

# RS/GIS Application for Community-based Disaster Prevention and Environmental Management in the Central Vietnam

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**Abstract:** The central coast of Vietnam is frequently and heavily suffered from typhoon and monsoon flooding. In order to diminish the human and economic damages under limited inputs, community-based efforts are expected to play an important role. Paying respects to the residents' own initiatives, effectual activities for disaster prevention and recovery should be designed and implemented in cooperation with scientific analysis and technical supports. A research project toward the formation of "disaster resilient communities" was launched this year under a cooperation between Kyoto University and Hue University of Agriculture and Forestry. The study team consists of experts from various fields, e.g. disaster and environmental management, architecture, agriculture and forestry. Expected products of the project include hazard mapping and resource assessment at village scale, community learning resources for disaster prevention and environmental management, and further measures toward the enhancement of social and economic capabilities through proper use of local resources. Remote sensing and GIS applications are expected to make great contributions in i) providing basic information of the study area and compiling findings from field studies into maps and databases, ii) analyzing spatial characteristics of physical and social resources and their interrelations, and iii) making visual presentation of problems, analysis and solutions to be shared by community members. Setting focus on a study site located in mountainous area in Thua Thien Hue province, the team is currently working on detailed activity design and data collection.

**Keywords:** Disaster Prevention, Environmental Management, Central Vietnam, Community-based Approach

## 1. Introduction

Natural disasters in Vietnam, particularly of climatic causes, are bringing severe damages to human lives, economy and environment of the country. The central coast is an easy target of the attacks, due to its location and geographic conditions. A major flood in October 2003 killed at least 40 people in 6 provinces in the north- and south-central coast regions [1], and typhoon Muifa in November 2004 claimed 56 lives in the same area. The total number of lives lost by floods, wind storms and landslides during 1995 - 2004 counts 7,500 throughout the country, with 23.8 million affected people and \$1.87 billion economic loss [2].

Meanwhile, the central Vietnam and Japan's main island share similar physiographic characteristics such as the long shape of land with backbone mountains and narrow alluvial plains, generating steep slopes with short and rapid drainage patterns. Attacks of typhoons and windstorms are also common in addition to earthquakes, whose damages are enhanced by such geographic features. There are a lot of lessons learned by the people and the communities, as well as by the government of the two countries through these disaster experiences. While engineering approaches for disaster control are essential but never be a perfect measure, individual and community awareness, efforts and cooperation play important roles for damage reduction and fast recovery. Environmental management through proper use of natural resources such as forestry and irrigation is also closely related with disaster prevention and rehabilitation. Moreover, we should not overlook that these solutions are often found and practiced in indigenous lifestyles and activities of the people and communities, with great variations and localities.

In 2005, Hue University of Agriculture and Forestry (HUAF) and Graduate School of Global Environmental Studies, Kyoto University (GES-KU) initiated a research cooperation on community-scale approaches for disaster and environmental management in the central Vietnam. Setting a target to the establishment of "disaster resilient community", researchers from various fields including disaster management, architecture, agriculture and forestry are participating to conduct multidisciplinary studies in a case site. In this scheme, simple transfer of external knowledge or technology is not an option, but great respect is paid for local wisdom and manner of living, which will be shared and improved by both villagers and researchers under carefully designed processes of learning.

The present paper describes an outline and current progress of the project, to which remote sensing and GIS techniques are expected to make great contributions.

## 2. Project Outline

The research initiative is designed and implemented under cooperation between GES-KU and HUAF study teams, for the period of three years from 2005 as a primary stage. The basic idea, target, and approach of the study are described hereafter.

### 1) Objectives

Safe and comfortable life under severe environment must be consistent with properly managed natural and social resources. The present study explores a participatory approach toward the formation of “disaster resilient community”, setting focus on the empowerment of the people in disaster prevention and environmental management at a local scale. Based on field studies in a case site, history of natural disasters and possible hazards, state of natural resources and their uses will be revealed. Attention is also paid to the individual and community knowledge, practices and efforts for human and environmental security, which might be found in their housing, emergency measures and production systems. The learning processes among villagers and researchers will take place to call for community participation toward the enhancement of safety and the improvement in resource usage, where some trial activities are introduced, practiced and monitored.

### 2) Study Area

The primary research site is set to Hong Ha Village in A Luoi District, Thua Thien Hue Province (Fig. 1). The province expands around the historical city of Hue for a total area of 5,050 km<sup>2</sup> with population of 1.1 million. A Luoi has the largest area among nine districts in the province, stretching in the mountain range bordering Laos. Hong Ha lies adjacent to the northern boundary of the district and is accessible from Hue city in approximately one hour by highway 49.



Fig. 1. Location of the Study Area

The village is situated in the upper Bo River watershed occupying a total area of 14,100 ha. Small fans and floodplains are formed at the foot of steep slopes with elevation ranging from 70 to 1,400 m (Fig. 2). Natural and planted forests cover some 11,000 ha (78 % of the village territory), while only 92 ha (0.7 %) is cultivated and 2,800 ha (20%) remains unutilized [3]. The total population counts 1,269 with 259 households in 2005, consisting of varied ethnic groups namely Ca Tu, Pa Co, Pa Hy, Ta Oi, and a few Kinh. Average population increase rate in 2001 - 2005 is 2.9 % per year, with very few incoming or outgoing migration. Five settlements (sub-communes) are formed along the main valley traversing the village, each resided by 35 to 60 households.

Pa Rinh settlement, sitting at a confluent fan in the east of the village center, was chosen for the site for the detailed study. The frequently flooded hamlet is resided by 49 households with 255 people dominated by Ca Tu (2004). A community house is planned to be constructed at the edge of the settlement overlooking the stream.

A panoramic view of Pa Rinh landscape over the river gives us a lot of hints for understanding the interactions between human activities and the environment (Fig. 3). The settlement is covered with homestead garden providing variety of tree crops, while paddy and upland fields show extent over the terrace and the fan. Bamboo trees behind the settlement are highly utilized for home use and industry products, and afforestation programs are undertaken in the neighborhood hills where the damages of the war remain visible after some 30 years.

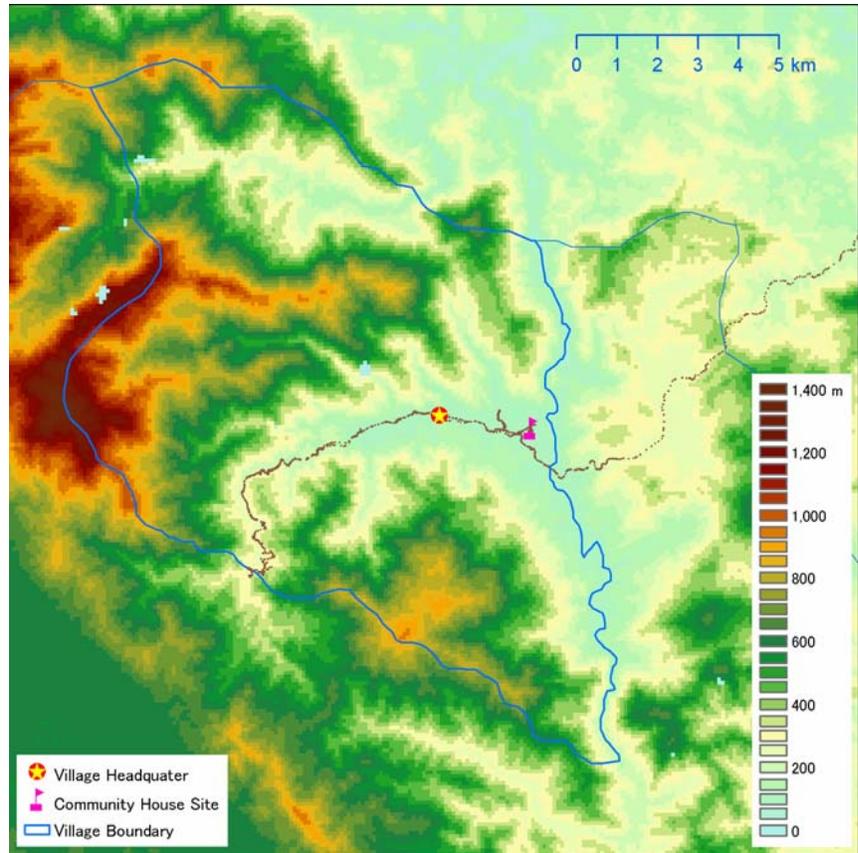


Fig. 2. Topography of Hong Ha Village



Fig. 3. Landscape of Pa Rinh Settlement

### **3) Methodology**

Hong Ha has been studied by a group of HUAF experts since 2002 under Community-Based Upland Natural Resources Management Project (CBNRM), by which several programs for economic and social development are implemented and evaluated [3]. While some participatory approaches were undertaken in order to stimulate the residents' self-direction toward the higher stage of development, introduced solutions and their evaluation stand in rather conventional views such as an increase in crop yield and afforested area, and a decrease in ratio of "poor households". The village administration and the residents in general welcomed the access of the researchers, and firm relationship among the villagers and the HUAF team has been established through the project.

The present research scheme adds dimensions and depth to the previous study, and further refers to the human security and harmonious life with quality environment toward the establishment of a disaster resilient community as an ultimate target. The study approach is characterized by several imperative stages to be followed; i) great amount of time and efforts are put into basic studies including field surveys and interviews for understanding the reality of the community, ii) focal features and key issues of the community are extracted through the findings, and detailed studies are designed accordingly, iii) trial solutions are considered and implemented under close monitoring, and iv) analysis and evaluation of the activities are reflected to the improvement and extension of the solution. These processes are iterated and improved according to the progress of the research and activities.

It should be remarked that the proposed approach does not encourage one-way feeding of knowledge and technologies from academic world to the community, but fully pays respect for the processes of mutual learning among various stakeholders including villagers, administration, and researchers. It can be regarded as being consistent with the principle of PRA (Participative Rural Appraisal), but will not be restrained to its formal procedures.

A community house will be established in the study site, in order to facilitate the research and learning activities. Ideas found in the current local housing and some lost traditions, as well as those from the latest architectural study in Japan will be incorporated into its design, demonstrating the safe and comfortable living.

### **4) Outputs and Evaluation**

Since the study is aimed at overall empowerment of community in diverse aspects, the target outputs can not be simply listed out. Basic and detailed researches may bring about a variety of analysis, maps and databases, which are not considered as the final products but as resources to further the understanding and to arouse effective solutions toward the enhancement of the community's resilience. Some trial activities including improvement in housing and diversification of production will also be implemented, but their evaluation should be based not only on quantitative measurements but rather on the consequential outcomes and the processes by which they are brought to the community.

## **3. Roles of Remote Sensing and GIS**

The multidisciplinary approach of the study is fully benefited by application of remote sensing and GIS techniques combined with field studies. The current data availability and some of the expected products are discussed.

### **1) Base Map Preparation**

Due to the poor coverage of published maps in the rural areas of the country, it is required to prepare accurate base maps of the village at several map scales. At the moment the topographic profile of the village is given by a 90-m resolution DEM from the SRTM (Shuttle Radar Topography Mission) dataset as shown in Fig. 2, which is not fine enough to represent complex geomorphology of the basin that provide great variety in land characteristics and suitability. Either aerial photographs or high resolution satellite imageries will be used to generate precise contours, as well as the present land-cover and vegetation classifications for the entire village extent, at a map scale of 1:10,000 to 1:25,000.

Larger scale maps are to be prepared for the detailed study site, Pa Rinh settlement. Individual houses and fields, the state of communal and protected forests will be plotted in order to create a spatial database of natural and social resources. Household surveys on social, economic, and other related attributes will also be conducted and compiled into the database.

### **2) Hazard Mapping**

The lack of meteorological and hydrological records in the study area makes accurate projection of possible flood damage beyond our target. However, recognition of the past damages and potential hazards are one of the key elements

to be studied. The primary stage is to plot out the exact location and degree of damages in the previous major disasters through interviews and field surveys. This information will enable us to nominate particular locations, physiographic features, and human activities of significant vulnerability, which are to be mapped and shared by the residents and researchers as a basis of discussion and learning toward strengthened protection of life and assets.

### **3) Resource Assessment**

Recognition of the state of natural resources and their use at a macroscopic scale is essential for designing the future of the community. While many households in the village are experiencing difficulties in obtaining sufficient food production and cash income, there is still considerable extent of land that has not been fully utilized. Periodical flood attacks also reduce the overall productivity of the developed land. Destruction of forest along the main road caused by the war and subsequent human activities result in lost or disturbed vegetation with poor water storability, in contrast to rich and diverse forest resources in remote hills that are used for communal purposes.

In this study, land cover/use analysis will be done based on aerial photo and high-resolution satellite image interpretation combined with field observation. Spatial analysis of these features by overlaying with topographic map will reveal the land characteristics by geomorphological units, which are useful to assess the potential suitability for development and vulnerable locations for protection.

### **4) Visualization for Community Participation**

GIS provides powerful devices for community participation. Visual presentation and analysis of the current conditions and problems will help deeper understanding of the situation, and to further extent, visible simulation of possible future changes and feasible solutions will facilitate the decision making process by stakeholders. As a successful example, Carl Steinitz' framework on "alternative future" fully utilizes the GIS capability of spatial analysis and visualization in the practical scenes of landscape planning in various locations of the world [4], whose concept and methodology are also applicable to the present study.

## **4. Current Progress and Perspectives**

In August 2005, an introductory workshop by HUAF and GES-KU researchers was held along with intensive field observation in Hong Ha, where both teams shared understanding in the objectives and approach of the study. The site for detailed study and community house location were determined, and individual research activities are currently under planning process. Baseline surveys including household questionnaire, field data collection and mapping are planned to take place from November, followed by designing and construction of the community house. Community activities will be initiated after considering the results of basic studies conducted by each researcher.

The project will also contribute to educational purposes both for KU and HUAF students. Some of the specific studies might be conducted as graduate students' research, while chances will be provided for undergraduate students to join a field excursion as an introductory step to their development-related studies. Trustful interrelations among villagers, administration, researchers and students are the key for the success of the project.

## **Acknowledgement**

The research team is grateful to Prof. Nguyen Van Toan, Vice Rector of HUAF, for his sponsorship and support for the project implementation. The research activities are principally financed by Grant-in-Aid for Scientific Research, Japan Society of the Promotion of Science (JSPS).

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