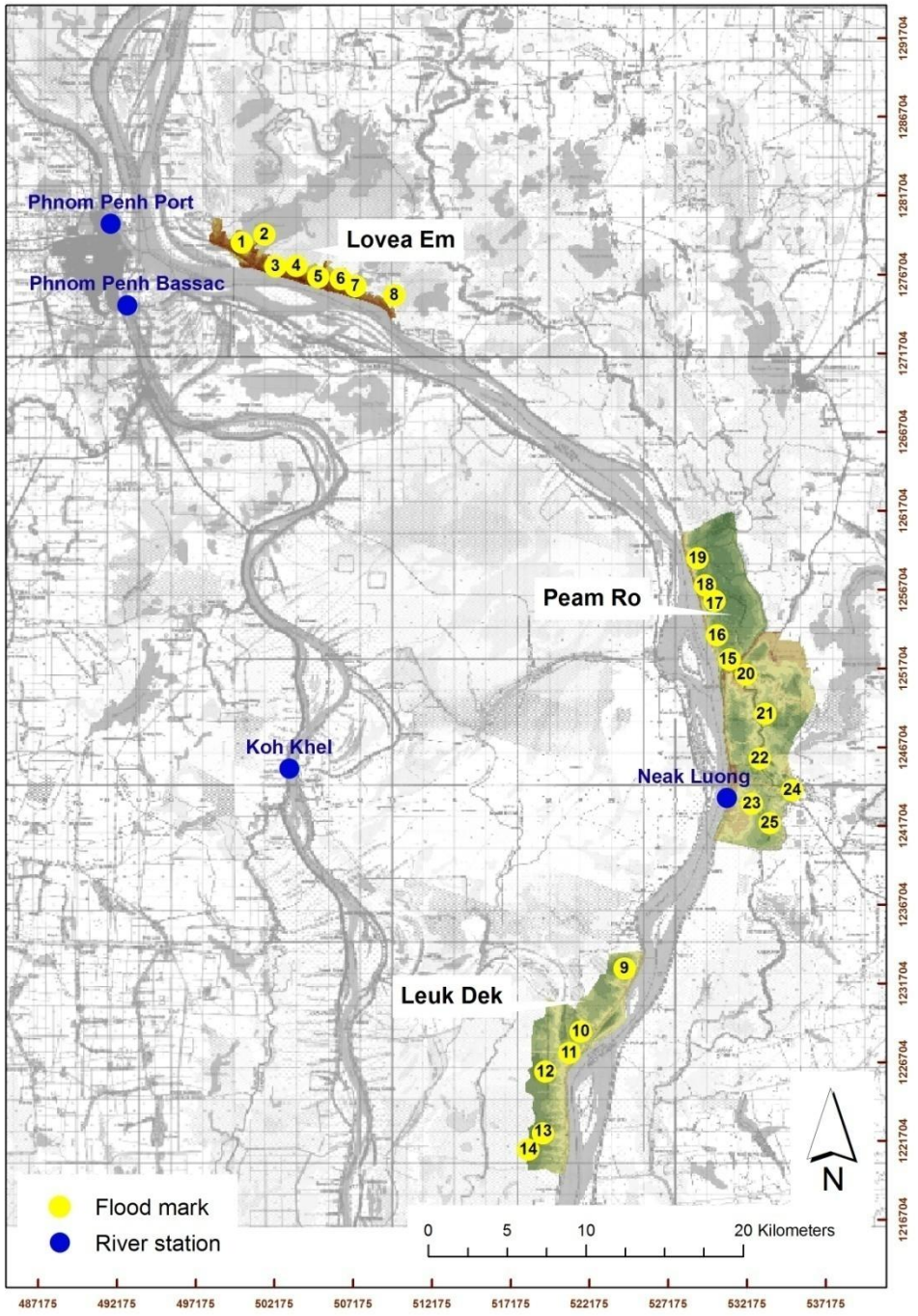
REVIEW OF FMMP C 5

-Phase 1 & 2 (2004 to 2011)-

- METHODOLOGY-

The approach of FMMP C 5 (Phase1) was – based on 3 Pilot Districts in Cambodia - the creation of reliable Flood Probability Maps for subsequent use in Land Management by the relevant authorities and organisations.

Location of River Stations and Flood Marks in the 3 Pilot Districts in Cambodia (Phase 1)



Data sources

Village flood mark

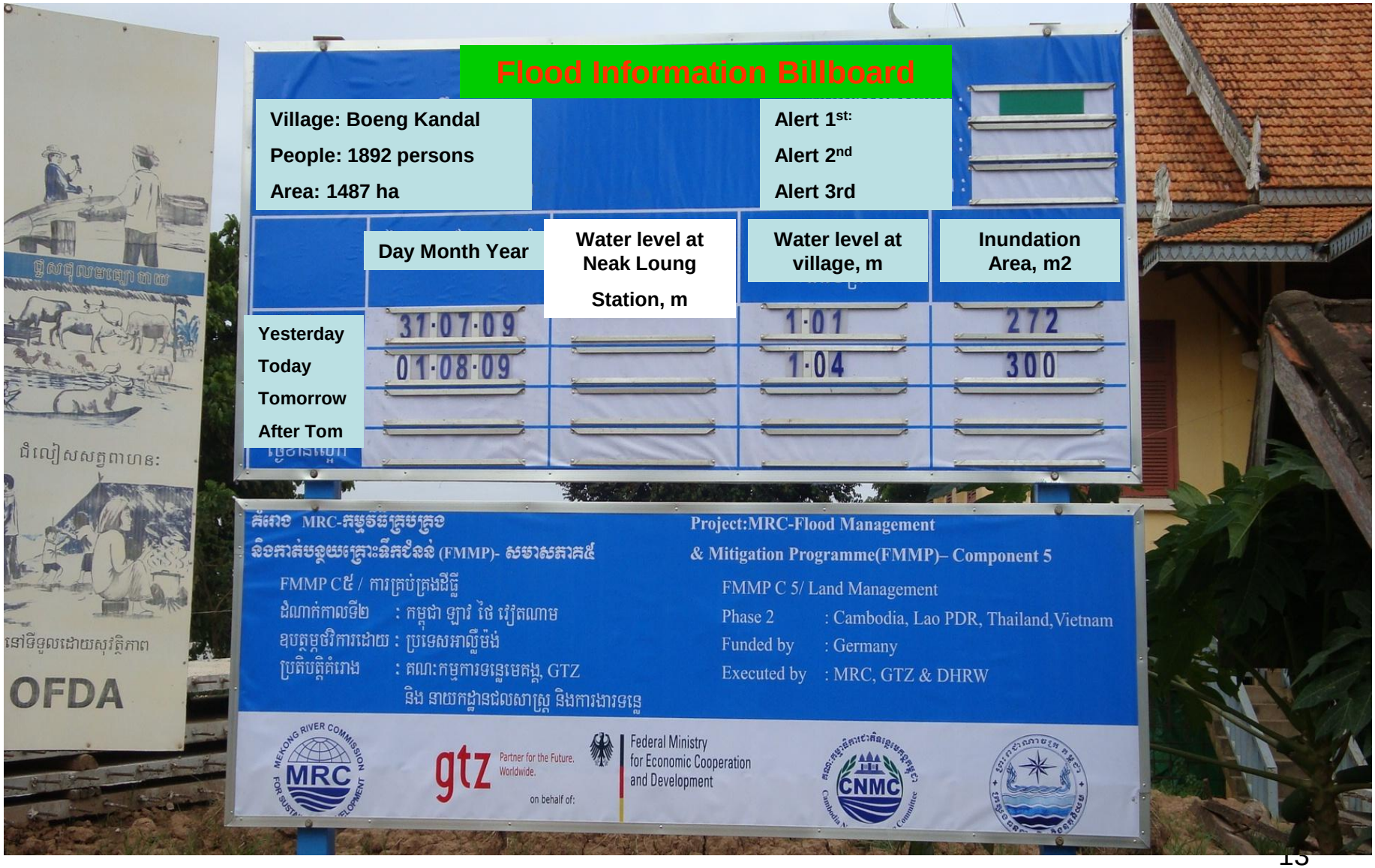
River station

Daily records from flood marks during the flood season 2003 to 2010

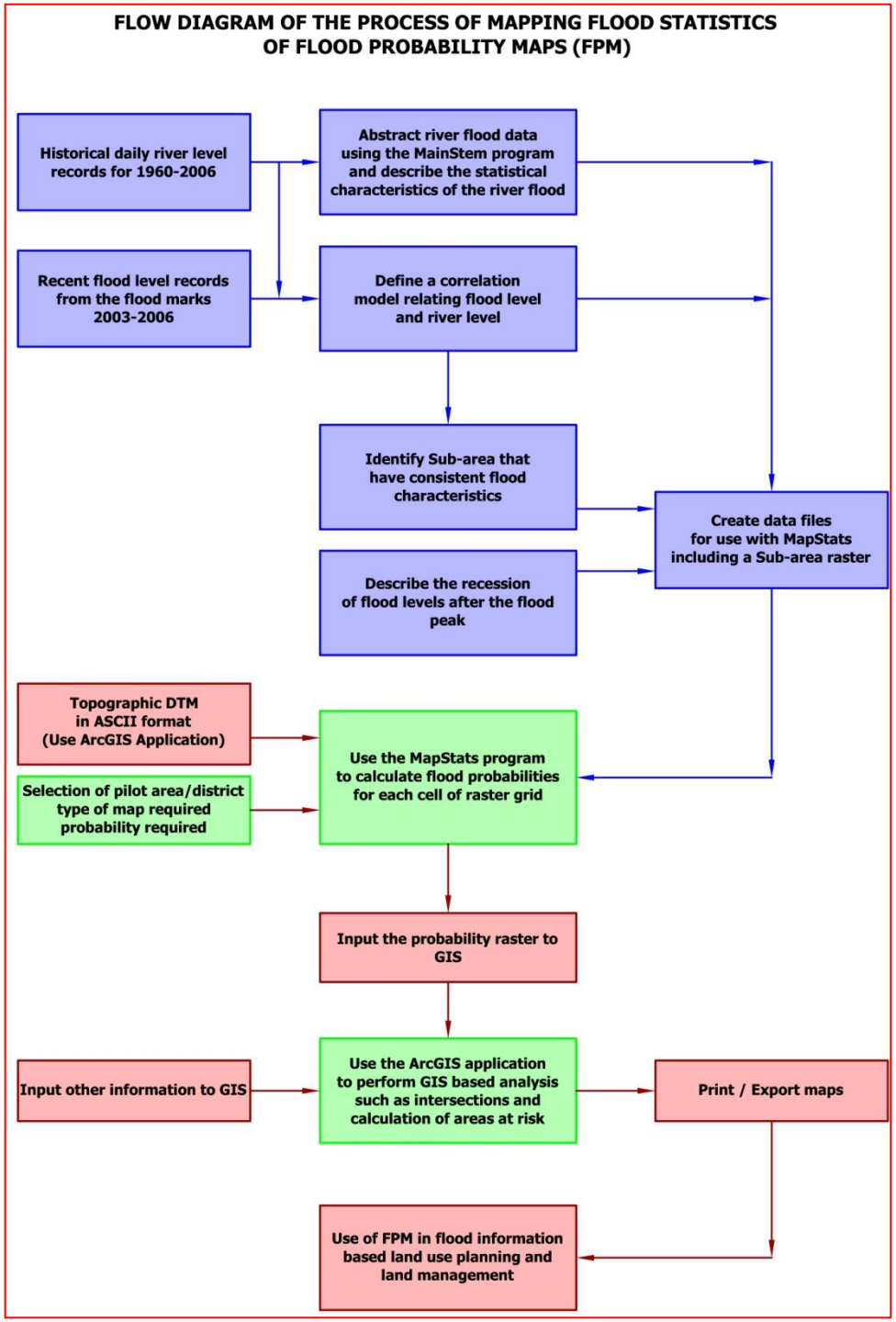
and

daily river levels since 1960

Flood Information Billboard

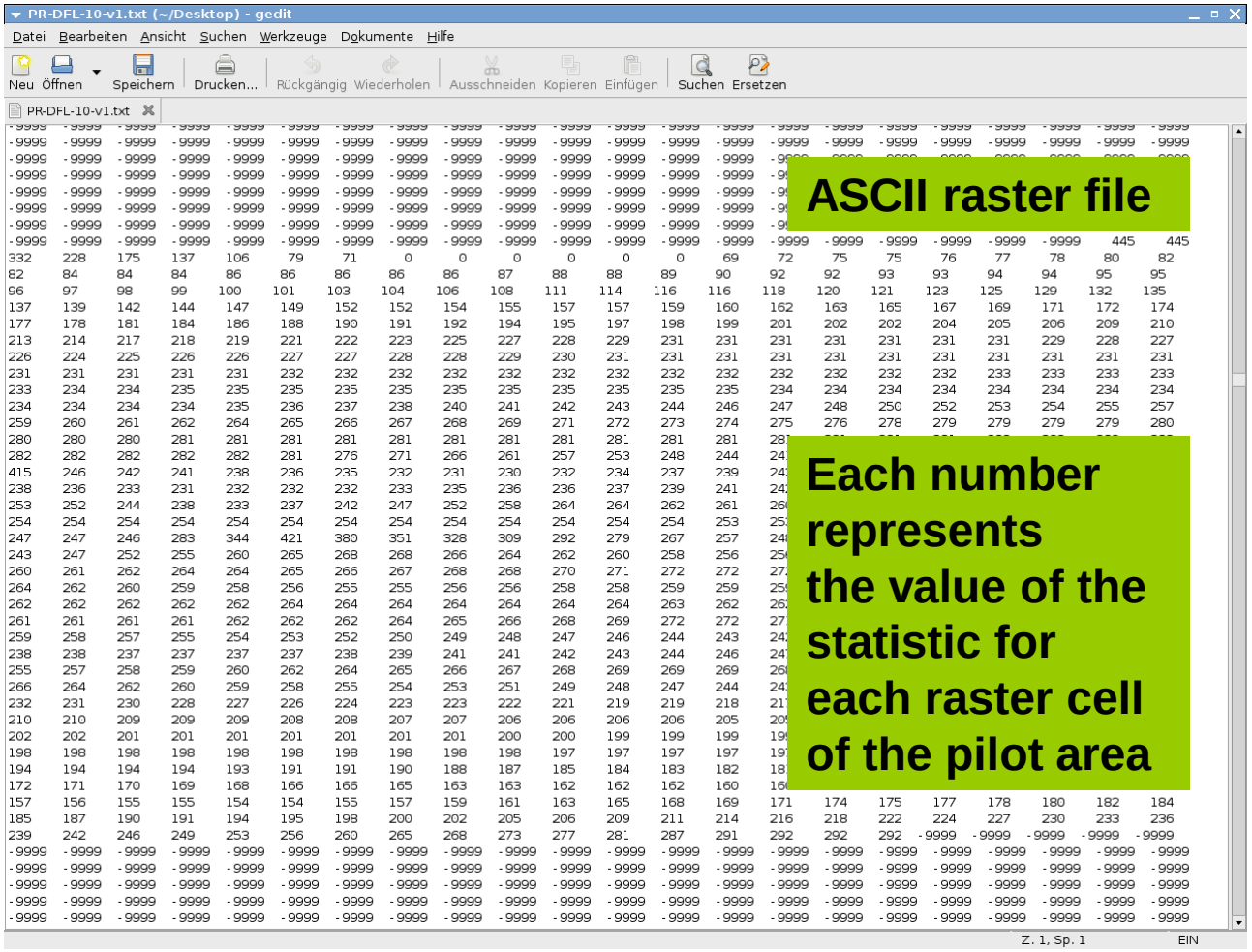



BẢNG THÔNG TIN VỀ LŨ LỤT
Năm 2009
Xã An Hoà, huyện Tam Nông, tỉnh Đồng Tháp
Dân số: 10.203 người
Diện tích: 2.630 ha
Mực nước báo động trên sông Tiền tại Tân Châu (m)
Cấp 1 3,60
Cấp 2 4,20
Cấp 3 4,80
Ngày/tháng
Mực nước sông Tiền tại Tân Châu (m)
Mực nước nội đồng tại xã (m)
Diện tích đất bị ngập (ha)
Hôm qua 17/08 3 12 2 17
Hôm nay 18/08 3 15 2 22
Ngày mai 19/08
Ngày mốt 20/08
Dự án: Quản lý lũ lụt và Giảm nhẹ thiên tai
Học phần 5: Quản lý đất đai
Giai đoạn 2: Tại Campuchia, Lào, Thái Lan, Việt Nam
Tổ chức tài trợ: Chính phủ Đức
Cơ quan thực hiện:
Uỷ hội sông Mê công Quốc tế
Cơ Quan Hợp tác Kỹ thuật Đức
Uỷ ban sông Mê công Việt Nam
Đài Khí tượng Thuỷ văn khu vực Nam Bộ
Project: MRC-Flood Management & MitigationProgramme (FMMP)
Component 5: Land Management
Phase 2: Cambodia, Lao PDR, Thailand, Viet Nam
Funded by: Germany
Executed by:
Mekong River Commission (MRC)
German Technical Cooperation (GTZ)
Viet Nam National Mekong Committee (VNMC)
Southern Regional Hydro-Meteorological Center (SRHMC)
MRC
gtz
Partner for the Future Worldwide
on behalf of :
Federal Ministry for Economic Cooperation and Development
VNMC
KTTVNB

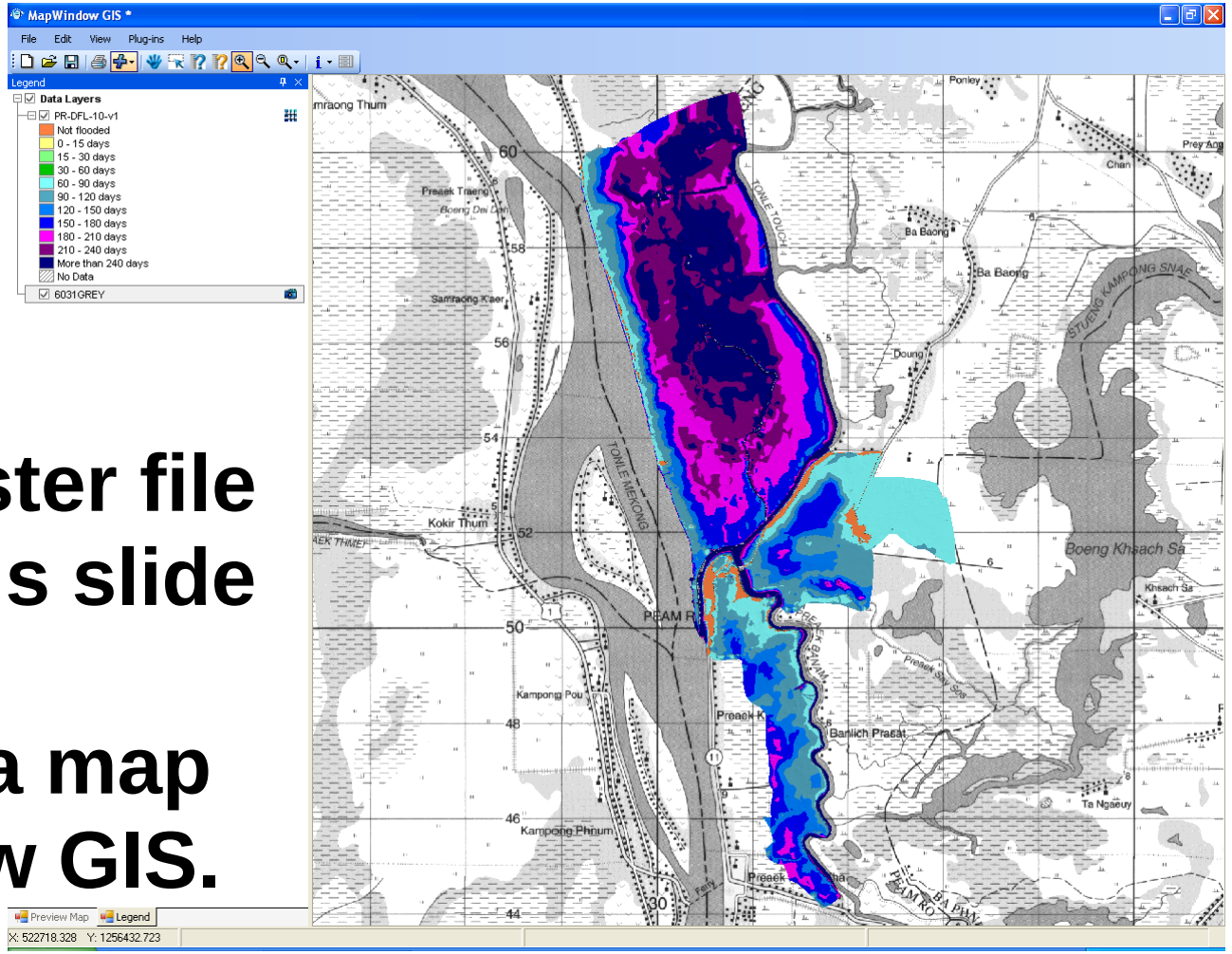

FLOW DIAGRAM OF THE PROCESS OF MAPPING FLOOD STATISTICS OF FLOOD PROBABILITY MAPS (FPM)
Historical daily river level records for 1960-2006
Abstract river flood data using the MainStem program and describe the statistical characteristics of the river flood
Recent flood level records from the flood marks 2003-2006
Define a correlation model relating flood level and river level
Identify Sub-area that have consistent flood characteristics
Create data files for use with MapStats including a Sub-area raster
Describe the recession of flood levels after the flood peak
Topographic DTM in ASCII format (Use ArcGIS Application)
Selection of pilot area/district type of map required probability required
Use the MapStats program to calculate flood probabilities for each cell of raster grid
Input the probability raster to GIS
Input other information to GIS
Use the ArcGIS application to perform GIS based analysis such as intersections and calculation of areas at risk
Print / Export maps
Use of FPM in flood information based land use planning and land management

Displaying the Results:

In this example, each number represents the duration of flooding in days of a particular cell of the Peam Ro-DTM



MapWindow GIS



This is the raster file of the previous slide (Table) displayed as a map in MapWindow GIS.

Creation of Flood Probability Maps

The resulting raster files can then be displayed as maps in a GIS platform (ArcGIS/ MAP WINDOWS) showing any of the following statistics:

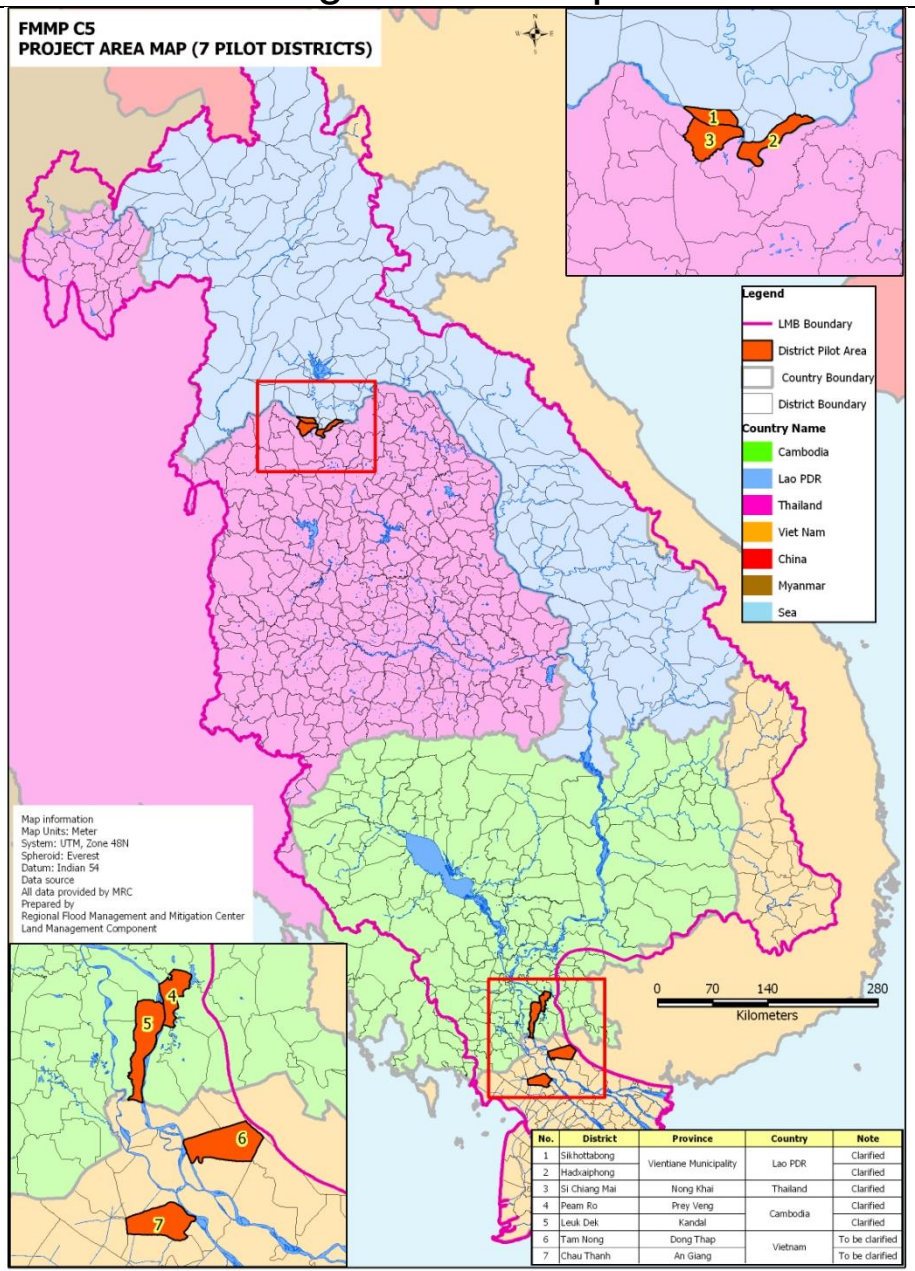
- **Probability of flooding**
- **Start of Flooding**
- **Maximum depth of flooding for a range of probabilities**
- **Duration of flooding for a range of probabilities**
- **Completion of drainage for a range of probabilities**

FINAL STATUS OF FMMP C 5 (Phase 2), DATA COLLECTION & ANALYSIS, RESULTS

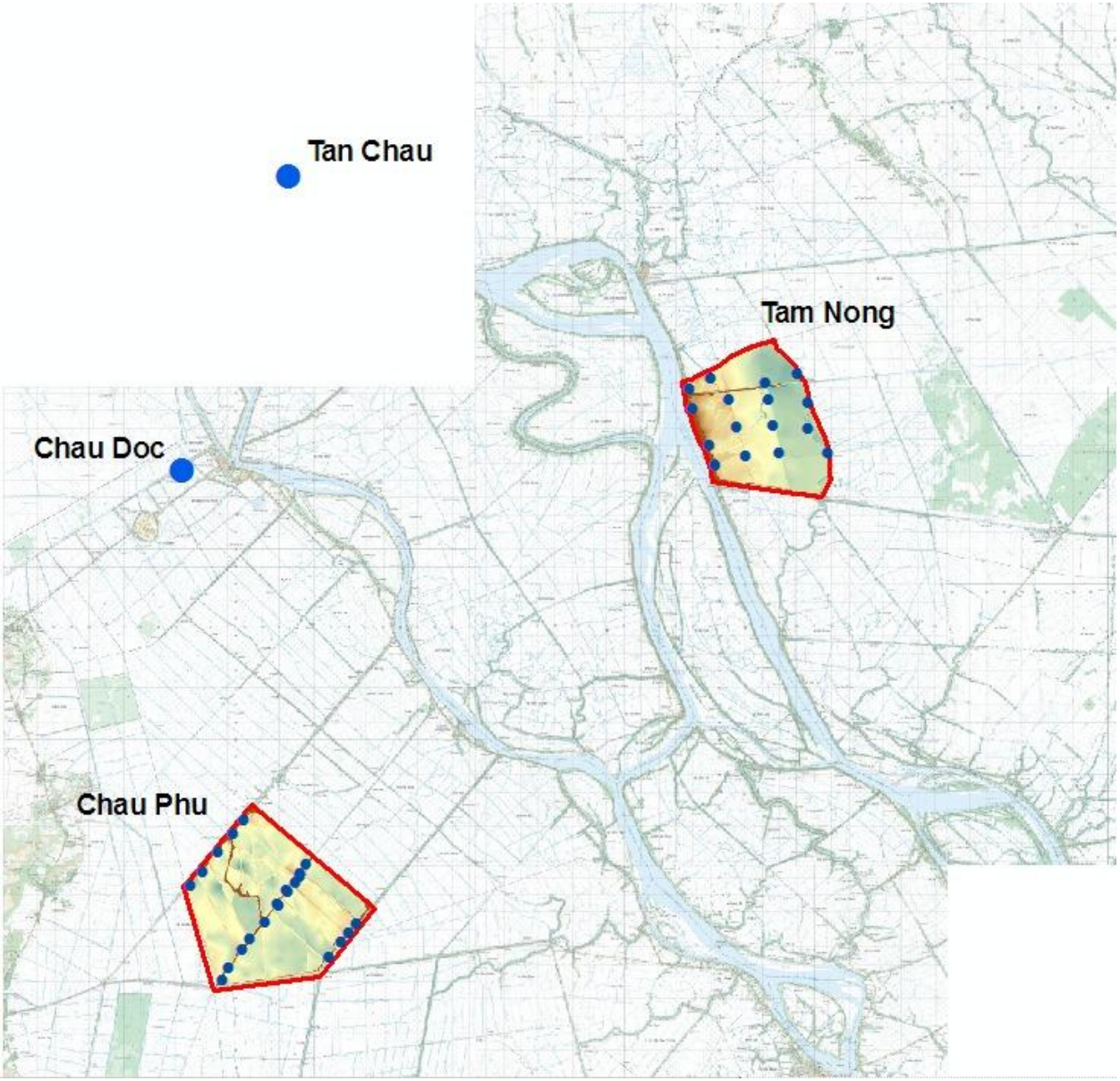
FMMP-C 5

Flood Management and Mitigation Programme

- Land Management Component -

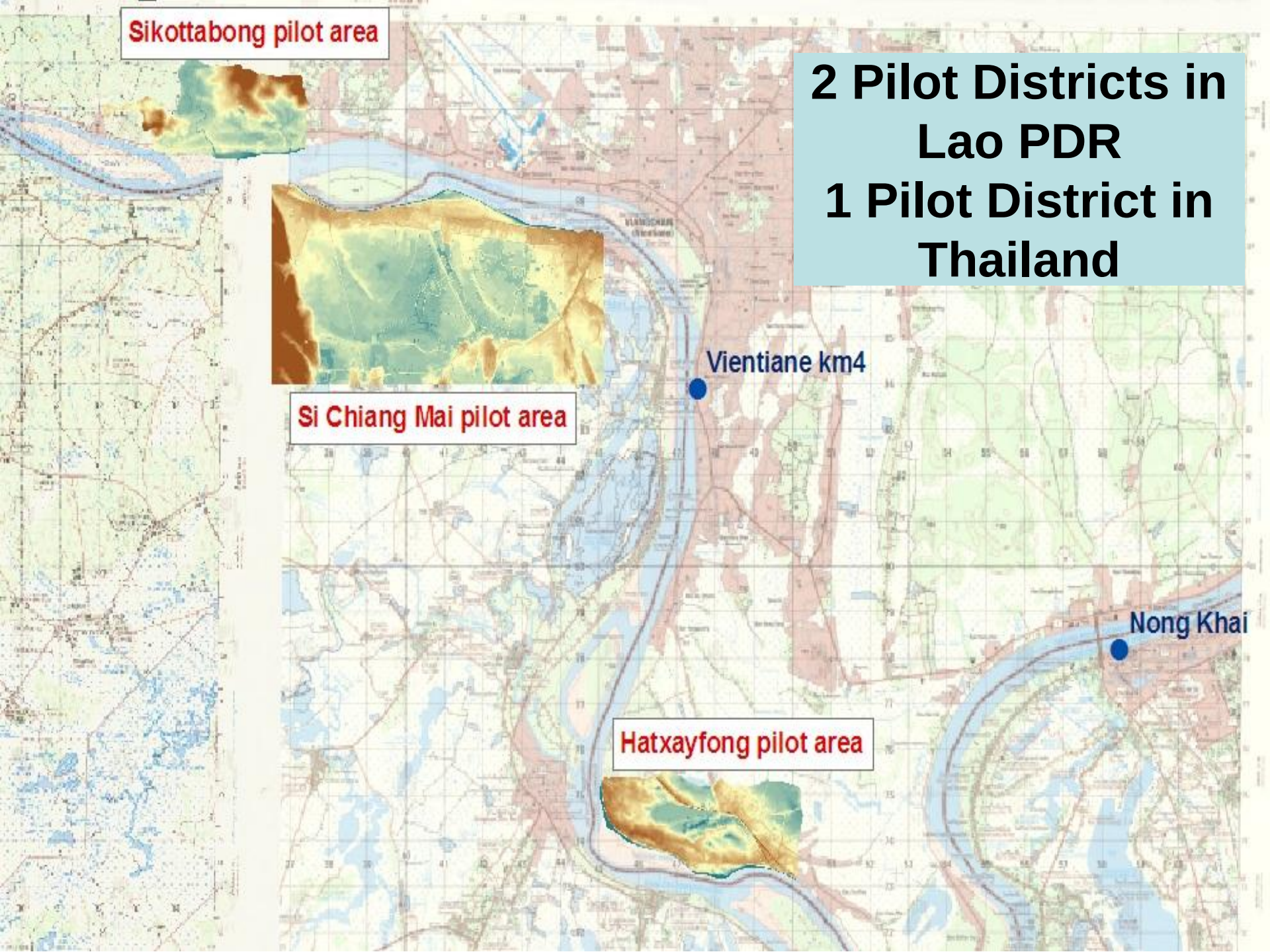


2 Pilot Districts in Vietnam



Daily records from flood marks during the flood season for 2009 & 2010 in Tam Nong and Chau Phu pilot areas

Daily river levels since 1979 from Tan Chau and Chau Doc


Sikottabong pilot area
2 Pilot Districts in Lao PDR
1 Pilot District in Thailand
Vientiane km4
Si Chiang Mai pilot area
Nong Khai
Hatxayfong pilot area

FMMP-C 5

Flood Management and Mitigation Programme

- Land Management Component -

PROJECT STATUS OF FMMP-C 5 (PHASE 2) in the 4 MRC-MEMBER COUNTRIES (February 2011)

	CAMBODIA (2 districts)	LAO PDR (2 districts)	THAILAND (1 district)	VIETNAM (2 districts)
National Workshop conducted	4 National Workshops completed in 10/ 2008			
National Working Group established/ Meetings conducted	Completed	Completed	Completed	Completed
Topographic Surveys conducted	Completed	Completed	Completed	Not required
DEM/ DTM established/ provided	Completed	Completed	Completed	Completed
Flood marks (FM) & Flood Billboards (BB) established	Completed 30 FM & 14 BB	Completed 19 FM & 4 BB	Completed 20 FM & 6 BB	Completed 38 FM & 4 BB
Communities equipped & trained for data transmission	Completed	Completed	Completed	Completed
Flood Mark Reading Data Base established	Completed/ (Upgrading in process)	In Process (no flooding in 2009 & 2010)	In Process (no flooding in 2009 & 2010)	Completed (Upgrading in process)
Hydrographic Data collected (Main River Stations)	Completed/ (Upgrading in process)	Completed/ (Upgrading in process)	Completed/ (Upgrading in process)	Completed/ (Upgrading in process)
Flood Probability Maps produced	Completed/ (Upgrading in process)	Not possible within C5-Phase 2	Not possible within C5-Phase 2	In Process since January 2010
Flood Probability Maps used by Line Agencies	In Process	Not possible within C5-Phase 2	Not possible within C5-Phase 2	In Process

FMMP-C 5
Flood Management and Mitigation Programme
- Land Management Component -

PROJECT STATUS OF FMMP-C 5 (PHASE 2) in the 4 MRC-MEMBER COUNTRIES (February 2011)

	CAMBODIA (2 districts)	LAO PDR (2 districts)	THAILAND (1 district)	VIETNAM (2 districts)
TOT-Trainings for Line Agencies (and at University) conducted	**Completed:** 1. At RFMMC: Feb-March 2009/13 Participants 2. At National Level: Nov 2009/ 27 Participants 3. At Province & District Level: Nov 2009/ 50 Participants 4. At RUA: Nov 2009/ 22 Participants 5. At RUA: Feb 2010/ 30 Participants 6. At RFMMC: March 2010/10 Participants 7. At Province & District Level: June 2010/ 50 Participants 8. At RUA: July 2010/ 31 Participants 9. At DALRM: Oct 2010/ 14 Participants	**Completed:** 1. At RFMMC: March 2010/ 5 Participants 2. At Udonthani: Sept. 2010/ 10 Participants	**Completed:** 1. At RFMMC: March 2010/ 5 Participants 2. At Udonthani: Sept. 2010/ 10 Participants	**Completed** in March 2010/ 15 participants
Education Material produced & translated into the 4 riparian languages	3 Manuals, 2 DVDs & 1 Report **completed**	3 Manuals, 1 DVD & 1 Report **completed**	3 Manuals, 1 DVD & 1 Report **completed**	3 Manuals, 1 DVD & 1 Report **completed**
Study Tour to Cambodia conducted		**Completed** in February 2010 for 5 participants from Lao PDR, Thailand & Vietnam each (plus 36 participants from Cambodia)		
M & E- System established	4 National Workshops **completed** in 11/2008; 1st & 2nd Monitoring conducted in October 2009 & April 2010; 1st & 2nd M & E-Reports completed in December 2009 & May 2010			
Impact Study on FIBLM-Achievements conducted	**Completed in 2nd half of 2010**			
Regional Workshop conducted	**Completed in February 2011**			

Project Implementation-Status in the 4 MRC-MEMBER COUNTRIES (January to September 2009)

	CAMBODIA (2 districts)		LAO PDR (2 districts)		THAILAND (1 district)	VIETNAM (2 districts)	
Districts	**Paem Ro**	**Leuk Dek**	**Sikhottabong**	**Hatxayfong**	**Si Chiang Mai**	**Tam Nong**	**Chau Phu**
Pilot Area (km^2)	**91**	**42**	**7**	**7.5**	**33**	**53**	**61**
Flood Marks established	**16**	**14**	**8**	**11**	**20**	**16**	**22**
Billboards established	**8**	**6**	**2**	**2**	**6**	**2**	**2**
Total Nr. of Flood Marks	**30**		**19**		**20**	**38**	
Total Nr. of Billboards	**14**		**4**		**6**	**4**	

USE OF FLOOD PROBABILITY MAPS (FPM) IN LAND MANAGEMENT & LAND USE PLANNING

- Examples from Cambodia -

Land Use Planning can be considered as one of the most cost effective means of reducing the growth of future flood damage (= REDUCTION OF COSTS OF FLOODS).

Therefore practical applications for the use of Flood Probability Maps & Flood Information in the most significant areas of Land Management & Land Use Planning in the Flood Plains are the following:

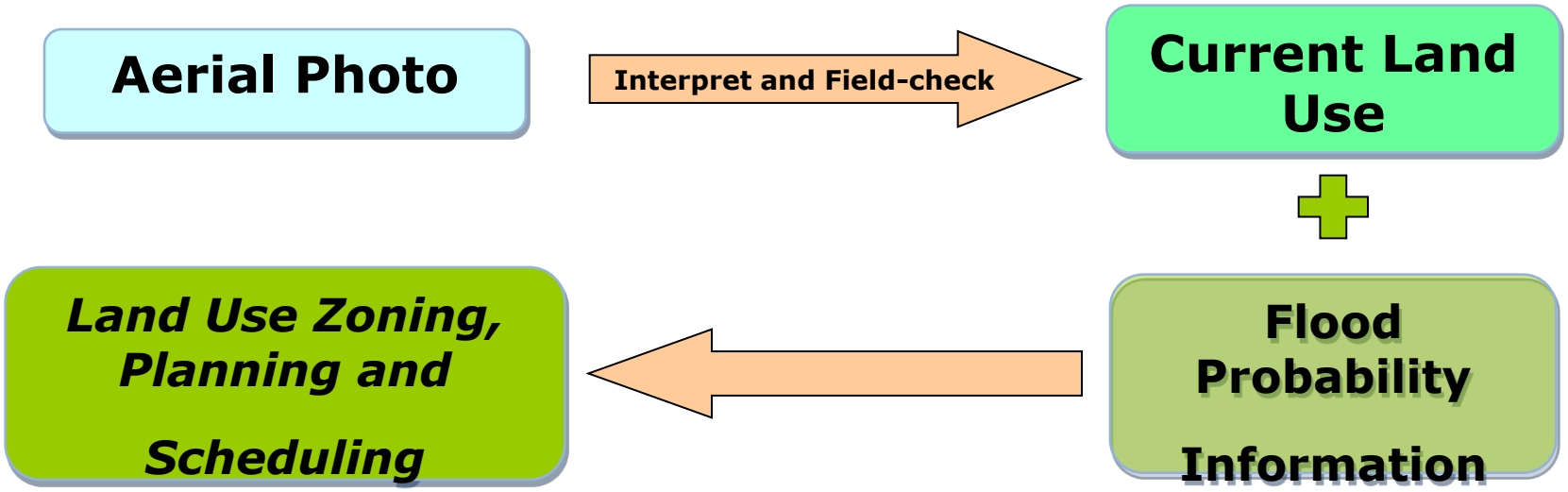
Use of Flood Information & Flood Probability Maps in Land Management & Land Use Planning of Flood Plains

Areas of Land Management & Land Use Planning	Most relevant Flood Information required	Resulting practical applications
Flood Conform Policy Formulation for Flood Plain Management	• Probability of flooding • Maximum depth of flooding • Duration of flooding	• Land Use Zoning with exclusion of certain activities • Design Characteristics for Buildings (Minimum height, water proofing measures) • Defining conditions for Irrigation Modernization/ Rehabilitation & Expansion
Provincial Flood Disaster Preparedness & Early Warning	• Probability of flooding • Maximum depth of flooding • Duration of flooding	• Identification & Delineation of vulnerable villages, safety areas, escape routes and emergency food stores • Improved Flood Disaster Preparedness & Early Warning Systems with life saving effects for villages & communities • Integrated into provincial & communal Development & District Strategic Plans • Improved Planning for the Location & Design of Schools & Health Centers (e.g. Height of Stakes) • Quantification & Assessment of anticipated flood impacts (= Risk Assessment) • More focused Projections & Recommendations for flood preparedness according to the Risk Assessment
Rural Infrastructure Planning & Design	• Probability of flooding • Maximum depth of flooding	• Better flood adjusted planning concerning Design & Location of Rural Infrastructure Development like • Roads • Bridges • Electricity Networks • Waterways • Water Supply • Sanitation Structures

Use of Flood Information & Flood Probability Maps in Land Management & Land Use Planning of Flood Plains

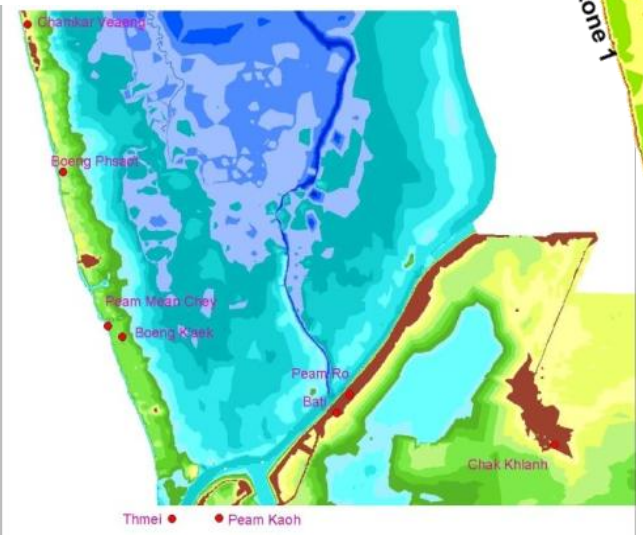
Areas of Land Management & Land Use Planning	Most relevant Flood Information required	Resulting practical applications
Irrigation & Flood Protection Master Planning	• Probability of flooding • Maximum depth of flooding • Duration of flooding • Completion of draining	• Flood Probability Maps are crucial for the Preparation of Irrigation Development Plans (District Master Plans) • Categorization & Prioritization of Irrigation Schemes and their Rehabilitation & potential Modernization • Design of Protection Facilities of the schemes • More appropriate Irrigation System Design (e.g. for more diversified cropping systems)
Agricultural Planning & Programming (incl. Fisheries)	• Probability of flooding • Start of flooding • Duration of flooding • Completion of draining	• Flood Probability Maps facilitate the Elaboration of Communal- District- & Agricultural Development Plans • Area- Delineation suitable for certain crops & varieties (e.g. Maize) becomes possible • Development of a more diversified Cropping System becomes possible • Better flood adjusted site selection for aquaculture locations (e.g. fish ponds) • The Cropping & Variety Recommendations of Agricultural Extension Services become more flood-conform & precise (e.g. concerning costly short-duration lowland rice varieties) • Better flood adjusted & more precise Cropping Schedules become possible (e.g. concerning short-duration lowland rice & recession rice) • Improved Identification of suitable locations for Emergency Food Stores in case of Flooding • The Integration of Flood Probability Information/ Maps into the Agricultural Extension Service will greatly improve the FOOD SAFETY of the Population living in the flood prone areas

Technical Flow Chart for the Map Elaboration in a GIS-Application

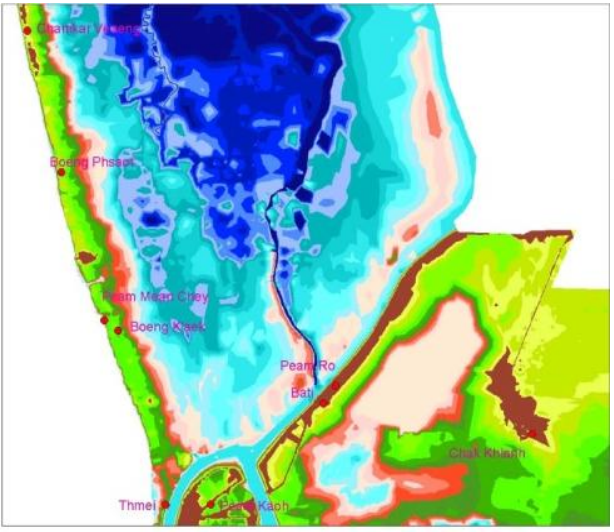


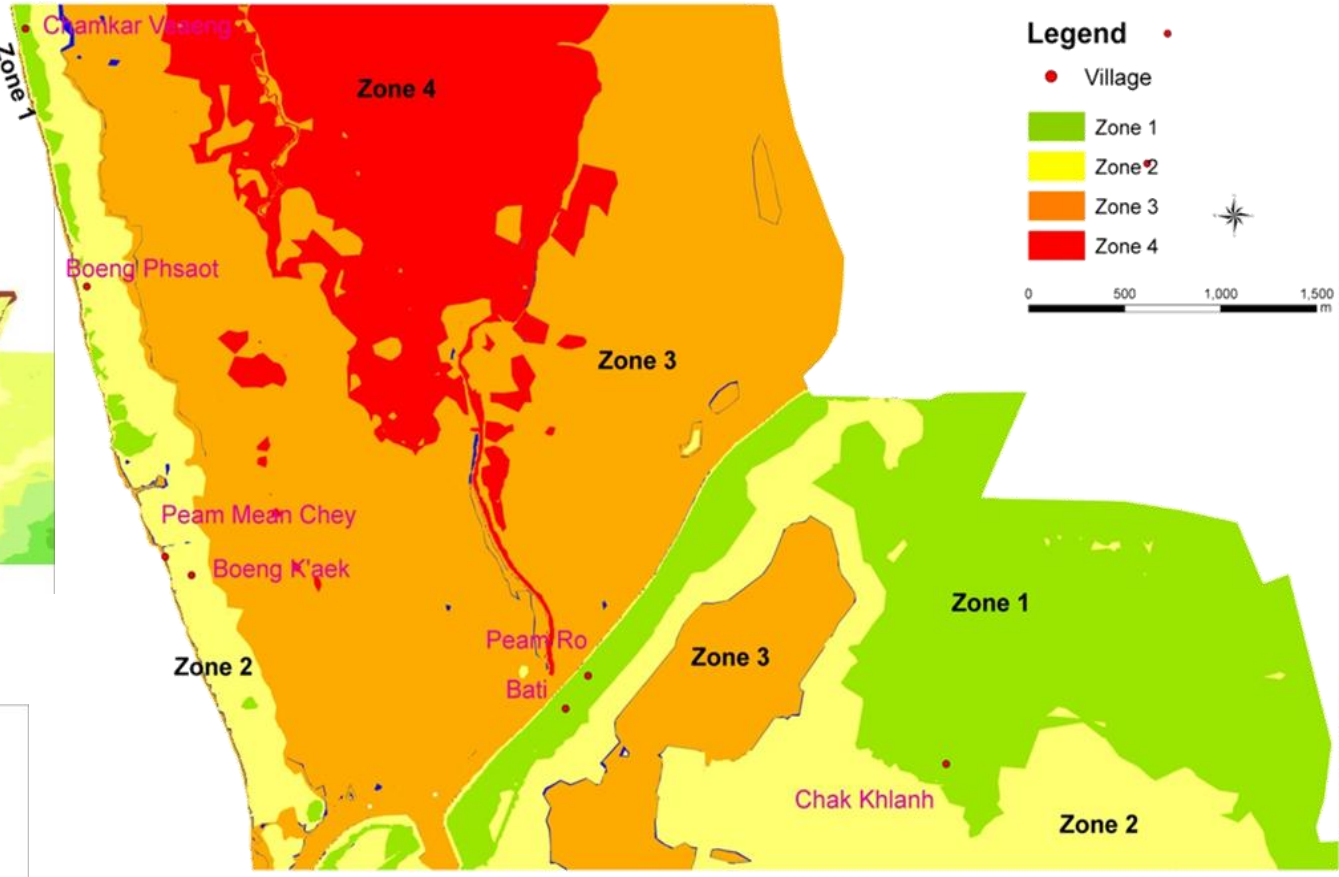
LAND MANAGEMENT ZONING

MAXIMUM DEPTH OF FLOODING
(20% PROBABILITY OF EXCEEDANCE)



DURATION OF FLOODING
(20% PROBABILITY OF EXCEEDANCE)



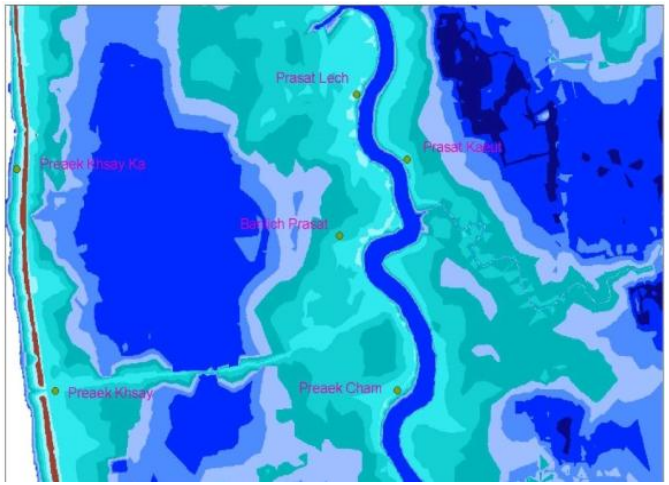


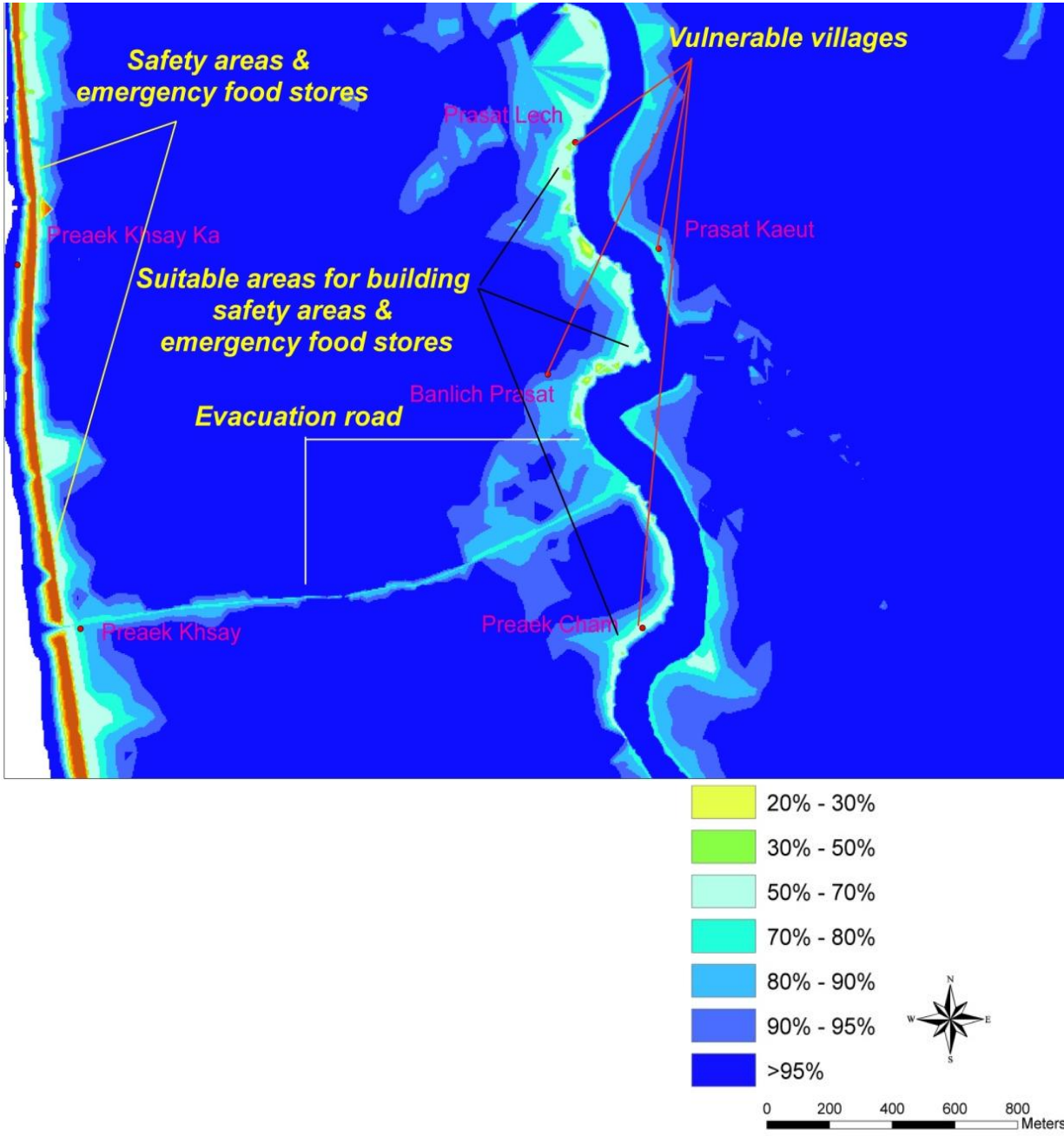
LAND MANAGEMENT POLICY FORMULATION FOR 4 ZONES

DISASTER MANAGEMENT PLANNING

MAXIMUM DEPTH OF FLOODING
(1% PROBABILITY OF EXCEEDANCE)

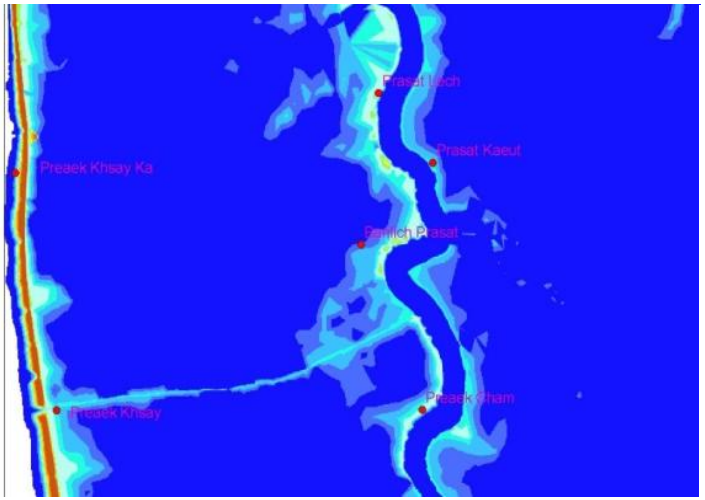
DURATION OF FLOODING
(1% PROBABILITY OF EXCEEDANCE)



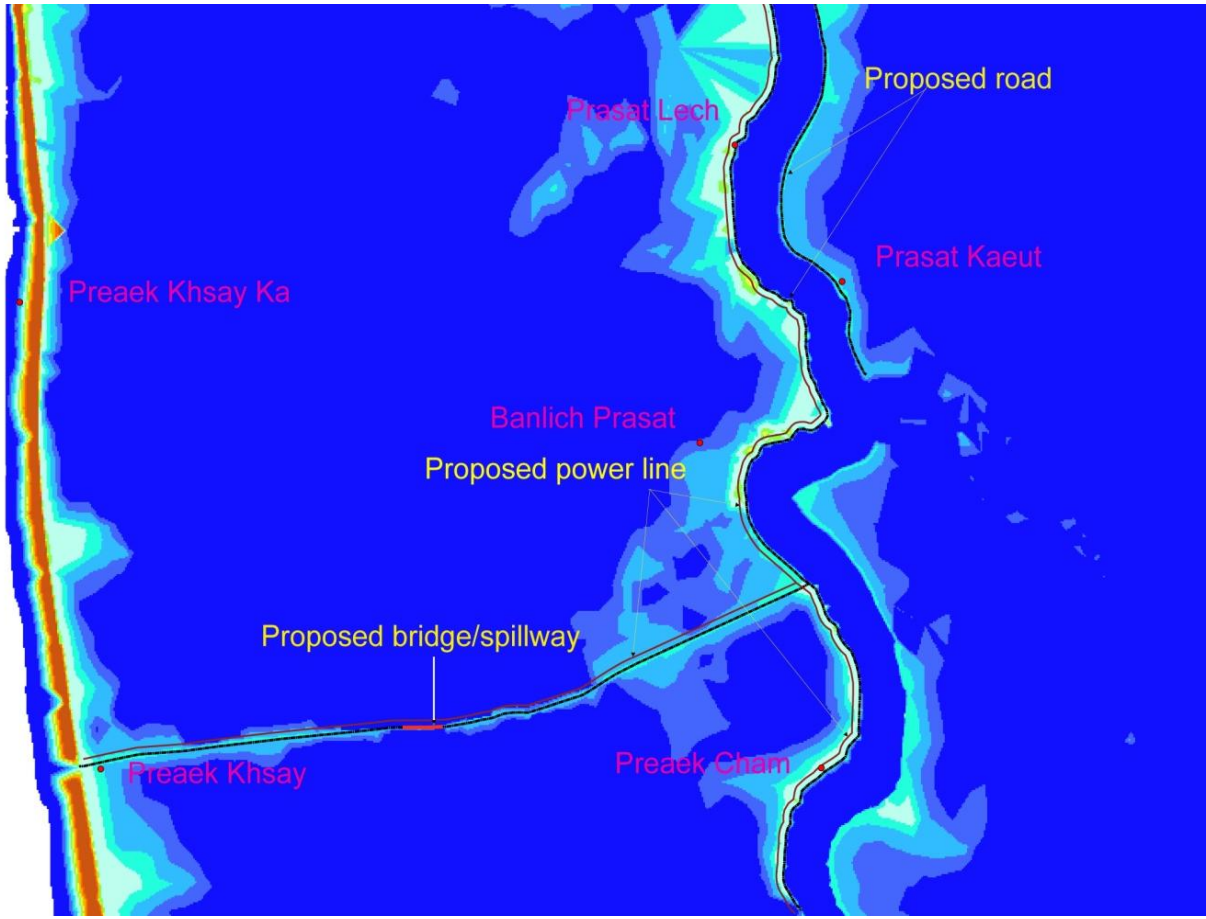


INFRASTRUCTURE PLANNING

PROBABILITY OF FLOODING



MAXIMUM DEPTH OF FLOODING
(1% PROBABILITY OF EXCEEDANCE)

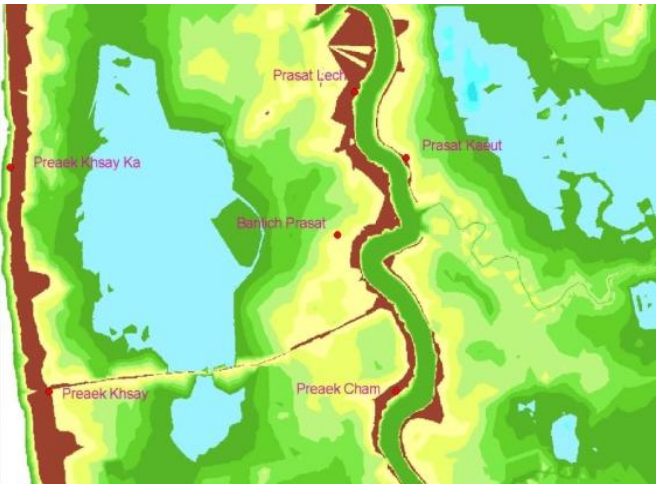


10% - 20%
20% - 30%
30% - 50%
50% - 70%
70% - 80%
80% - 90%
90% - 95%
>95%

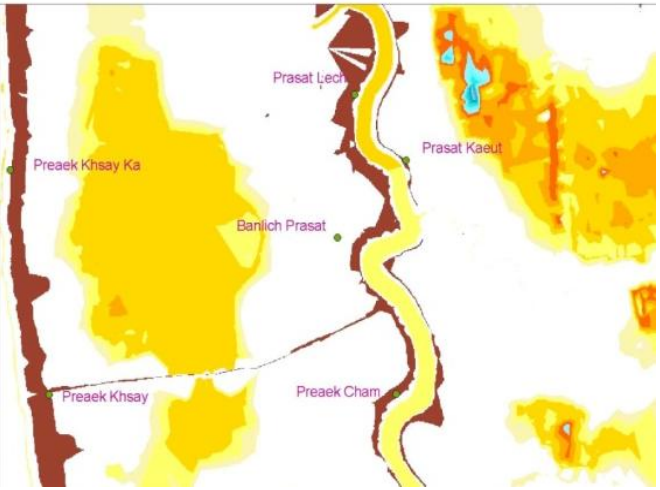
0 200 400 600 800 Meters

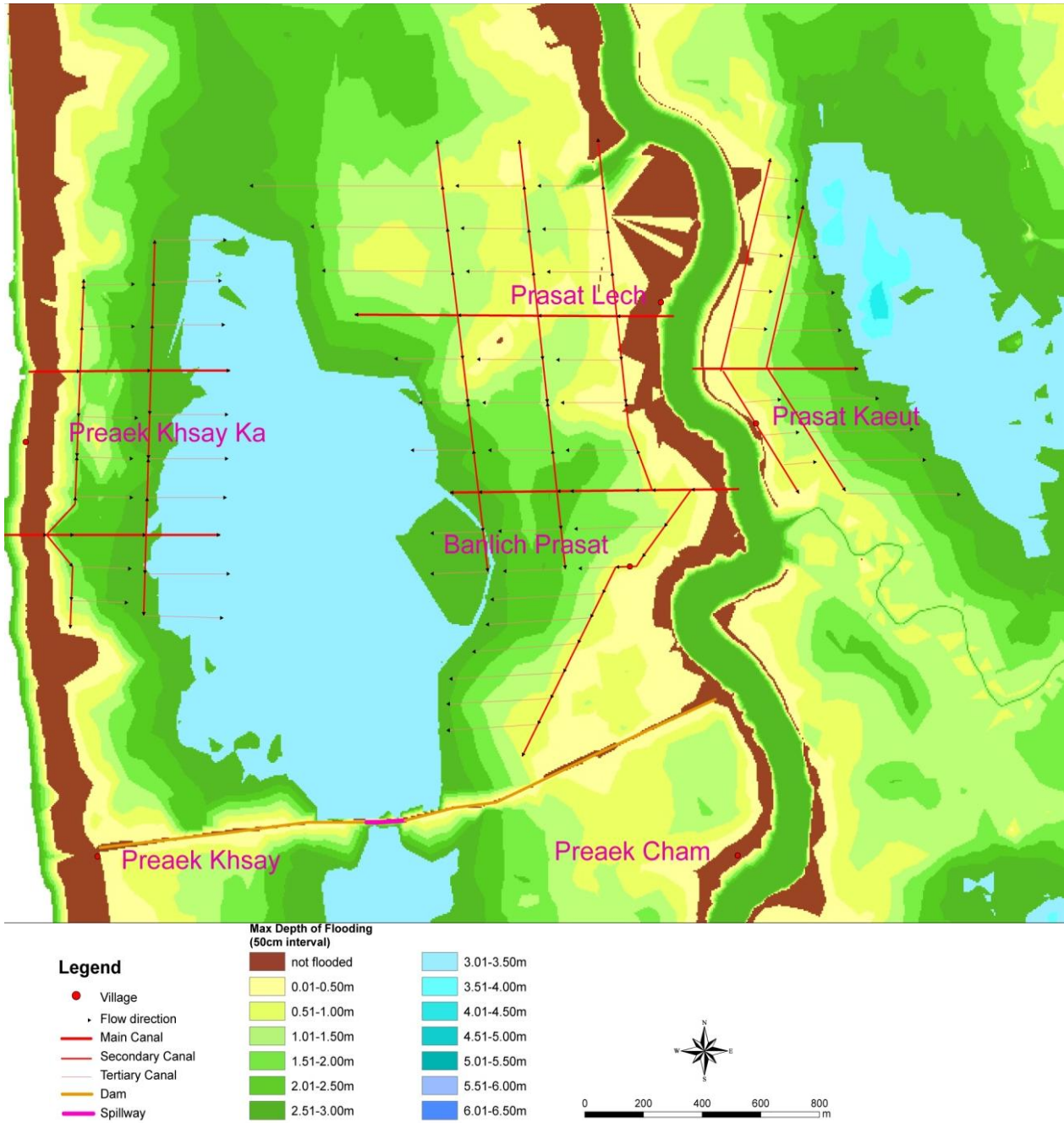
IRRIGATION PLANNING

MAXIMUM DEPTH OF FLOODING
(80% PROBABILITY OF EXCEEDANCE)



DURATION OF FLOODING
(80% PROBABILITY OF EXCEEDANCE)

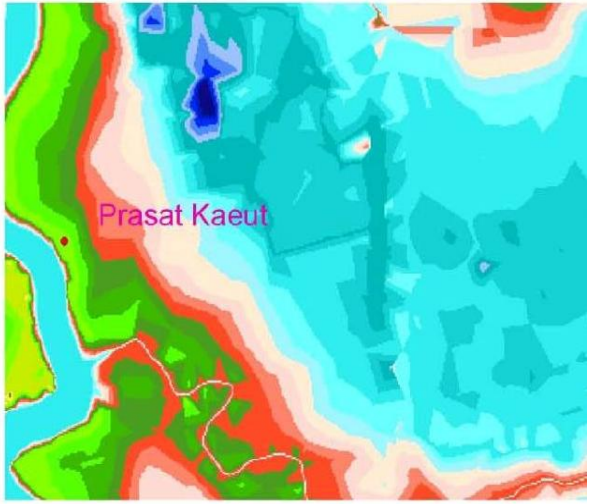


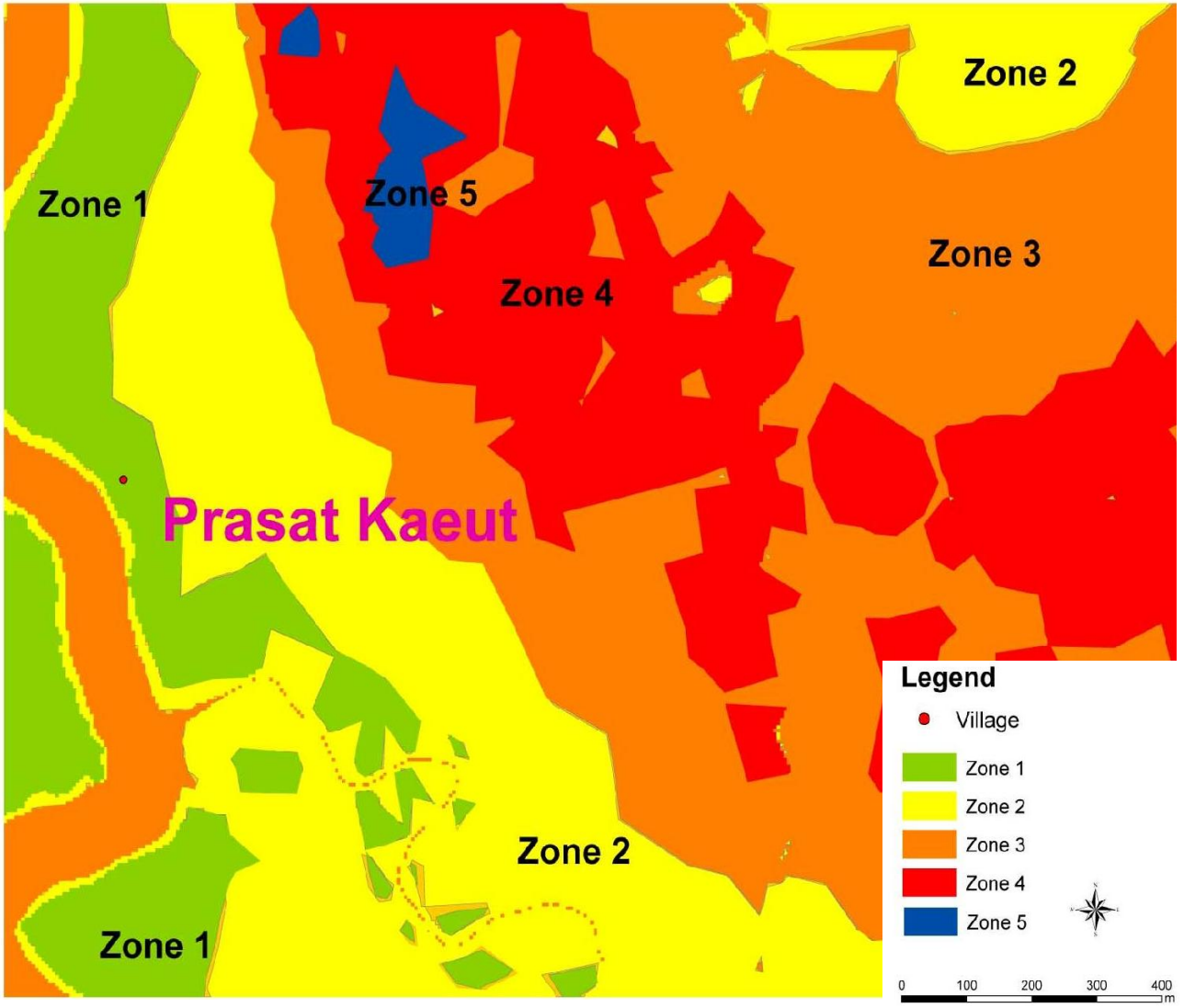


AGRICULTURAL PLANNING

MAXIMUM DEPTH OF FLOODING
(20% PROBABILITY OF EXCEEDANCE)

DURATION OF FLOODING
(20% PROBABILITY OF EXCEEDANCE)



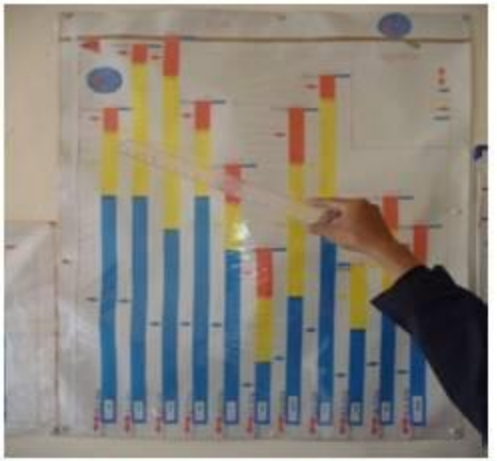


AGRICULTURAL LAND USE ZONING (5 ZONES) FOR RICE PRODUCTION

Recommended "*probability-of-exceedance*"-values for the use of Flood Probability Maps in Land Management:

Land Management Area	probability of *exceedance*
Flood conform policy formulation for flood plain management	3% to 20%
Rural infrastructure planning and design	
Flood disaster preparedness and early warning	1% to 5%
Irrigation planning	15% to 25%
Agricultural planning and programming	

probability of *exceedance*	= one year in …
1%	100
3%	33
5%	20
10%	10
20%	5
50%	2



CONCLUSIONS & RESULTS

- **So far the FMMP-C5 - methodology for mapping flood statistics has been shown to be reliable for three pilot areas in the Cambodian flood plains during FMMP-C5 - Phase 1 & 2.**

- **Based on the produced FPM FMMP-C5 developed pilot examples in Cambodia concerning the potential use of FPM in Land Management and Land Use Planning – in cooperation with Line Agencies (on National, Provincial and District/Commune Level) and the Faculty of Land Management of the Royal University of Agriculture.**

- **The Faculty of Land Management of the Royal University of Agriculture (RUA)/ Phnom Penh has implemented the FMMP-C5 TOT-Curriculum (including all existing, readily available and translated FMMP-C5 education materials) into their university teaching plan.**

- **University-students and -staff as well as Line Agencies (on National, Provincial- and District/ Commune – Level) have been trained by FMMP-C5 on the FPM-Production & - Use in Land Management in Cambodia (up to now 247 participants).**

- **Line Agency-Staff from Cambodia, Lao PDR, Thailand and Vietnam participated in a study tour to Cambodia (51 participants in total/ February 2010) and received FPM-production- trainings (23 participants from Cambodia, 5 participants each from Lao PDR & Thailand, 15 participants from Vietnam/ March 2009 & 2010), for Thailand and Lao PDR based on the Cambodian experiences and examples.**

- **The Cambodian FMMP-C5-methodology – designed to deal with regular annual flooding of several months duration – has now been applied in Vietnam to produce similar maps of flood statistics. However, the influence of flood management measures, including accelerated drainage by pumping, needs to be identified so that maps of quasi-natural conditions can be produced.**

- **An alternative approach is needed for the districts in Laos and Thailand, apart from the lack of flood mark data, caused by the absence of flooding in 2009 & 2010, due to**
  - **ongoing flood protection works in the pilot districts causing instabilities of the statistical description of river hydrographs and**
  - **because the MapStat-procedure is not applicable where the floodwaters are not related to river levels throughout the flood season.**

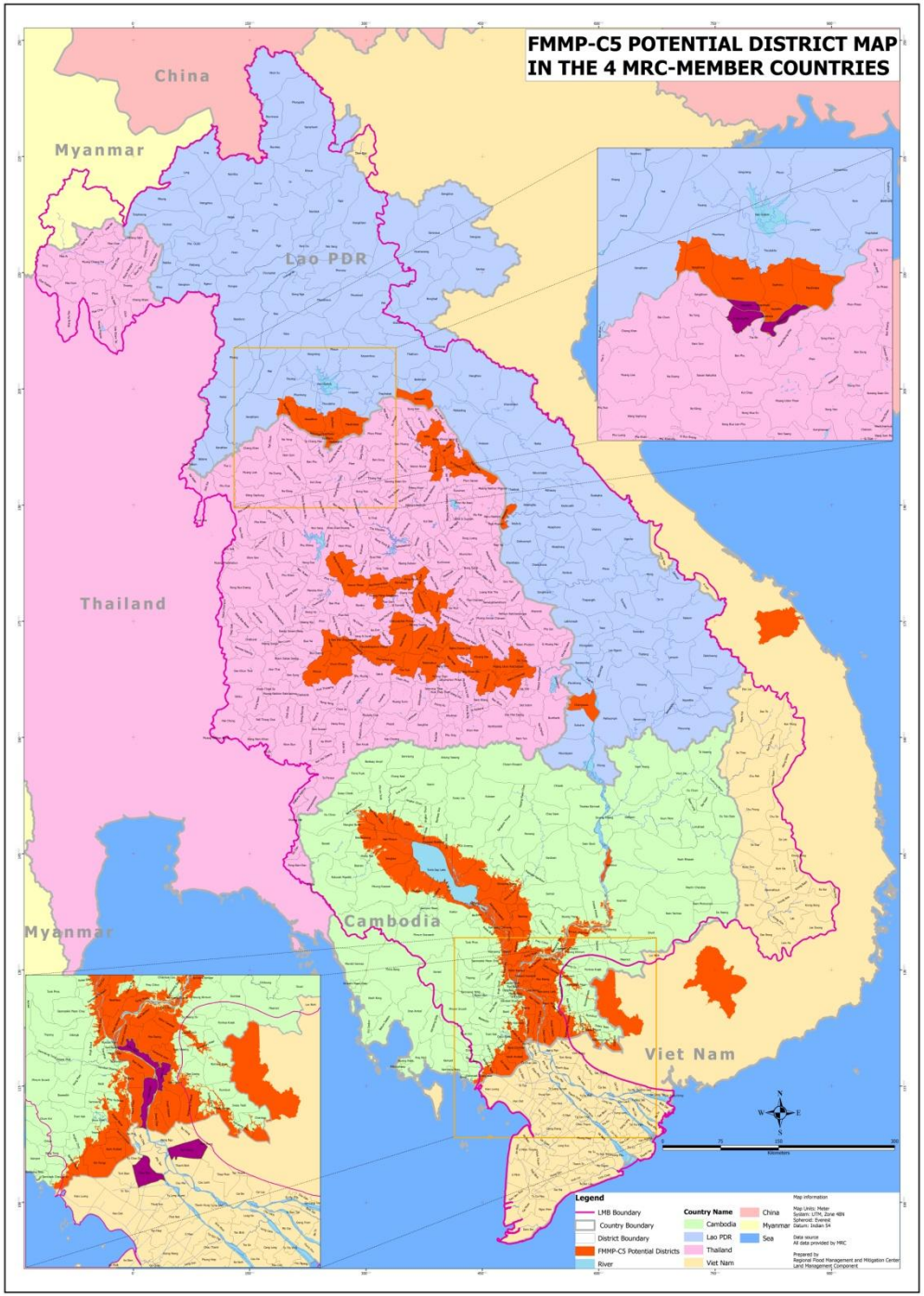
- **Therefore, the correlation model used in Cambodia & Vietnam could not be applied effectively and no FPM, meant to be used in Land Management, could be produced for Lao PDR and Thailand during Phase 2 of FMMP-C5.**

RECOMMENDATIONS

- **FMMP C 5 produces flood probability maps at a scale of 1: 10 000 or larger. This should become a planning tool for line agencies in the four participating countries, which will help to avoid or at least minimize flood risks and damages along the Mekong River.**

- **The Planning Authorities in the four participating countries as well as the MRC-CCAI (Climate Change and Adaptation Initiative of MRC) should use the FMMP- C5 – Approach and its Maps for their strategy against Climate Change Effects (e.g. increase of flooding) as an ADAPTATION & MITIGATION TOOL.**

- **Particularly for Cambodia, extension of the map coverage and the sustainability of map production are recommended after Phase 2 of Component 5 is completed (03/ 2011).**


FMMP-C5 POTENTIAL DISTRICT MAP
IN THE 4 MRC-MEMBER COUNTRIES
China
Myanmar
Lao PDR
Thailand
Cambodia
Myanmar
Viet Nam
Legend
LHB Boundary
Country Boundary
District Boundary
FMMP-C5 Potential Districts
River
Country Name
Cambodia
Lao PDR
Thailand
Viet Nam
China
Myanmar
Sea
Map information
Data source
All data provided by MRC
Prepared by
Regional Flood Management and Mitigation Center
Land Management Component

Country	District	(planned) Pilot area [km²]	C5-Approach implementation costs [US-$]	Thereof: topographic survey costs	thereof: flood mark- and billboard installation	potential damage costs [US-$]	potential avoided loss [US-$]	Ratio "damage costs/C5 costs" factor 1:
CAMBODIA	*Koh Andet*	*269*	*1.017.004*	*881.550*	*135.454*	***1.846.000***	*828.996*	*1,8*
	Leuk Dek	**42**	**211.254**	**168.000**	**43.254**	980.616	769.362	**4,6**
	Peam Ro	**91**	**409.174**	**364.000**	**45.174**	2.124.668	1.715.494	**5,2**
	Lovea Em	**14**	**95.664**	**56.000**	**39.664**	326.872	231.208	**3,4**
LAOS	*Champasack*	*9*	*55.173*	*37.035*	*18.138*	*1.070.000*	*1.014.827*	*19,4*
	Nong Bok	*8*	*70.374*	*52.650*	*17.724*	*455.000*	*384.626*	*6,5*
	Paksane	*5*	*35.232*	*25.350*	*9.882*	*546.875*	*511.643*	*15,5*
	Sikhottabong	**7**	**34.245**	**27.105**	**7.140**	**760.156**	725.911	**22,2**
	Hatxayfong	**7**	**37.007**	**29.117**	**7.890**	**843.750**	806.743	**22,8**
VIETNAM	*Tan Bien*	*41*	*41.500*	*15.000*	*20.000*	*1.052.205*	*1.010.705*	*25,4*
	Trang Bang	*48*	*41.500*	*15.000*	*20.000*	*1.998.769*	*1.957.269*	*48,2*
	Chau Phu	**61**	**78.500**	**15.000**	**18.755**	**4.273.000**	4.194.500	**54,4**
	Tam Nong	**53**	**78.500**	**15.000**	**18.480**	**9.609.000**	9.530.500	**122,4**
THAILAND	*Tha U Tain*	*297*	*90.932*	*52.105*	*38.827*	*266.667*	*175.735*	*2,9*
	Sri Chiang Mai	**33**	**38.980**	**19.682**	**19.298**	**284.060**	245.080	7,3
district average		**66**	**155.669**	**118.173**	**30.645**	**1.762.509**	1.606.840	**11,3**
total for C5 pilot districts		**308**	**983.324**	**693.904**	**199.655**	**19.202.122**	**18.218.798**	**19,5**
total for planned pilot districts		*677*	***1.351.715***	***1.078.690***	***260.025***	***7.235.516***	***5.883.801***	***5,4***

- **The establishment of an extensive DEM/ DTM by MRC (using LIDAR), covering the entire LMB (at least the flood prone areas adjacent to the Mekong River), is recommended, which would reduce the C5-Input Costs (for expensive topographic surveys) immensely.**

- **In Cambodia, establishment of flood marks, collation and processing of the data, and production of the FPM should remain a major function of the DHRW (Department of Hydrology and River Works)/ Phnom Penh, which should provide the FPM as a service to other, "data & map using" agencies.**

- **If a regular FPM-Production becomes possible in the other three Member Countries in the future, these should be the tasks of the DMH (Department of Meteorology & Hydrology) in Lao PDR (under WREA), the DWR (Department of Water Resources) in Thailand and the SIWRR (Southern Institute for Water Resources Research) in Vietnam.**

- **Line Agencies, lacking capacities, could be supported by competent local consultants experienced in statistical analysis and GIS applications.**
- **For Laos and Thailand an alternative solution – for the production of Flood Event Maps - could be to use a hydraulic model such as ISIS applied to each flood event and based on observed data.**
- **The area modelled would have to be expanded from the present pilot areas, including an extension of the DEM/ DTM and the number of flood marks, supported by high quality satellite based flood extent mapping.**
- **Since FMMP-C5-Phase 2 finishes in 03/ 2011, such a new approach should be considered only for an overall 2nd Phase of FMMP.**

Thank you very much for your attention !

Dr. Martin Falke

Team Leader (GFA-Consulting Group)
MRC Flood Management and Mitigation Programme (FMMP)
Land Management Component (C 5)
Regional Flood Management & Mitigation Centre (RFMMC)
Phnom Penh/ Cambodia
Email: falke@mrcmekong.org