FLOOD RISK MAPPING
(QUẢNG PHÚ - QUẢNG ĐIỀN - THỪA THIÊN HUẾ)

DWF
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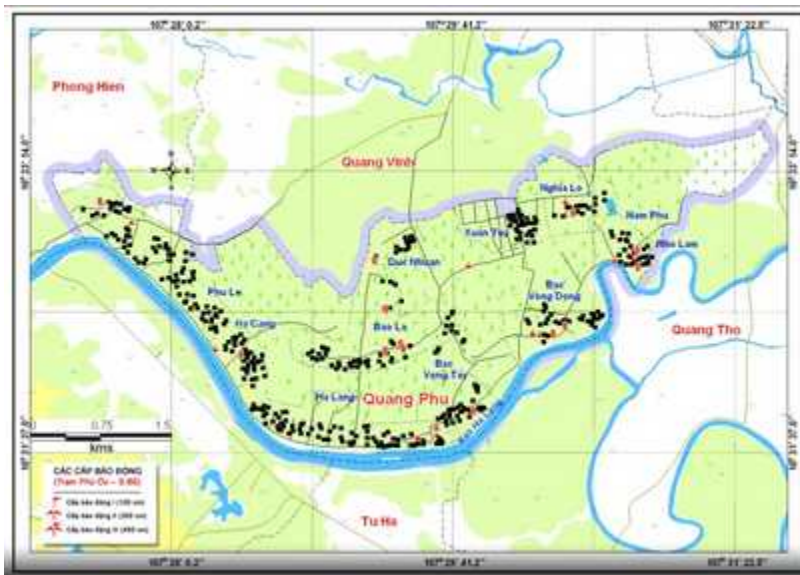**Nguyen Quang Tuan**
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I.   OBJECTIVE

Picture 1 *: Map of Quang Phu Commune, Quang Dien , Thua Thien Hue*

Quang Phu is a commune of 11.900 ha, located to the North of Thua Thien Hue, 18 km from Hue City.
- East: border Quang Vinh Commune
- West: border Tu Ha Town
- South: border Phong Hien Commune
- North: border Quang Tho Commune

There are 11,500 population, 2,300 families in the whole commune, settle in 13 villages (Bac Vong Dong, Bac Vong Tay, Bao La (1 & 2), Phu Le, Nho Lam, Nam Phu, Nghia Lo, Ha Cang, Ha Lang, Van Ha Lang, Xuan Tuy, Duc Nhuan).

Quang Phu is a commune in low plain, along Bo River. Most of the people are poor; infrastructure remains un-solid. Annually, when disaster occurs, the people have to deal with serious damages, to life and assets.

DWF, one of partners of Quang Phu, supports the Commune to reach the imperative need in disaster damages reduction. Reduction action in Quang Phu is in the framework of DWF's Project, from that, "Flood risk mapping" in Quang Phu is made.

II.   IMPLEMENTATION METHOD

During the implementation, we use topography map (scale: 1/10,000) to set up basic (background) map and DEM matching the requirement of establishing "Flood risk mapping", and use reproduction problem to reproduce flood following warning levels by Hydrometeorology Centre, basing on Phu Oc Observation and Warning Station (Bo River).

From digital altitude model, different view directions could be set up, then slope, topography, hydrography, and flood water level spitting could be analyzed. Mapinjfo 9.0, ArcGIS 9.2 is used to spit attribute information; space information is collected with GPS. After the collection, information was analyzed and shown in flood risk warning map.

III.   IMPLEMENTATION PERIODS

- **Field visit**
- Survey families as below:
  - Building of Quang Phu Commune → Bac Vong Dong → Bac Vong Tay → Duc Nhuan.
  - Building of Quang Phu → Van Ha Lang → Xuan Tuy → Ha Cang.
  - Building of Quang Phu → Phu Le → Ha Cang → Bao La.
  - Building of Quang Phu → Nam Phu → Nho Lam → Nghia Lo.
- Use GPS to collect longitude and latitude at the spot of survey
- Use quick investigation method with the participation of local people, following the questionnaire (about flood water level for past years, the height of foundation/floor, house condition and situation…)

- **Data analyzation**
- Use MapInfo 9.0 to set up background map
- All collected information was processed in Excel, and then connected into the risk map, using MapInfo 9.0.
- Use ArcGIS 9.2 to analyze digital altitude model (DEM) in Quang Phu
- Digital altitude model was set up with 3D "Interpolate to Raster/Inverse Distance Weighted" (ArcGIS)
- Show the height splitting by "Vertical Exaggeration"
- Combine results with remote sensing data to improve the display during model establishment.

- **Flooding rate splitting model establishment**
  Flooding risk warning system need to be set up and used on computer, use statistics method to deal with the change of flooding rate according to national warning level at different areas as followings:

  Base on investigation results on flooding situation at locality
  Each area (locality) has different kinds of topography and hydrography systems. We can see, in reality, that flooding level in this area is not the same as in other places, not in place but time also.

  Base on flooding warning system on Bo River

River	Hydrography station	Warning level I	Warning level II	Warning level III	Emergency warning
Bo	Phu Oc	100 cm	300 cm	450 cm	> 450 cm

  We apply warning levels and other specific elements of local river (Bo River) for urgent need, and reality, in term of risk warning.

  Base on topography in Thua Thien Hue
  Base on data from Hydrometeorology Centre, results from the investigation (about flooding), the difference (the height) in Thua Thien Hue, and remote sensing photos, flooding rate model would be set up as above-mentioned periods. The result is to display flooding rate in researched areas.

- **Reasons causing flooding analyse**

  In this period, the theory model and practical model will be considered in different terms. We consider, in researching areas, about endosmosis (of soil), flora covering, drainage system, welfare – economic work...

  We will, by turn, consider the capacity of being flooded in researching areas with different flooding level:

Warning level I	Warning level II	Warning level III	Emergency warning
100 cm	300 cm	450 cm	> 450 cm

  For the above flooding level, it will be different from each locality, even in the area of the same height because the foundation of each house is different in the height. That's why the participation of local people into the investigation is to test for the final product.

  Cross two methods: Use Theory flooding risk splitting model and Practical flooding situation for the past years to produce "Flood risk mapping" displaying the followings:

  – Commune border, living area borders
  – Localize flooding areas according to flooding levels (historical floods such as in 1999, 2004, 2007).
  – Flooding risk mapping: there are 4 maps; each displays different warning levels: Flooding risk map of N warning level, warning level I, warning level II, warning level III.
  – Safe areas need for evacuation in case of flooding.
  – Traffic roads, especially the shortest and most advantaged roads/access to safe areas, in case of flooding, are shown.
  –

IV. DATABASE

During implementation, following data was used:
– Digital topography map (scale: 1/10,000) of Quang Phu Commune, Quang Dien District, Thua Thien Hue Province.
– Geographic data was collected practically with GPS.
– Data about socio-economy, housing situation, damages caused by flooding were investigated practically at locality in June and July 2009, by quick investigation method in rural areas with the participation of local people and by field survey.
– Observation data from Hydrometer Centre.
– Photos from satellite Landsat TM+7.

V. ARCHIEVED RESULTS

- **Database about society**

  Among 416 families surveyed:

  Housing situation: 22 families have solid houses, 371 families have semi-solid houses, 23 families have temporary houses

  Flooding in 1999: Flooded from 0 – 100 cm (171 families, make up 41%), flooded from 101 – 200 cm (200 families, make up 48%), flooded from > 200 cm (45 families, make up 11%). Families who have little damages: 0.3 million dongs, most serious damages: 45.0 million dongs, average damages: 3.92 million dongs.

  Flooding in 2004: Flooded from 0 – 100 cm (303 families, make up 73%), flooded from 101 – 200 cm (91 families, make up 22%), flooded from > 200 cm (22 families, make up 5%). Family who have little damages: 0.1 million dongs, most serious damages: 25.0 million dongs, average damages: 0.343 million dongs.

  Flooding in 2007: Flooded from 0 – 100 cm (327 families, make up 79%), flooded from 101 – 200 cm (76 families, make up 18%), flooded from > 200 cm (13 families, make up 3%). Family who have little damages: 0.1 million dongs, most serious damages: 10.0 million dongs, average damages for each family: 0.326 million dongs.
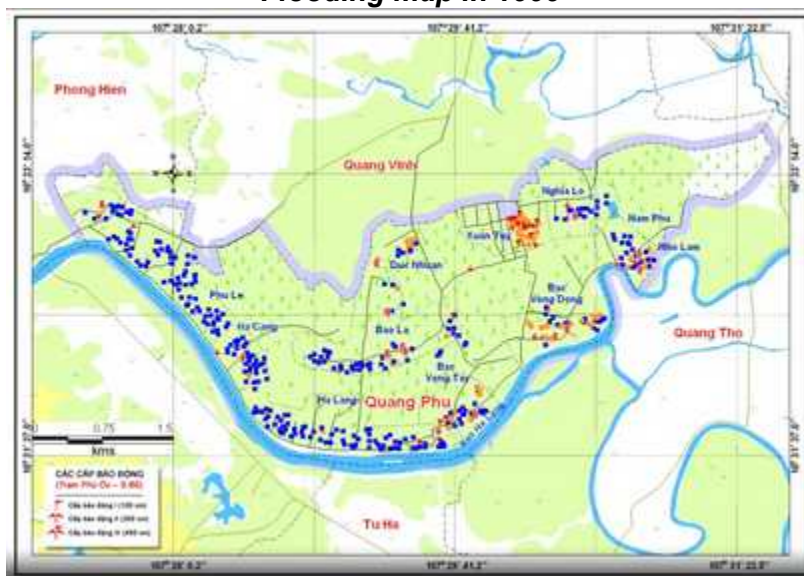
- **Define flooding risk areas**

  – **High risk areas:** Xuan Tuy, Nghia Lo, Bao La (1 & 2), Bac Vong Tay.
  – **Flooding risk areas**: Duc Nhuan, Nam Phu, Nho Lam, Bac Vong Dong, Ha Lang, Van Ha Lang.
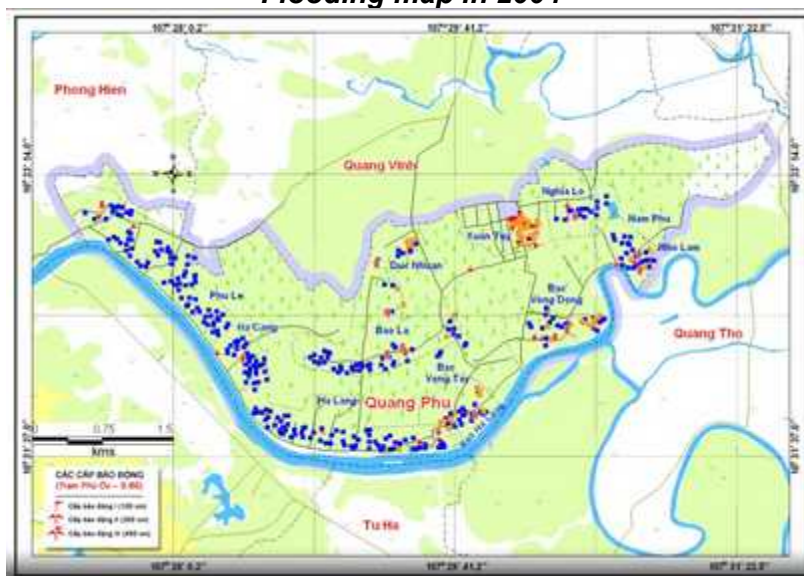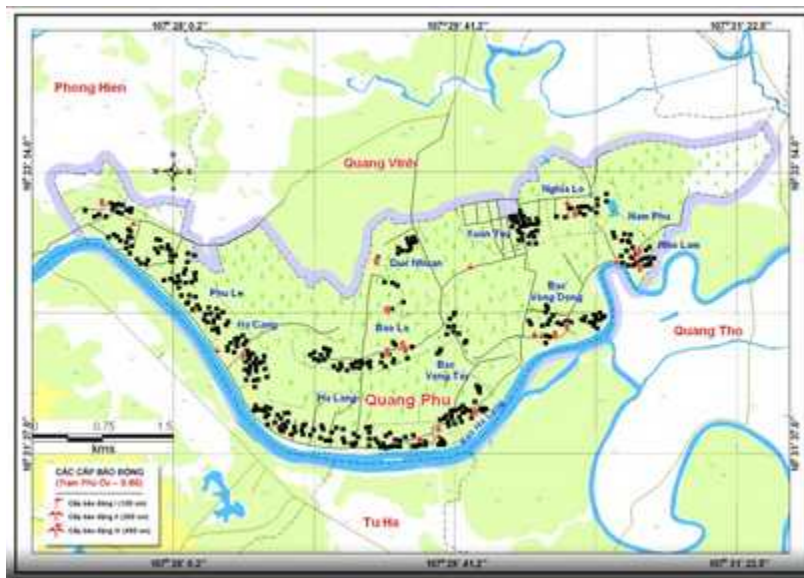 – **Low risk areas**: Phu Le, Ha Cang.
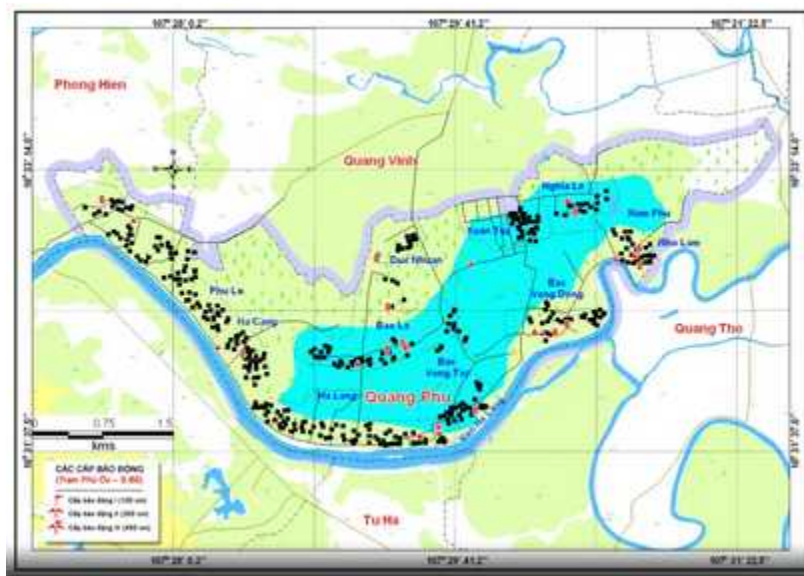
- **Flooding maps**
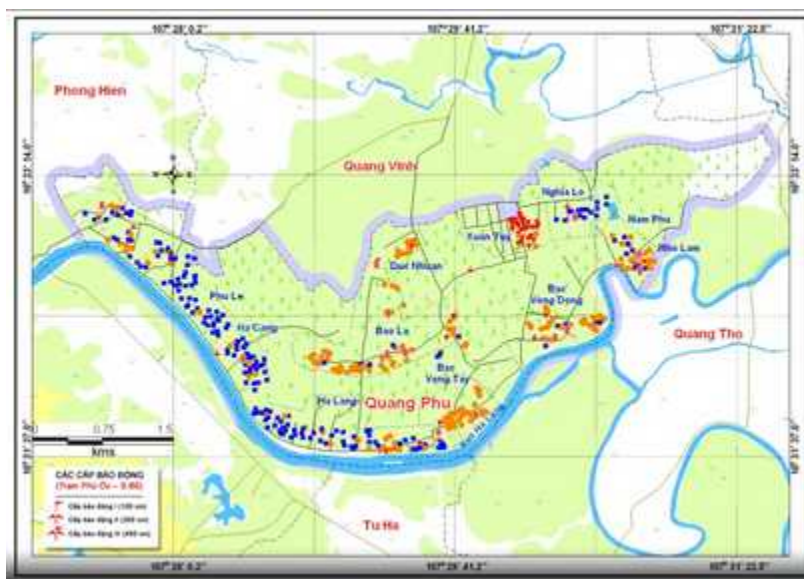
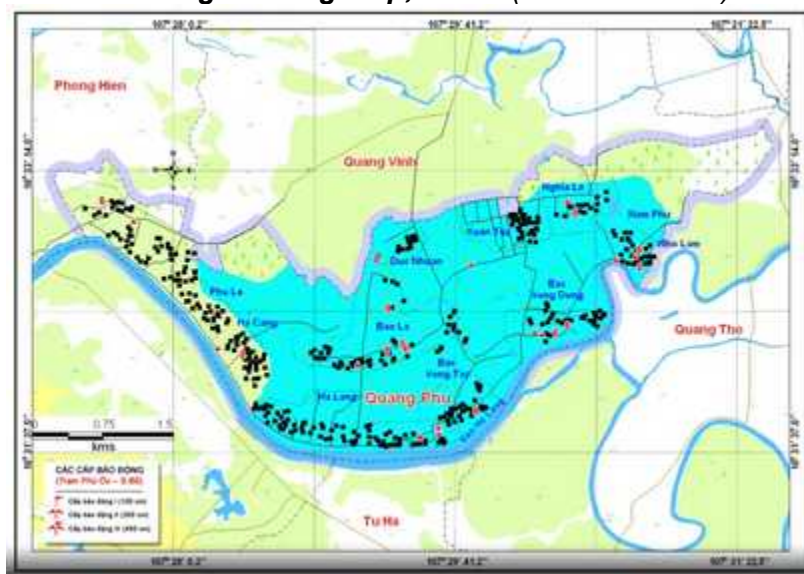*Flooding map in 1999*
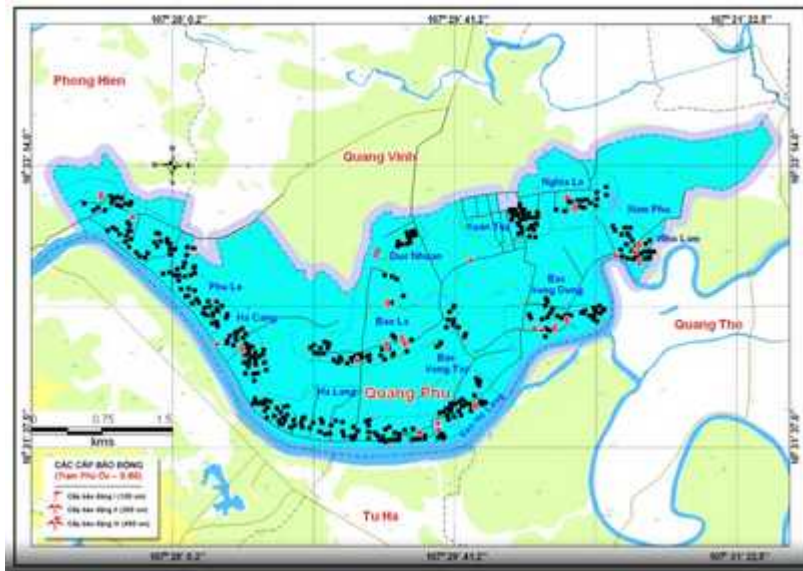

Flooding map in 2004

Flooding map in 2007

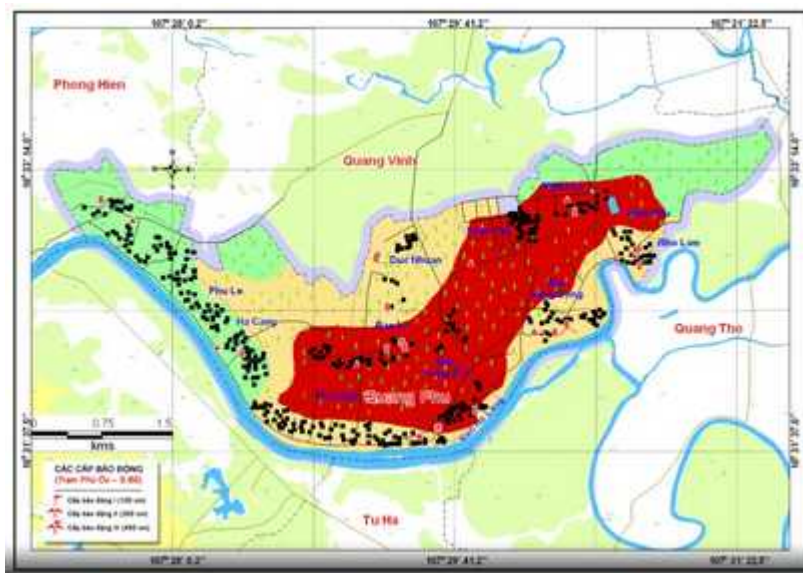*Flooding warning map, level N (Not be flooded)*

Flooding warning map, level I (flooded 100 cm)

Flooding warning map, level II (flooded 300 cm)

Flooding warning map, level III *(flooded 450 cm)*

Flooding areas splitting

Database – Houses – with level of water in case of flooding, compared to house level