A Flood in Hue

A report on the causes of the damage on Tam Giang Lagoon Dyke

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1 Introduction
In Thua Thien Hue province a dyke is under construction along the Tam Giang Lagoon with the support of WFP. The part in Quang Dien district is also supported by ICCO (co-financed by the European Community and EZE from Germany). With this dyke the local people will be protected against floods coming from the lagoon; furthermore, salt intrusion will be significantly reduced.

This report focuses on the part that was co-funded by ICCO.

The implementation started on 15 April 1994 and the project is expected to be finalized before June 1996. At present most of the dyke is ready; some sluice gates still need to be constructed.

In the night of 6 - 7 October 1995 a flood hit the dyke. It was the first test of the dyke this year. The result was negative: several parts of the dyke were damaged. This result is sad because the design was more sturdy than needed, according to Vietnamese experts.

This report is the result of my efforts to find out more details about the circumstances during the flood and the causes that led to the damage. It does not pretend to be comprehensive, since that would require a much larger effort than I could give. Nevertheless, it is my opinion that it gives a representative picture.

2 The area
The dyke is 7850 m long. It starts north of Ha Do village at Km 24+855 and ends at Quan Cua village at Km 32+705. From north to south the largest villages close to the dyke are:
- Ha Do
- Phuoc Ly
- Mai Duong
- Quan Cua

3 The flood
It was reported that on 7 October 2 A.M. the flood entered the pumpstation at Phuoc Ly village. The duration of the flood varied from place to place. In Ha Do it was reported that the flood lasted 7 days instead of the usual 2 days. Phuoc Ly residents also reported that the flood lasted much longer. In Quan Cua it was said that the duration was just as usual.

Besides the amount of water the duration of the flood depends largely on the drain capacity of the sluices and, in this case, other holes in the dyke. Near Ha Do the dyke was not damaged and there is only one narrow sluice (2.2 m). At Phuoc Ly there are two sluices

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1 Total cost:
   - ICCO contribution: 234,680 USD
   - EC contribution: 782,264 USD
   - EZE contribution: 547,585 USD

2 According to the Vietnamese experts 12 cm thick revetment would be enough; the dyke under discussion has a revetment of 30 cm thickness.

3 The locations of each end of the dyke and the sluices were read from a length profile of the original design. Other locations were estimated.
and the dyke was broken at one place. At Quan Cua there is one sluice and the dyke broke at two places.

At Ha Do the dyke was overtopped by 1 m of water; this was told by both the villagers and the Hydraulic Service of Thua Thien Hue province (HSH). It was considered a serious flood.

According to Mr. Le Van Ham of the Hydraulic Service some river dykes had broken at the place where Bo River splits into two branches (one branch leading to the lagoon and one branch to Huong River). I visited that area but found no evidence. Some erosion had occurred and the dykes were overtopped with 0.5 m water. The dykes were in a good condition.

4 Problems experienced by the villagers

It was generally agreed upon that the new dyke is an improvement: it keeps the salt water from the fields and the boats of the fishermen can be brought behind the dyke for shelter. However, there are some shortcomings that hamper the latter.

In Ha Do village there is one sluice to bring the boats behind the dyke in times of danger. The people complained that
- it is too shallow
- the quarry stones and bamboo poles at either side of the sluice damage their boats and wound their legs
- it is too narrow

It was explained to them that during flood the water table is higher so there will be enough water to pass the sluice. They said that still the boats could not pass then since the sluice is too narrow and the current too high. At present the sluice is 2.2 m wide, while according to the villagers the original plan was to make it 3.2 m wide. Hydraulic Service should be asked about the design of the sluice.

The villagers request a wider sluice to allow the boats to pass. For the present sluice I can imagine that it will not function properly during the flood.

In Phuoc Ly the villagers complained that the dyke increases the duration of the flood. The boat problem was not mentioned. They request 1 km of dyke without the ridge on top, and more sluices as well.

At Quan Cua the main complaint was about the shelter for the boats. There is a wide sluice with 2 gates, but the villagers experienced problems when trying to manoeuver their boats through the sluice. This flood they were able to steer their boats through the holes caused by the flood.

During a visit I observed that also under normal circumstances it is not easy to pass the sluice.

Their suggestion is to make the crest of the dyke 0.5 m lower along a stretch of 5 - 6 m. In the dry season the gap could be filled with earth and removed when the flood comes. The cooperative should be responsible for the earthfill because the farmers profit 10 months from the dyke and fishermen only 2 months of the year.
5 The damage

The list below goes from north to south along the dyke.

- Ha Do villagers mentioned that the flood water had eroded the bottom of the narrow canal between the village and the dyke. Before the flood the depth was 20 - 30 cm; after the flood it was up to 1.5 m. They are afraid that it may be a danger in the future.

  Hydraulic Service denies the story and says that the soil in the canal had been used for the dyke and to protect the houses.

- At the location of the old An Gia sluice (Km 25+743; not existing anymore) the revetment was a bit depressed.

- At Phuoc Ly the flood washed away a part which was still under construction. It was reported by people working at that location that they did not expect the flood, although it had been announced through the weather forecast. On Friday 6/10 they put cement on the dyke which was washed away the following night.

- Directly north of the sluice at Km 30.652 the revetment was damaged; south of the sluice the dyke was damaged at several places. All those places were still under construction and not protected before the flood.

- South of the next sluice (Km 30.830) the revetment disappeared/was undermined over a stretch of 4 - 5 m. It was reported that construction still was going on the afternoon just before the flood. A weak clay foundation could have played a role as well.

- North of Bau Tan sluice (Km 31.623) 8 m was damaged; 15 m was washed away south of the sluice. Clay had been used as earthfill here, which was not compacted well. Maybe the revetment was placed too shortly after the earthfill.

- At Km 32+100 à Km 32+200 (600 - 700 m north of Quan Cua sluice), blocks had sunk into the slope facing the lagoon. It happened over a stretch of 6 - 10 m. Compaction seems the problem.

- At Km 32+300 à Km 32+400 (300 - 400 m north of Quan Cua sluice) the ridge on top of the dyke has broken over a stretch of about 20 m. The sand content of the concrete seems too high and the cement content too low.

- The last few 100 metres are still under construction. The slopes had been reveted but not the crest. At two places the dyke has broken there. Besides the damage just mentioned minor damage was seen, such as damage caused to places under construction. A minor shortcoming was the wide gaps between the revetment blocks at several places. Villagers from Phuoc Ly had observed that sand and gravel escaped through the gaps because of the flood.

6 Explanation of the damage

Both the Hydraulic Service and the villagers agree that the flood was bigger than usual. Nevertheless, it is my opinion that human mistakes were made during construction.

According to me the main shortcomings are:

- weak foundation, especially in the southern part of the dyke. The use of clay instead of sand maybe the main cause for weakness. However, it is well possible to make a good clay foundation if the earthfill is given time to settle. I doubt whether that time was given; during the inspection visit on October 19 the team came across one location where revetment was made on fresh clay. The clay was so weak that it was hardly possible to walk across.

  The original plan was to implement the project in three years. The Hydraulic Service, however, wanted to realize the project in two years and insisted on that
despite lags behind schedule. Time pressure could lead to this kind of problems.

The flood season is not a suitable time to make clay foundations, because of the dry period it needs to settle. Originally the Hydraulic Service would stop work during the flood season.

The absence of protection at many of the construction sites. Dutch Rijkswaterstaat, who gave advice during the design phase, strongly recommended to make temporary protection and has given suggestions.

The absence could (partly) be explained by the fact that the workers at several locations did not know that the flood was coming, although the villagers around them did. The Hydraulic Service or the respective construction company could have ensured that their workers prepared for the flood.

During monitoring visits in the dry season (27/06; together with Rijkswaterstaat, 28/07, 07/09) it was mentioned that the gravel filter is too thin. However, it can not be concluded that it is one of the factors that caused the damage.

7 The repair

Soon after the flood the repair started. Since it is in the middle of the flood season they face the risk that their work is washed away before it is finalized. This is especially dangerous at places where clay is used as foundation: time pressure may force the workers to put the revetment before the clay has settled. Whatever the workers do (wait for settlement or continue quickly) the risk of failure is high.

After the flood the people from Phuoc Ly were contracted by the commune for repairing the dyke. The contract was for 1,400 labour days, amounting to 11 million VND. Until 21 October they had received only 4 million. When asked about the money, the commune suggested to ask the Hydraulic Service to check the dyke, after which they would receive the money. The villagers, however, were worried because the Hydraulic Service did not check yet; they are afraid that another flood comes before their work has been approved.

8 Dyke management

In the past months discussions were held with the Hydraulic Service and Bac Song Huong Company about the dyke management after completion. It was agreed that the staff of 3 pumpstations would be responsible for the management. An emergency stock would be made at the 3 stations. It was explained by the Hydraulic Service that the stretch from Ha Do to Mai Duong village would be ready in September and transferred to Bac Song Huong Company. That company would be responsible for the dyke after completion.

During my field visits I found only one pumpstation (at Phuoc Ly) between Ha Do and Mai Duong. That station, however, had no machines and no staff. No stock, was seen either.

It could be that the transfer of the dyke to Bac Song Huong company had been postponed. Anyway, it is worthwhile to follow the setup of the management teams.
9 Conclusions
It is my opinion that the Hydraulic Service, together with the construction companies, have made serious mistakes that led to poor quality and unnecessary damage. The problems encountered are:
- weak foundation of parts of the dyke
- no protection of (many) parts under construction
- weak concrete at several places
- command lines seem to be weakly developed in the project
I fear that, if the current way of execution is continued, this will not lead to a permanent improvement of the situation.

Another conclusion that can be drawn, is that the sluices are either too narrow or too small in number.

10 Recommendations
It is recommended by me to:
- stop the repair until the flood season is over and until the advice mission (see below) has given advice.
- protect the sites under construction
- appoint an advice mission. The mission should propose improvements in the design and execution, taking into account the views of the local population and leading to a more sustainable result. Among the participants could be:
  - a member of the Department of Dyke Management and Flood Control of the Ministry of Water Resources
  - a person appointed by WFP, since the outcome could also be useful to their dyke projects
  - a person appointed by ICCO
- improve the quality control of
  - concrete,
  - compaction and
  - filterlayer
- improve the communication between
  - field and office staff
  - the different companies and institutions involved
- start soon with the appointment and training of the management staff, and the arrangement of emergency stock.
ANNEX 1: The location of the dyke in Quang Dien
ANNEX 2: Visits paid to collect information

13/10:
Made a phonecall to Hue to arrange a visit to the dyke. Hydraulic Service (Mr. Hue) declined, saying that the flood was still there and 60 cm of water was flowing over the dyke.

15/10:
In the morning I came to Quan Cua. The flood was over. Some villagers accompanied me and showed some bad spots. After that it was decided to take a boat and inspect the dyke over a long stretch.

16/10:
In the morning it was tried to contact Mr. Ho Ngoc Phu, the director of Hydraulic Service. However, he was busy so it was decided to see Mr. Hung. He had heard about the problems but did not yet go there. The pictures, made on 15/10, were handed over to him. It was decided to make a fieldtrip to the dyke together with Hydraulic Service.

Mr. Hung said that the PAM dyke had suffered as well. UNDP was informed.

18/10:
In the morning a visit was paid to Ha Do.

19/10:
This day the whole dyke was inspected. Present were:
Hydraulic Service:
- Le Van Ham
Investigation & Design:
- Tran Kim Thanh; vice manager
- Vinh Dung
Provincial Hydraulic Construction Company:
- Dinh Nhu Quy; vice manager
Construction Company:
- Tran Minh Le
- Nguyen Dinh
- Ho Huu Mau
- Nguyen Van Dinh; technical superviser
- Nguyen Van Don; technical superviser
Group A:
- Phan Thanh Hung; vice head group A
- Nguyen Lanh; engineer Group A
- Nguyen Van Chanh; supervising engineer (working either for a construction company or the Hydraulic Service)

During the visit the management staff of the executing companies were not very tempted to come out of the boat and take a look at the dyke itself.
21/10:
Bat Vong Dong and Nam Phu village were visited, resp. just upstream and downstream the split of Bo River. Some erosion was visible but the dyke had not broken.

According to me it is unlikely that any dyke had broken upstream Tam Giang Lagoon dyke along the Bo River during the recent flood.

The next visit was to Ha Do; then on Phuoc Ly, where the pumpstation was visited and villagers were met. Then back to Ha Do.

22/10:
Visited the pumpstation at Quang An; this station spills on a canal that leads to the sluice at K 30.830.

The next visit was to Quan Cua, where the main topic was how to get the boats behind the dyke.
ANNEX 3: A depiction of some of the problems encountered

Bau Tan sluice at Km 31+623.
15 m vanished at the south side and 8 m was damaged north of the sluice.
Clay had been used as earthfill here, which was not compacted well. Maybe the revetment was placed too shortly after the earthfill. (Date: Oct 15, 1995)

North side of Bau Tan sluice at Km 31+623.
8 m was damaged at this side. In the picture repair has already started. During the visit Hydraulic Service told the workers to use sand instead of clay. (Date: Oct 19, 1995)
South side of Bau-Tan sluice at Km 31+623.  
15 m has vanished here. (Date: Oct 15, 1995)

Km 32+100 à Km 32+200.  
Revetment blocks have sunk into the dyke over a stretch of 6 - 10 m. Either the compaction was not well done or the clay had no time to settle before the revetment was placed. (Date: Oct 15, 1995)
Km 32+300 à Km 32+400, near Quan Cua.
Here the ridge on top of the dyke has broken. The concrete contains too much sand and too little cement. (Date: Oct 15, 1995)

Near Km 32+000.
Another location where the ridge has broken. Here also the sand fraction of the concrete was too big and the cement fraction too small. (Date: Oct 15, 1995)
Sluice at Km 30+830. (ANXUAN SL)

The revetment disappeared/was undermined over a stretch of 4 - 5 m. It was reported that construction still was going on the afternoon just before the flood. A weak clay foundation could have been at play as well.

In the picture repair has started. Hydraulic Service told them to use sand instead of clay. (Date: Oct 19, 1995)
Construction of revetment; however, the earth is so soft that one can hardly walk across. One could say that a new breakthrough is under preparation here. (Date: Oct 19, 1995)