



*Strengthening local capacity
in the economic analysis
of environmental issues*

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Is Dike Heightening a Viable Mechanism for Agricultural Intensification? A Cost-Benefit Analysis from Vietnam

The construction and upgrading of large-scale water control infrastructure is seen as a key way of agricultural intensification in the delta regions of many less-developed countries. This is the case in Vietnam's Mekong Delta (VMD), where there has been an ongoing process of dike heightening to prevent floodwaters from entering the fields so that three rice crops can be grown annually rather than two. However, there are concerns that upgrading low dikes into high dikes may have negative impacts on both people and nature, and that it may not be the best development option. In order to see whether this is the case, a new EEPSEA study conducted a cost-benefit analysis (CBA) on the recent dike-heightening projects in the Mekong Delta.

This study is the work of Tong Yen Dan from the School of Economics and Business Administration at Can Tho University, Vietnam. The study found that profits from rice farming in high-dike areas were not as large as had been expected. This was due to the longer-term effects of these dikes on the overall crop productivity. There are also adverse external effects that result in substantial social costs if the dikes are raised. The findings and recommendations of the study have important policy implications for dike-construction programs throughout the Mekong Delta. They raise serious questions regarding the design and construction of dikes in similar rice-producing areas in Vietnam, as well as other countries in Southeast Asia.



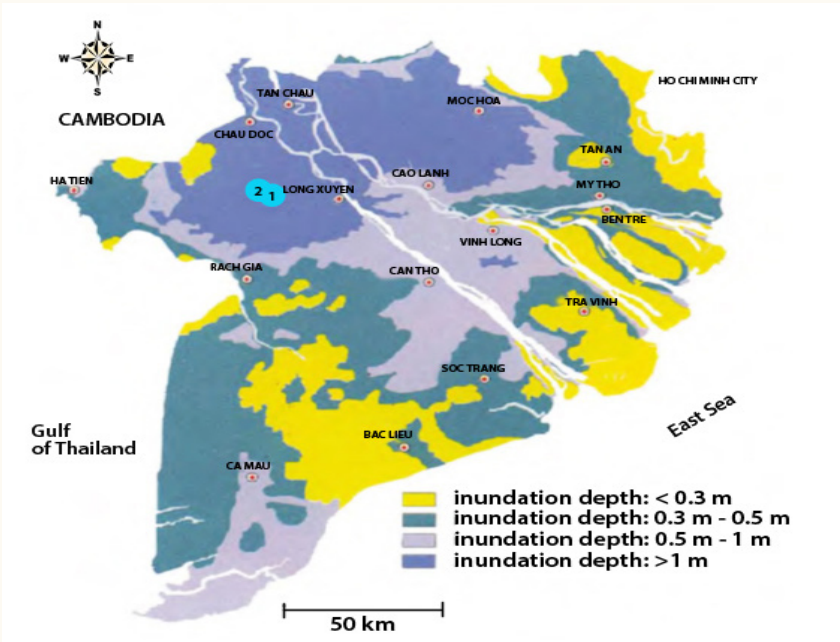


Figure. Map of An Giang province, Vietnam

Dikes in the Mekong Delta

The floodplain of VMD has high biological diversity and supports productive agriculture and fishery sectors. This floodplain (or high-flood zone) lies in the Plain of Reeds, which is a vast wetland covering the northern parts of Dong Thap, Tien Giang, and Long An provinces, and the Long Xuyen Quadrangle. A few decades ago, the cropping system in this floodplain involved cultivating one floating rice crop during the flood season. This provided low yields but was environmentally benign. Agriculture in the floodplain is now more intensified. Low dikes delay the effects of flooding, thus allowing two rice crops to be grown annually. In addition, high dikes have also been constructed in order to totally prevent floodwater from flowing into the fields during the flood season. This infrastructure development has allowed farmers to grow three rice crops annually.

The development of dikes in the delta’s floodplain systems has protected crops and other infrastructure from floods. However, it is also becoming apparent that the dikes and their associated irrigation systems have fragmented the floodplains and have interrupted the natural flows of water, sediments, nutrients,

and aquatic life. This situation has prompted many researchers to ask whether dike development in the Vietnamese floodplain is a sensible policy option.

Rice Farming in An Giang Province

To help answer this important question, Tong Yen Dan conducted a CBA of the effects of dike heightening in VMD. In her study, she took the “low-dike system” as a base scenario and looked at the difference in the impact between the implementation of low dikes and high dikes. Note that the case for the construction of low dikes was not addressed in her study since it is highly improbable that the long-term existing low dikes would be demolished to bring the area back into its previous state. In addition, for a long time, the construction of low dikes in Vietnam enabled the country to overcome past food shortages and transform from being a rice importer to one of the world’s largest rice exporters.

Her assessment was particularly wide-ranging in terms of the factors it took into account. For example, it looked at the impact of dike heightening not only on rice productivity, but also on the

knock-on effects that the use of pesticides has had on farmers and on the environment.

The CBA focused on the province of An Giang, which is on the northwest of the Mekong Delta. A significant amount of intensive rice cultivation takes place in this province. It has also been the location of major dike-heightening work over the past 10 years. The study was conducted in two communes in An Giang province, specifically in Vinh Phu commune (in Thoai Son district) and Vinh Binh commune (in Chau Thanh district). Farmers in Vinh Phu cultivate three rice crops annually in fields that are protected by high dikes. Farmers in Vinh Binh only grow two crops. Low dikes protect their fields.

Information for the CBA was obtained through surveys in the two communes. Surveys were conducted among 110 farms in high-dike/three-crop areas, and among 99 farms in nearby low-dike/two-crop areas. Secondary information was also collected. By comparing the two systems of rice production in the two communes, the author was able to assess the monetary costs and benefits of dike heightening. These costs and benefits were estimated in terms of the overall socioeconomic well-being (i.e., public sector perspective) and from the perspective of individual farmers, fishermen, and other stakeholders (i.e., private sector perspective).

In the CBA, the benefits of dike heightening included the incremental profits that Vinh Phu farmers obtained from their third rice crop. The costs that were assessed included those of dike construction, maintenance, and management costs required to upgrade existing dikes; the decrease in profits from the reduced productivity of the first and second crops; the increase in external costs associated with pesticide use; and the loss of net revenues in wild fishery resulting from a smaller water body.

Table 1. Benefits gained by public sector from dike heightening in An Giang, Vietnam

Category	Estimated Values	Present Value ('000 VND/ha)
Benefits	Profit from the third crop in high-dike areas	139,311
Costs	Decrease in profit from the first and second crops	101,626
	Construction costs	29,489
	Maintenance costs	15,333
	Management costs	8,201
	Cost due to foregone revenues from floodplain fishery	29,919
	Increase in external costs of pesticide use	2,508
Total net benefits ('000 VND/ha)		−47,767
Total net benefits (USD/ha)		−2,293
Total net benefits (billion VND/whole province)		−7,165
Total net benefits (million USD/whole province)		−344

Note: (1) Base year = 2012; (2) Discount rate = 3%

The Impact of Dike Heightening

Farmers in high-dike areas plant rice varieties that have higher levels of resistance to diseases and insects and can also tolerate low levels of soil pH. However, these rice varieties have low commercial value and have restricted export market, so their selling prices are significantly lower than that of other rice varieties. It is thought that the rice farmers chose these more robust rice varieties to cope with the unfavorable conditions caused by the intensive nature of their agriculture (which have both encouraged pests and changed soil fertility) enabled by the high dikes.

Overall, this means that the three-crop farmers in the high-dike areas have obtained lower profits from their first two rice crops than the two-crop farmers in the low-dike areas. It has also meant that the profits that the former have earned from their third rice crops have been relatively low.

It was also found that high dikes have had adverse effects on the productivity of the two crops grown in the low-dike areas. This was because dike heightening caused golden apple snails (a rice pest) to move from high-dike areas

Table 2. Benefits gained by private sector from dike heightening in An Giang, Vietnam

Category	Estimated Values	Affected Groups	Present Value ('000 VND/ha)
Benefits	Profit from the third crop in high-dike areas	Three-crop farmers	139,311
Costs	Decrease in profit from first and second crops	Three-crop farmers	101,626
	Construction cost	Three-crop farmers	8,847
	Maintenance cost	Three-crop farmers	2,300
	Value of foregone revenues from floodplain fishery	Fishers	29,919
Net benefits of three-crop farmers			26,538
Net benefits of fishers			−29,919

to low-dike areas. In addition, dike heightening has reduced the fish catch of local fishermen, as they can no longer use the high-dike areas for floodplain fishery.

The Economic Impact of Dike Heightening on Society

From an economic perspective, the net benefits of dike heightening were found to be negative. It was found that dike heightening has led to overall losses to society of VND 47,767,000/ha. These losses have amounted to VND 7,165 billion for An Giang province as a whole (USD 2,293 per hectare or USD 344 million for the province).

The CBA showed that the main cost of dike heightening was the decrease in the profits that three-crop farmers earned from their first and second crops (54.5% of all dike heightening costs). Other key costs were related to infrastructure developments and the income that local fishermen lost from floodplain fishery. The estimated external costs of pesticide use turned out to be only a small percentage of the assessed overall costs. Overall, the CBA showed that in terms of socioeconomic well-being, dike heightening is very undesirable.

The Economic Impact of Dikes on Farmers, Fishermen, and Other Local People

The actual net benefits that the three-crop farmers gained from dike heightening was VND 26,538,000/ha within the 15-year lifespan of the high dikes (VND 1,769,000/ha each year). This is equivalent to only 19% of the profit that these farmers earned each year from their third crop. Thus, although the result was positive, it shows that dike heightening is not financially attractive for the farmers it is intended to benefit. The interesting issue here is that the rice farmers who cultivated three crops in high dikes is supposedly the group who would benefit the most from the dike-heightening program. However, in reality, they actually suffer as the others because they are forced to work harder (i.e., they must plant three crops rather than two) with little extra return. These farmers are also in an unfortunate position, as they cannot easily revert to a less-intensive form of agriculture. In addition, the results of the study suggest that the actual net benefits would turn negative if farmers in the high-dike areas decide not to grow a third crop since they are still expected to pay all of the

dike-related costs similar to what the farmers in the high-dike areas do.

Dike heightening was also found to cost local fishermen an average of VMD 29,919,000/ha within the 15-year lifespan of the high dikes. The study shows that the Mekong's fishery is crucial to the livelihoods of the people in the area. The bulk of the catch from these fisheries is harvested by part-time and subsistence fishers who are poor and who generally use fishing as part of a diversified livelihood strategy. As dike heightening disadvantages these fishers, it is clear that the whole dike-heightening process has the potential to escalate socioeconomic tensions by increasing poverty and reducing community self-sufficiency.

In addition, dike heightening was found to have a negative economic impact on the two-crop farmers working in the low-dike areas. As explained, this was due to the pests that transferred into the fields in the low-dike areas (and the resulting expenditure they had to make to buy molluscicides to tackle the problem). Aside from farmers, local people also suffer from the increase in the external costs of pesticide use. Although those above impacts were observed in this study, it was not possible to ascertain these costs in monetary values at the local scale.

In total, from the perspective of the general community, it was found that dike heightening causes the local people to lose an average of VND 3,381,000/ha (USD 162/ha). Overall, the study shows that the dike-heightening project has cost the whole of An Giang province VND 507 billion or USD 24 million. This result highlights the economic inefficiency of the project at the local level.

Other Benefits and Costs

The study estimated the total net benefits based only on the current available data; some important values were not quantified. These include the following benefits:

- The reduction in flood damages due to breaking or overtopping low dikes, mainly the damages to the second crop; and
- The benefit of using high dikes as roads for transportation.

A number of other adverse impacts of dike heightening and their associated costs were not incorporated in the study as follows:

- Damage costs due to breaking of high dikes, mainly the damages to the third crop;
- Increase in fertilizer-use external costs;
- Increase in flood damages by displacing flood in downstream areas;
- Decrease in water retention capacity and groundwater recharge;
- Increase in duration and extent of saline intrusion in the lower delta during the dry season;
- Increase in dredging costs caused by deposition in the canals and estuaries; and
- Increase in maintenance cost caused by the increase in flow velocity and collapse of the river banks.

All of these costs point toward an even greater level of social cost resulting from dike heightening, and would seem substantial relative to the benefits that were not considered.

Recommendations

Based on the CBA analysis of the dike-heightening project, the study makes the following key recommendations:

First, it advises that dike heightening in the Mekong floodplain is not a suitable approach for rice cultivation intensification. No further dike heightening is therefore recommended in the Mekong Delta's floodplain. The study also states that there is an urgent need to limit the negative impacts of dike heightening by improving the design and management of the existing high dikes.

Second, the study recommends that the emphasis of future work in the regions should be on protecting the existing wild fish supply. Future work should also focus on integrating rice agriculture and fishing so that the pressures on wild fish stocks are mitigated.

Finally, the study recommends that the overall strategy of rice intensification in the VMD should be reconsidered. Rather than focusing on the volume of rice produced, the government should focus on rice value-added. Likewise, the government should account for environmental values.

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