Management of River and Dyke Protection Red River Delta, Vietnam

Eric J Lesleighter and Tran Xuan Thai***

ABSTRACT: *The paper reveals how the scale of the dyke protection works in the Red River Delta which have been needed has not been matched even closely by the budget available. The Government strategy has been to concentrate on critical areas, with the inevitable result that many needy areas miss out or are covered insufficiently. The suggestion is that embarking on a course of large-scale river training would greatly compound the budgetary constraints faced by the Government and the provinces, and would create a compelling ongoing program of river "control" that would be never-ending. The paper addresses the specific areas of concern, the river management works which economically meet the requirements, and the program of strategic personnel training, in order to optimise the budgetary allocations by sound management of the costs of design, materials and construction.*

1. INTRODUCTION

Flood and storm control, and natural disaster mitigation, are a State strategy for countries where there is intense monsoonal rainfall over a dense river system like that of the Red River in Vietnam. The realities of yearly flooding has been a part of life for the Delta's 17 million inhabitants for centuries. The scale of the problem is reflected in the extensive system of major river levees (dykes), and the measures which are taken to safeguard the integrity of the system.

While not the only method of flood management, systems of levees along river banks have been adopted in many countries as a tangible, and visible, way of protecting riverine lands. The use of such an approach has been criticised. In the major floods in the central USA in 1993, a number of levees were breached, naturally leading to the inundation of large areas of land. Criticism has included the claim that the resultant flooding would have been less if the levees had not been there in the first place; or at least the flooding would have been more "equitable" with "all" being flooded rather than the unlucky ones who happened to have properties beside the breach.

The major flooding in Bangkok in October 1995 was blamed (probably wrongly) on riverside embankments by residents in certain eastern areas of the city. As a result many embankments were demolished in efforts to "let the water out", only to lead to more flooding from the river during subsequent high tides and discharges. So the debate goes on. When the studies, which spauned this paper, were commenced in Hanoi in 1993, some of the local opinion was that the levees along the Red River should be removed.

In reality, no such measures would be technically or socially acceptable, and as in many other cases, highly developed systems are there, and there to stay. Following extreme flooding in 1971, active measures for flood control, dykes management, and bank protection in the Red River Delta have produced appreciable benefits in the development of the Vietnam economy.

2. THE DYKES IN THE RED RIVER DELTA

In the Red River Delta, the system of dykes is the result of the labour of the Vietnamese people for over 1 000 years. In 70 years of this century, a large amount of money has been allocated to increasing the dyke elevation, repair, and generally upgrading the dykes in the Red River system, to keep the top elevation above certain design flood water levels. All of the river bank protection works are initiated and developed in response to changes in the river morphology and socio-economic demand in the Red River delta. Although the river works concentrate on protecting critical areas only, even then the total budget allocated to them each year is significant for a limited economy such as that of Vietnam.

The rivers are bordered by 3 000 km or so of river dykes. The major tributaries of the Red River are the Da, Thao, and Lo Rivers. The three main tributaries have catchment areas (including those outside of Vietnam) of 52 900 km^2, 51 800 km^2, and 39 000 km^2, respectively, in a total Red River catchment (including the delta) of 155 000 km^2. Figure 1 presents a general map of the Delta river system.

Over a large part of its length the Red River is 1 km or more in width, and is characterised by large mid-channel shoals, elongated shoals adjacent to the banks, and occasional islands. The banks of the rivers are alluvial, typically 3 m to 4 m in

* *Eric J Lesleighter, Chief Engineer Water Resources, Snowy Mountains Engineering Corporation Limited, Cooma, NSW, 2630*

** *Tran Xuan Thai, Director, River and Coastal, Vietnam Institute of Water Resources Research, Hanoi, Vietnam*

height (excepting adjacent to the main dykes where they are higher), and erodible. It is when the erosion occurs along banks where the dykes are close to the river's edge that measures are taken to stabilise the banks and avoid direct erosion of the river side of the dykes.

3. MANAGEMENT

In the Red River delta, bank protection works, water intakes and drainage structures along the rivers have been built and managed by the Ministry of Water Resources (MWR) and local water resources services. The MWR comprises a number of key departments. Of particular relevance to river works, dykes, river intakes and associated facilities are the Department of Dyke Management and Flood Control (DDMFC), and the Vietnam Institute of Water Resources Research (VIWRR).

The DDMFC, includes the Dyke and Bank Protection Works section and the Planning Section. Both act on advice from the VIWRR. Together, decisions are made on how the Government's budget for such works is used. While the DDMFC has a vital role in safeguarding the integrity of the dyke system, its functioning comes down to a 'balancing act' between the available budget and the actual needs. The construction of river engineering works is both difficult and expensive.

In the whole Ha Tay Province dyke system (Figure 1) there is a total length of 294 km of main and sub-dykes. Every year new and repair dyke work is necessary. Seepage is a major problem under dykes in a number of places, as is the occurrence of fracturing due to differential settlement.

Figure 2 shows the reach of the Red River from the entry of the Da and Thao Rivers down towards Hanoi. On the right bank of the Da River in the vicinity of the Thao River confluence, bank protection to safeguard dykes have been constructed over a 5 km length. The works generally consist of revetment of riprap and short groynes spaced at about 150 m. For some 5 km or more the dyke in the 'loop' downstream of the Thao River confluence in recent times has been perilously close to the water's edge, and the bank protection works have been an essential part of assuring the integrity of the flood protection system.

The Hoa Binh Dam on the Da River is approximately 100 m high. Its reservoir is used to supply an 1800 MW underground power station, but it is also utilised in a significant flood mitigation role. The Da River makes up 34 % of the Red River catchment. The present operation rules for Hoa Binh reservoir require lowering of the reservoir level during June each year just prior to the flood season. It has been estimated that utilisation of the Hoa Binh reservoir for flood control would lower the Hanoi flood level for a repeat of the 1971 flood by 1.3 m.

While upstream reservoirs are proposed as a flood control device, the Hoa Binh dam was built primarily for power. The reservoir, however, provides flood mitigation in the Red River and its branches, and it is a trap for the large amount of sediment originating in the Da catchment. Consequently, the classical degradation situation prevails in the Da River downstream of the dam.

4. BUDGETS

The scale of the river and dyke works which have been attempted over the years has not been matched even closely by the budget available. Accordingly, the strategy has been to concentrate on critical areas, with the inevitable result that many needy areas are not being attended to, or some group areas are being covered inadequately.

The annual budget for the various provinces has been allocated for

- ★ construction of new bank protection works on severely eroded river bank reaches
- ★ repair of bank protection works which have been attacked and damaged
- ★ repair of dyke reaches which are damaged, and there is the danger of dyke failure by sliding or undermining, and
- ★ maintenance of dykes and bank protection works.

The amount of the budget spent in a certain area depends on the physical length of the dyke under attack, a judgment on how imperative the work is, and the population of the province. Besides the central Government's budget, each province contributes from its own budget for river works and dyke repair, but its budget is usually smaller that the allocation from the Government.

5. DESCRIPTION OF RIVER WORKS

The bank protection works are usually distributed along the river in 'groups'. Due to budget limitations, however, the necessary works in a certain reach are often not completed and the subsequent flood season places great stress on

those works which were. In addition to the limited number of groynes which can be funded on a particular reach, resulting in groynes which are spread too far apart, the complex nature of the river geomorphology means that it is difficult to foresee problem areas. In order to illustrate the ongoing challenge, a brief history of events in the Thao-Da area is presented. Figure 3 shows the river features in the area in 1979 and 1985.

The main types of bank protection that have been used in the Red River system are revetments or groynes, or a combination of these. Groynes are almost invariably of an impermeable construction.

The Thao - Da confluence group of work includes bank protection on the right bank, in the Co Do village portion of Ha Tay Province (Figures 2 and 3), and works on the left bank at Le Tinh in Vinh Phu Province. The morphological processes in this area, being at the confluence of the Thao River and the Da River, are particularly complex. The thalweg and formation of mid channel bars are subject to major changes from year to year. Moreover, the construction of the Hoa Binh Dam on the Da River has been found to have a direct effect on this area. This group of works is the most extensive in the Red and Thai Binh River system.

In typical fashion, urgent remedial measures were performed during 1989/1990, consisting of a number of new groynes and upgrading of four groynes by increasing their top level and their length.

In 1979, (Figure 3), a large point bar is present alongside groynes 1 to 8, where previously the flow pattern was such that protection works were necessary. Subsequently, the bar extended to groyne 12, the main stream was directed towards the bank upstream of groyne 13, and groynes 16 and 17 were generally away from the main stream. In 1985, the point bar had extended almost to groyne 13, the main stream was directed towards the groyne 16 and 17 area, the mid-channel bar across from groynes 13 to 16 was enlarged, and the main channel was almost all directed across the river towards the mouth of the Lo River.

In the light of such major morphological changes, a situation which is repeated in other areas of the river system, the engineering of the river aimed at protecting the dykes should emphasise the management of the problem areas rather than wholesale control, which in fact is not possible.

6. IMPROVED RIVER ENGINEERING PRACTICE

6.1. Summary of Present Practice

The works which have been implemented, the unpredictable nature of where the next trouble spot will occur, and the limited budget, has imposed a 'reactionary' situation of responding to evident needs.

The budgetary constraints will not be removed without a sizeable injection of funds from other than normal sources, but the present practices of revetments and impermeable groynes needs to be re-evaluated in an effort to 'stretch' the value of allocated funds.

Over the years, hydraulic model testing has been carried out at the VIWRR to assist in understanding the flow patterns during flooding and to selecting the best locations for groynes. There are a large number of 'trouble spots' which means that the modelling process is faced with a huge task of keeping abreast with the apparent need.

In addition to the evident budget limitations in the face of a huge system of dykes, intakes and river works, the authors proposed a training program for river engineering personnel in the VIWRR as a tangible means of upgrading present practice.

6.2. Summary of Problems with Existing Techniques

Technical measures to train rivers to displace sand bars from the front of water intakes are very costly, and in any case, due to the river's response to other major flow and sediment transport influences remote from the intake locality, such works would not be effective in many cases. Structural measures such as river training to direct water and separate water and sediment flow is very difficult, in fact, infeasible for the wide rivers which make up the Red River system.

The imbalance between a limited budget and a very great demand on that budget to stabilise rivers is very real. The use of impermeable groynes has been accompanied by problems experienced in many other fine-bed rivers due to the 'sudden' impact they have on the flow, causing intense eddies and turbulence, the difficulty in

Rutherfurd, I.D. & Walker, M. (1996). Proceedings of the 1st National Conference on Stream Management in Australia, 19 – 23 February, 1996, Merrijig, Australia.

constructing them with sufficient foundation depth to adjust, without significant collapse, to the scour hole which normally forms at the tip of the groyne, and the sheer volume of materials required to construct them. This raises the need for a better technical solution accompanied by economies of construction.

6.3. Alternative Techniques

Permeable groynes have been proposed as a technical solution more suited to the bank protection requirements in the Red River system.

River works have to optimised for cost as well as durability, and thus a flexible approach is desirable. Materials have to be chosen which are appropriate to the area. Given the immense scale of the river system and the protective works required, the management of such a program points up a clear need for training of engineers in river engineering and river management. The first author has experienced the need and the value of training so that new concepts are appreciated and better management is achieved.

6.4. Implementation Plan for Improved Practice

The need is to address the specific areas of concern, and introduce river engineering (management) works which economically meet the requirements and embark on a program of technical upgrading for VIWRR and DDMFC personnel.

Budget enhancement may be considered a priority management measure. However, in this context, the authors suggest that this means more efficient use of funds tied into more durable and effective methods, and organisational streamlining. This is a management objective, even though increased funding may be required to handle critical problem areas in the short term.

Of the yearly budget for dyke and river works in the Red River system, little of this allocation is directed towards field studies and research to enhance the practitioner's appreciation of the problem/solution optimisation process, nor field investigations to provide information on which to base the design of works.

Policy and Planning

The authors' experiences on the Red River and its tributaries suggest scrutiny and possible modification of policy and planning which can be applied with benefit in other major river systems, particularly when funds are limited. The following guidelines are advanced:

- ★ there is no one correct answer to the river engineering problems
- ★ embrace a policy of management of the rivers' problem areas
- ★ recognise the economic disadvantages of completing insufficient works in specific trouble spots, ie, avoid spreading of the works 'too thinly', and resist the temptation to treat more areas than the funds will adequately cover
- ★ maximise the budget and optimise the budgetary allocations by sound management of the costs of design, materials, and construction
- ★ allocate a small proportion of the yearly budget (say 1%) to field measurements, survey, and research into better methods
- ★ recognise that the budget share between provinces needs to take account of the fact that improvements in problem areas in one province may have a significant benefit for a neighbouring province
- ★ ensure that there are clear lines of technical and financial management in one organisation, and that the knowledge gained with new techniques is disseminated and utilised, and
- ★ incorporate a program of training of key personnel.

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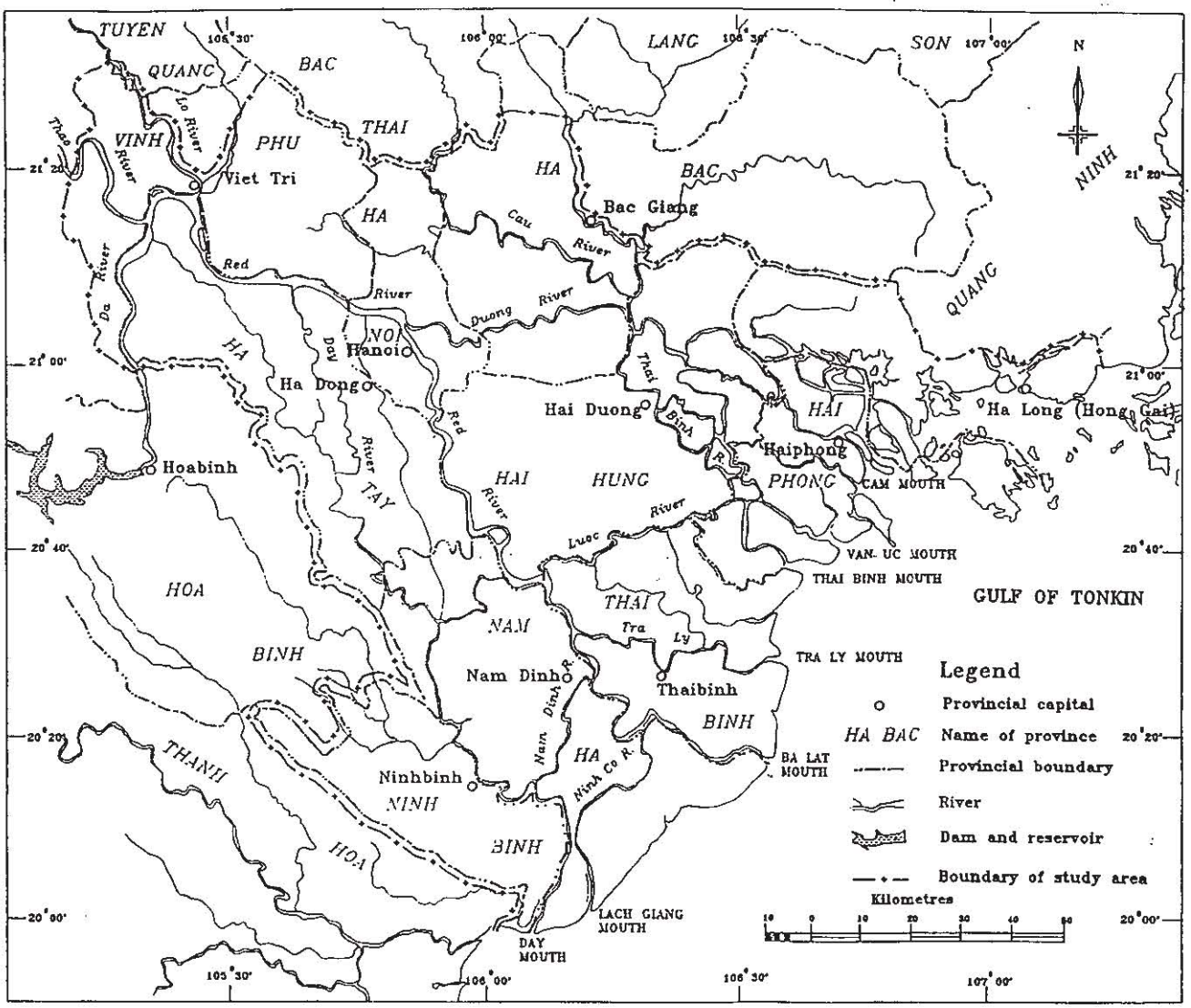

Figure 1 - Area Map Red River Delta, Vietnam

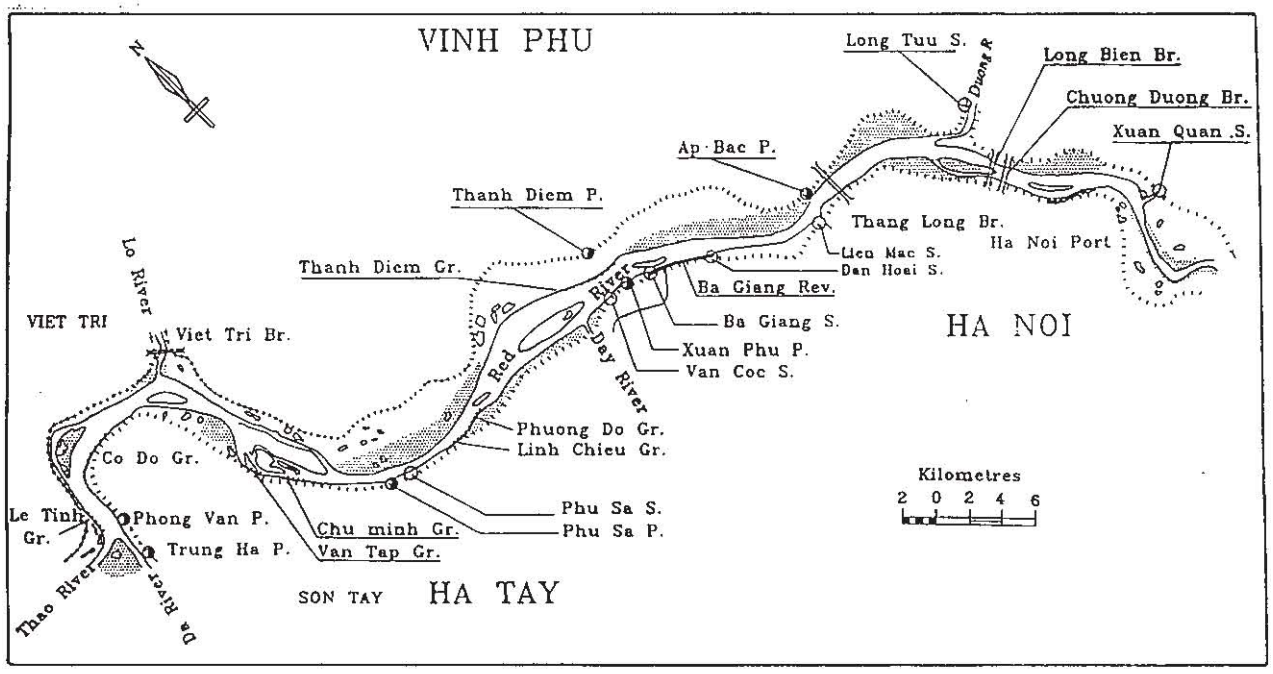

Figure 2 - Red River from Thao-Da Confluence to Hanoi

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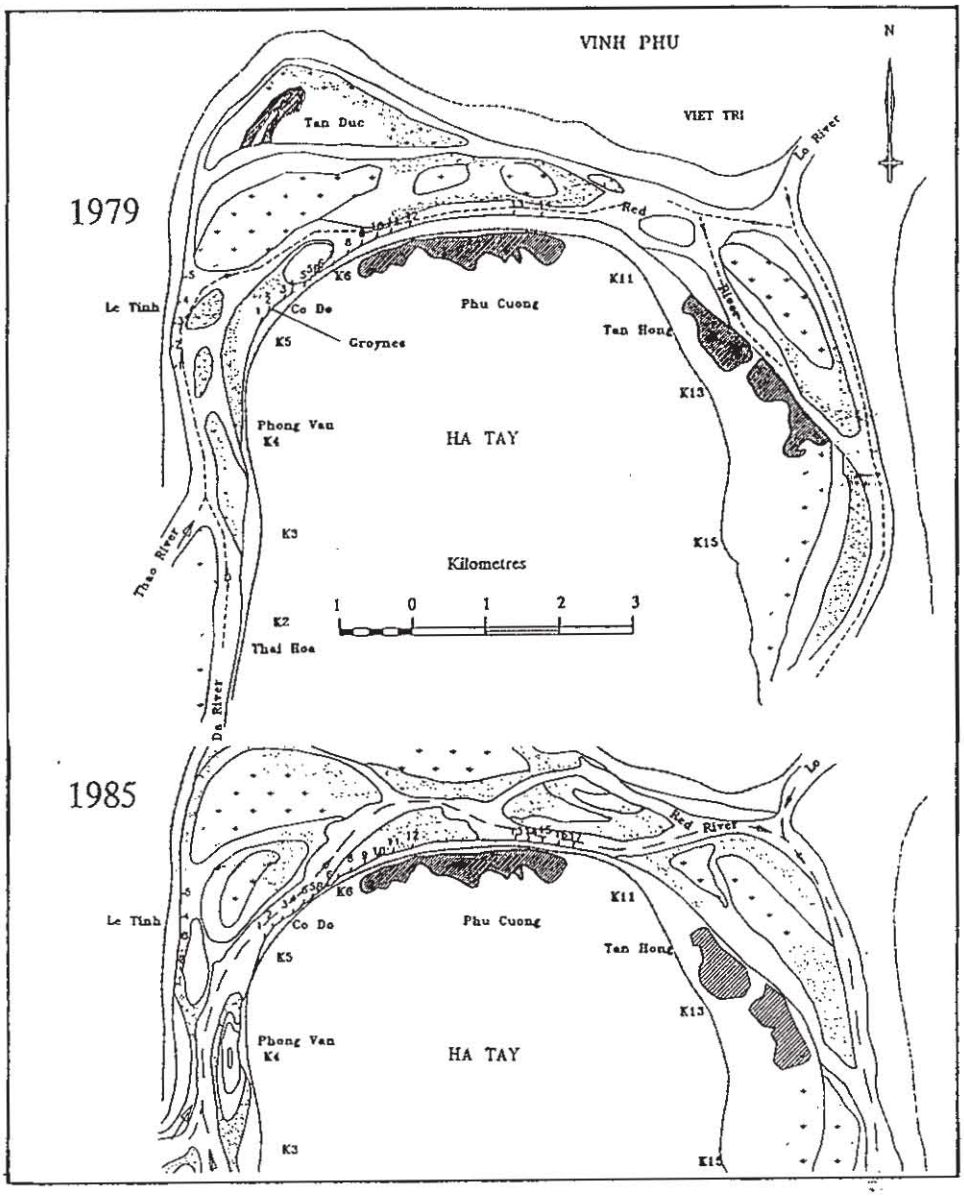

Figure 3 - River Features Thao-Da Confluence 1979 and 1985

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