Capacity Building

Hydraulics & Coastal Engineering

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Summary

Vietnam has a long coastline with two large river delta's and about 20 smaller estuaries in between. Much of the country is a "coastal zone". The need for education in coastal issues - Coastal Zone Management and Coastal Engineering - in Vietnam is evident.

Two decades ago a coastal education programme between Vietnam and the Netherlands began. This cooperation resulted in the establishment of a BSc coastal engineering faculty at the Water Resources University (WRU) in Hanoi in the period 2001 – 2005. Staff members were trained, the actual BSc coastal engineering teaching started in 2003. More than 50 BSc students graduated annually. In the second phase of the cooperation (2005-2009), the focus shifted to undertake applied research in two fields: sea dikes and estuaries. Within this framework there were two fields: MSc education and research in Hanoi, and PhD training in Delft. Both strengthen the Vietnamese coastal engineering and ICZM knowledge base. Continuously increasing the educational level parallel with the strong economic growth is the desire of Vietnamese authorities. This capacity building will also help sustainable policies to address the impacts of global change on the coast.

The first Coastal Engineering students *at Faculty of Marine & Coastal Engineering - Water Resources University, Hanoi. (photo: WRU - CE)*

1. Introduction

Vietnam's coastline is about 3300 km long. With two large river deltas, the Red River in the North and the Mekong in the South and about 20 smaller estuaries in between, much of the country can be considered to be part of the "coastal zone". The need for Vietnamese education in coastal issues, like Coastal Zone Management with specialisations in Coastal, River, Estuary and Delta Engineering, became apparent about 20 years ago. Until then, the population had to adapt more or less to the dynamics of the coastal region caused by flooding due to typhoon surges from the sea, flooding due to typhoon rains from the rivers and estuaries, coastal erosion, salt intrusion, navigation problems due to seasonal closing off estuaries particularly in the dry season. Population pressure on the coastal area in Vietnam has increased considerably: 50 % of the total Vietnamese population (around 86 million inhabitants in 2010) live in coastal provinces. Adaptation, in the sense of 'living with regular flooding' became more and more unacceptable from both an ethical and economic point of view. However, the country at that time had no real coastal engineering tradition and no formal coastal engineering education.

The Dutch Rijkswaterstaat/Ministry of Transport, Public Works and Water Management gave initial assistance to the Vietnamese Ministry of Agriculture and Rural Development in the 1990s and the Royal Netherlands Embassy in Hanoi supported the establishment of a coastal engineering education at BSc-level at the Water Resources University (WRU) in Hanoi from 2001. This was undertaken by Delft Partners (Delft University of Technology, UNESCO-IHE and WL/Delft Hydraulics) from the Netherlands. In the first phase of that programme (2001-2005) a Coastal Engineering faculty was established. Teaching staff were trained in Delft at MSc-level and Vietnamese staff under the guidance of staff in Delft developed lecture notes. Equipment was purchased and installed to support teaching and provide the basis for research (see Figures 1 and 2).

Figure 1: ***Testing a new wave flume*** *installed in the laboratory, WRU, Hanoi. (photo: WRU - CE)*

*Figure 2****: Study on the mechanism sand dune breaching,*** *in the laboratory. (photo: WRU - CE)*

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In the second phase of the programme (2005-2009), the focus shifted to research to meet the demands of the Vietnamese society in addition to the ongoing training of teaching staff and support for the BSc-education program.
Two focal points for research were defined: sea dikes and estuaries. The need for better sea dikes became apparent during the typhoon season in 2005 when many dikes were damaged by heavy typhoons. This required a better insight in the behaviour of estuaries in Northern and Central Vietnam. The very short rivers show a large seasonal variation in the rate of discharge. This leads to natural closure of the river mouth in the dry season by natural longshore sediment transport. River floods at the beginning of each wet season, remove these natural sandy, closure dams.
Training in Delft at PhD-level took account of these two focal points. These research topics also served as preparation for MSc-education. Teaching staff undertook research in order to help maintain their scientific knowledge. This part of the training programme ended in 2009.

In the period 2001-2009, about 15 staff members of Water Resources University (WRU) studied for a MSc degree in Delft and 4 for a PhD degree. At present about 60 students leave the WRU each year with a BSc-degree in Coastal Engineering, including preliminary knowledge of Coastal Zone Management. The Coastal Engineering faculty at WRU in 2010 consists of 12 lecturers with MSc level and 6 lecturers with PhD level qualifications. WRU undertakes research, on both sea dikes and estuaries, and participates in various national research programmes relating to these coastal issues.

More detailed information can be found on the WRU Faculty of Marine and Coastal Engineering website and includes:

- An overview of training curriculum and lecture notes;
- Relevant references in the library;
- Research facilities e.g. wave flumes, Remote Sensing and Geographical Information System laboratories.

Insert 1:

The relatively low sea dikes in Vietnam lead to frequent overtopping by waves during a typhoon surge. Raising the dikes to avoid overtopping is expensive and difficult in spatial planning terms. The inner slopes of the dikes therefore have to be strong enough to withstand the overtopping.

In the wave flume in the hydraulic laboratory of WRU, overtopping tests are undertaken to study e.g. the influence of a crown wall (see wave flume photo above) on overtopping discharges. (photo: H.J. Verhagen)

The strength of inner slopes cannot be tested on a small scale and tests have to be done on real dikes. Realistic overtopping volumes are simulated with a Wave Overtopping Simulator in Vietnam on the sea dike in Do Son – Hai Phong, in the same way as is done in the Netherlands. (photo: G.J.Schiereck)

Wave flume testing the reduction of wave overtopping by Vetiver grass. (photo: H.J. Verhagen)

The developments sketched above continue. Most economic growth takes place in the low-lying coastal areas of the country and, hence, the population pressure on these areas is ever increasing. The Vietnamese government has recognised the potential of the coastal and marine zones and has set a target that in 2020 more than 50% of the GDP will come from these zones (either from fisheries, mining, transport, tourism or any other economic activity).

This already offers enough challenges, but climate change makes the situation even more difficult.
Vietnam is in the top of the countries worldwide, vulnerable to sea level rise (see CCC II-8-1). Permanent inundation, more frequent flooding by rivers and typhoon surges, more and longer periods of low river discharges, lead to salt water intrusion and lack of fresh water are among the threats to development.

These threats are explicitly covered in the action plan on climate change prepared by the Ministry of Agriculture and Rural Development (MARD). This is part of the overall approach by the Vietnamese government, in which the Ministry of Natural Resources and Environment takes the lead on climate issues, and where MARD is responsible for the implementation in the water sector.

After about 20 years of coastal cooperation in the field of education in coastal engineering and ICZM, the Dutch assistance will gradually reduce, while the Vietnamese efforts will gradually increase.

Insert 2:

On top of the natural dynamics of inlets, human interference also plays a role. Sand mining takes place everywhere, in the mouth of the Hue estuary, although until now only on a small scale. (photo: G.J.Schiereck)

Coastal dynamics play an important role along the Vietnamese coastline. Here in Nam Dinh, complete villages have disappeared due to coastal erosion. (photo: G.J.Schiereck)

Inlets and estuaries, where rivers meet the sea, are widespread and well studied, dynamic areas worldwide. In Central Vietnam, these features show some specific difficulties. The distance from mountains to sea is relatively small (0 ~100 km). Such a small catchment area leads to large seasonal differences in river discharge, sometimes even zero in the dry season. The monsoon driven littoral drift causes the growth of large spits and sometimes even closes off the estuary completely. At the start of the wet season, these spits obstruct the river flows into the sea resulting in flooding of the coastal area before these natural sand dams are removed by either the river or waves from the sea. Also in less extreme situations, these dynamics cause problems for navigation to and from the estuary.

3. MSc coastal education in Vietnam

Vietnamese society has shown great resilience in the past and there appears to be enough drive to cope with problems that lie ahead. It is obvious, however, that a higher level of education and research is needed to meet the challenges. In the coming decades plans have to be developed and decisions made that may have far-reaching consequences. Major mistakes could be disastrous from an economic point of view or may be unsustainable. The need for advanced engineering is also obvious, since adaptation to global changes will require major infrastructure development.

Coastal Zone Management is a proper umbrella, for water and coastal management and for spatial planning in the low-lying areas of the country, including the large deltas and the estuarine systems. An integrated approach is the way to achieve the best possible and sustainable solutions for the areas under discussion and to avoid as much as possible, blind spots in spatial planning. In-depth engineering knowledge is in the mean time, of paramount importance, both for understanding the behaviour of the highly dynamic nature of coastal areas and in designing measures to accommodate society's needs.

MSc-education dealing with coastal issues will become more and more important in the coming years. Such an education should contain both general planning issues as well as engineering specialisations, covering all elements of the coastal and marine environment, including soils and subsoil.

More information for your updating: the first master course of marine and coastal engineering is opened in academic year of 2011 with 20 students. Course will last 1 and half year. Master education will be continued annually.

4. In Conclusion

The coastal zone of Vietnam is being rapidly developed, densely populated and is critically vulnerable to the impacts of climate change. Hence, creating its own Faculty of Marine and Coastal Engineering was a high priority for the Vietnamese Government. Finance and expert assistance in the fields of hydraulics, coastal engineering and ICZM is being offered by the Netherlands. In this way the government of the Netherlands shows its desire to contribute to the exchange and transfer of coastal knowledge as laid down in Conventions (UN-Framework Convention on Climate Change, UN-Convention on Biological Diversity, Agenda 21), Conferences (e.g. World Coast Conference'93) and Memoranda of Understanding.
As this expertise grows Vietnam will become more and more self-reliant by strengthening the application of knowledge from the WRU Faculty of Marine and Coastal Engineering to coastal management and development.

5. Websites:

- **Delft University of Technology - Hydraulic Engineering, Delft**
  http://www.citg.tudelft.nl/live/pagina.jsp?id=4807bd3d-131f-4004-ba64-5806648683e5&lang=en
- **Deltares: the institute for applied research in the field of water, subsurface and infrastructure - Delft.**
  http://www.deltares.nl/en
- **WRU – CE: Water Resources University - Faculty of Marine & Coastal Engineering, Hanoi:**
  http://coastal.wru.edu.vn/index.asp?lang=en&page=news1 and
  http://coastal.wru.edu.vn/wruce/index.asp?lang=vn&page=introduction
- **UNESCO-IHE, Delft:**
  http://www.unesco-ihe.org/