

ECONOMIC ANALYSIS (VIET NAM)

A. Introduction

1. The five subprojects to be financed under the Greater Mekong Subregion Drought and Flood Management and Mitigation Project (the Project) will be implemented using a sector modality approach with subprojects already identified prior to implementation. Whilst the overall project will be implemented in three countries - Viet Nam, Lao PDR and Cambodia, for the purposes of the Vietnamese Investment Report, the investment is considered a stand-alone project. It recognizes that Viet Nam already has a well articulated sector development strategy as outlined in the national Socio-economic Development Plan 2011-16 (SEDP)¹ and further described in participating provincial SEDPs and the National Sector Development Strategy as prepared by the Ministry of Agriculture and Rural Development (MARD) and presented in Resolution 26² of the 7th Congress in 2009.

2. Counterpart contributions will be provided by the central Government for the Central Project Office (CPO) operations and the participating provinces (Provincial Project Management Units in Departments of Agriculture and rural Development) that will meet a proportion of the resettlement costs as well as finance all preparatory studies for each subproject. The proposed Executing Agency, MARD, has considerable experience with internationally financed development through ADB, AFD and the World Bank funded initiatives in water resource management and is familiar with the financial management and reporting requirements of development partners. The overall project impact will be 'reduced economic losses and fatalities resulting from flood or drought events.' The outcome will be improved preparedness to manage and mitigate the impacts of flood and drought events. The reduction of flood and drought risk will enable communities to achieve enhanced livelihood resilience and sustainability through: (i) avoidance of loss of properties and reduced casualties (deaths, injuries and water-borne diseases during and after floods); (ii) increased agricultural productivity and incomes due to the improved management and availability of water; (iii) improved access by improved rural roads and canals; and (iv) reduction of economic losses from disruption of business and agricultural activities. The overall Project will improve flood and drought risk management on over 170,000 ha and reduce the vulnerability to floods of over 2.5 million people.

3. Project outputs include: (i) regional coordination for management of climate extremes strengthened, (ii) water management infrastructure developed and/or upgraded, (iii) capacity for community based flood and drought management enhanced, and (iv) effective subproject implementation management. In Viet Nam, the Project will be implemented in the two southern provinces of Dong Thap and Tien Giang. The four infrastructure projects to be financed include: (i) Upgrading of the Plain of Reeds Canals (Dong Thap), (ii) Thuong Thoi Tien Bank Protection (Dong Thap), (iii) Upgrading the Flood Control System in Ba Rai - Phu An (Tien Giang), and (iv) Salinity Intrusion Control System in Go-Cong (Tien Giang). Infrastructure investments incorporate: (i) beneficiary participation in subproject detail design - including capacity building for water user associations (WUAs) to achieve greater participation in subsequent operations and maintenance (O&M) particularly for lower level structures and canals; (ii) physical infrastructure development with any associated resettlement and indigenous peoples plans as

¹ Ministry of Planning and Investment 'Socio-economic Development Plan 2011-16'. Hanoi 2011.

² Resolution of the 7th Congress issued after Session X of the Central Executive Committee on Agriculture, Farmers and Rural Areas - referred to as Resolution 26 - Hanoi, 2009.

required; and (iii) provincial subproject management - including technical support for detailed design and provincial implementation support to enable the provincial implementing agencies (Departments of Agriculture and Rural Development [DARD]) to coordinate and supervise implementation.

4. In Viet Nam, the total investment is estimated at \$79.1 million with 1% being allocated to Regional Coordination in Drought and Flood Management, 88% to rural infrastructure development, 1% to Community Based Flood and Drought Management, and 10% to implementation management. In order to assess the overall impact of the investment, economic and financial (E&F) analyses have been prepared for each of the five subprojects. No assessment has been attempted for the impact from investments in regional coordination and community based flood and drought risk management as these are considered to have been taken into account for each of the subproject impacts.

1. Flood Control and Salinity Intrusion Control Subprojects

6. This includes Upgrading Plain of Reeds Canals, Ba Rai - Phu An Flood Gates and Go-Cong Salinity Intrusion Control subprojects. Regular flooding causes damage to fruit trees impacting severely on farmers' interest in investment in the more profitable perennial tree crops (citrus and durian). In Go Cong, the limited regulation capability of sluices in the Go-Cong system does not allow agricultural areas to be isolated from nearby urban areas and both have conflicting water requirements, agriculture wanting to retain water resources to minimize pumping costs while the urban areas benefit from the regular flushing of waste water with tidal movement. Construction of new sluices will permit waste water disposal for the urban areas while preventing salt water intrusion into agricultural areas by retaining fresh water in the desired areas. Water levels in the canals will be increased by up to 50 cm reducing pumping cost by as much as 30% to farmers.

2. River Bank Protection Subproject

7. With significant flooding in 1994, 1995, 1997, 2000, 2002, 2006, 2008, many areas along the Mekong River have been eroded threatening productive agricultural and urban areas alike. The Government is progressively addressing bank stabilization to arrest erosion but many sites remain under threat, especially embankment adjoining Thuong Thoi Tien town. Stabilization of the embankment will secure people's livelihoods, protect existing infrastructure, transportation networks and other public works in the immediate vicinity of the town. The removal of such a threat will provide economic benefits with improved delivery of public services, promoting tourism development and creating enabling conditions for economic development under a more secure investment environment.

8. Benefits from these investments have been assessed under two scenarios - 'with' the subproject and 'without' the subproject with benefits being assessed in economic terms to gauge the impact upon the Viet Nam economy as a whole. Economic benefits from flood control included the reduction of expected flood damage on industrial assets, public infrastructure, household assets, together with the reduced losses of agricultural production and industrial output with the subproject. For irrigation oriented subprojects, incremental economic benefits were derived from increased agricultural productivity - largely increased cropping intensity, crop yields, and crop diversification. Economic benefits from salt water intrusion interventions were based upon the causal link between poor sanitation and the incidence of waterborne diseases. The World Health Organization reports that improvements in urban and village water supply and sanitation have an immediate impact on human health. Benefits recorded include the reduction

in morbidity by 80-100% for cholera and typhoid, and 40-50% for diarrhea, dysentery, and gastroenteritis. Water and sanitation related diseases include diarrhea, urinary tract infections, infectious hepatitis (A and E), typhoid, skin, ear and eye infections amongst others. Vector-borne diseases (e.g. those transmitted through organisms such as mosquitoes or ticks from infected individuals to other persons, or from infected animals to human beings) include: diarrhea, typhoid, cholera, dysentery, tuberculosis, anthrax, ophthalmia, intestinal worms, skin disorders, pneumonia, parasitism, malaria, and hepatitis A. Economic benefits have been estimated on the savings from the reduced cost of healthcare together with the loss of income from these incapacitating diseases.

B. Methodology

9. Only significant benefits and costs are examined to assess subproject viability and to understand the expected impact on the economy and society. Costs and benefits are calculated for two alternative situations: “with” and “without” the subprojects. The irrigation command area³ has been examined under both scenarios, based on the full irrigated area after rehabilitation of delivery canals and water management structures. In the “without” project scenario this command is assumed inadequately irrigated and subject to inundation with consequent impact on crop yield. With extended periods of inundation, crops are often destroyed and the land remains unproductive until flood waters subside - requiring new planting. The analysis takes into account what might be produced on this land “without” the proposed development. The intent is to identify the incremental value of production and of losses prevented that can be attributed subproject investments (over its expected economic life) and compare this value to the cost of implementing the subprojects and of operating and maintaining (O&M) the rehabilitated or new infrastructure.

10. To develop a model for the analysis, assumptions are made regarding future farming practice (both “with” and “without” the subproject) and the reduced threat of flood events together with the valuation of inputs and outputs. These include:

- Subproject life is 25 years. That is, assuming adequate maintenance, the flood and/or drought management system should be able to maintain its expected benefits for 25 years before another major renovation is required.
- “Without” the subproject, existing cultivation patterns and technology are expected to continue for the life of the subproject.
- “With” the subproject, the full command area is expected to continue to be irrigated throughout the effective life of the subproject, allowing farmers to adopt higher value cropping patterns and technology as appropriate. In the case of the river embankment, the “with” subproject scenario is for reduced erosion of the river bank and consequent protection of the public assets and economic activity in the adjacent town site.
- Some agricultural outputs may be consumed within the household, but are valued as if sold.

³ The command area is that area that can be efficiently irrigated from the rehabilitated canal and water management structures. Where rehabilitation is the dominant activity - the command area often remains the same with and without the subproject whereas in the case of extension into new areas, the command area will increase in addition to the improved productivity on the established irrigated area.

- Some agricultural inputs such as farm labor are provided by the farm household but are valued at the market rate as if hired.
- Output values are expressed in constant 2010 terms so as to exclude inflation.
- Costs are expressed in constant 2010 Dong (local costs) and constant 2010 US dollars (foreign currency costs). Future price predictions in current terms are adjusted to constant 2010 terms using the Multipliers Unit Value (MUV) index as published by the World Bank.⁴
- The Viet Nam Dong is the unit of currency. The exchange rate used is the end year rate with the U.S. dollar for any conversions necessary.
- Future production on command areas are estimated based on historic achievements but modified post subproject to reflect the improved water management and reduced flooding resulting from the investment. In the case of the orchard area of the Ba Rai - Phu An subproject, benefits have been assessed using two crops, citrus and durian trees as proxies for other fruit trees grown. The reduced threat of flooding provides farmers greater confidence to replace rice production with fruit trees.

11. Financial prices used in this analysis were identified through field visits during the preparation studies. These prices have been cross-checked with prices identified in other projects and secondary sources.

12. To assess subproject contributions to the economy of Viet Nam, financial values have been converted to their economic equivalents. Economic valuations exclude transfers from one part of society to another (i.e. taxes, subsidies and compensation costs) and attempt to facilitate the comparison of subproject benefits and real opportunity costs to the economy by translating all prices into a common, undistorted footing. Basic assumptions (in addition to those above) used in the economic analysis include:

- The use of a domestic price numeraire.
- In the case of major tradable commodities (food grains and fertilizers), economic values are based on border parity prices.
- For non-traded goods and services, a standard conversion factor (SCF) of 0.9 is used. For rural labor, a shadow wage rate factor (SWRF) of 0.85 is applied. The SWRF reflects the productivity of rural labor in the area.
- Transfer payments such as taxes, subsidies and compensation are excluded in the calculation of economic values. The administration cost of compensation is included.
- To calculate the economic net present value (ENVP) of the subproject a discount rate of 12% is used as representing the opportunity cost of the capital invested.

⁴ <http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/0,,contentMDK:20587651~menuPK:3279864~pagePK:64165401~piPK:64165026~theSitePK:476883,00.html>

C. Subproject Benefits

1. Plain of Reeds Subproject

13. The rehabilitation of four canals comprising the Plain of Reeds Subproject will increase their capacity from their present level that can inadequately irrigate 37,000 ha of winter-spring crop and a similar area of summer-autumn crop to an adequately watered area of 38,000 ha for both crops with an associated increase in productivity given the timely application of water. It will also increase flood discharge capacity in the canals to protect property and economic activity in the immediate vicinity benefiting agriculture, public infrastructure, urban and private rural property whilst reducing the need to relocate flood affected households (estimated at D210,000 per person) at assumed levels depending on the severity of the flood. The subproject will improve road access along the length of the canals (about 19.7 km) for an incremental 75 passengers a day at a unit cost of D70/passenger-km respectively. It will improve water transport services (both freight and passenger) with the increased capacity of canals to accommodate larger and small craft in increasing numbers. Incremental cargo on larger barges is estimated at 54,750 tons per annum while the equivalent on smaller craft is 2,640 tons. Incremental passengers are estimated at 14,600 passengers a year on larger craft and 10,950 on smaller craft valued at the same rates and fares as for road transport. Benefit streams are anticipated to increase in line with the local economy assumed to be 2% for the first 10 years after subproject completion declining to 1.5% per annum thereafter. Rice values are treated similarly as for Canal 61 above.

2. Thuong Thoi Tien Town Embankment Subproject

14. The subproject involves the stabilization of the left bank of the Tien River in the vicinity of Thuong Thoi Tien township. There are signs of recent erosion (although at a very slow rate) with drainage pipes projecting unsupported into the air delivering into the river where footings have been eroded and drainage structures exposed. The embankment will have little impact on flooding in the immediate area of the town site but will at least stabilize the embankment from further erosion. Benefits from such an intervention are more difficult to quantify as it involves small areas of land and a limited amount of infrastructure that is threatened by bank erosion. The approach used to estimate the potential benefits are similar to other flood minimization initiatives but the area of impact is dramatically reduced. Instead of having an impact over a broader area of flooded land, the benefit area is restricted to the immediate location of the embankment. For this reason, only 5% of the potential flood estimated benefit has been adopted for this subproject. There is considerable commercial and industrial activity in close proximity to the planned embankment whilst agricultural production is limited to small scale household production of little impact. Similarly, the need for relocation of houses (and people) and businesses along the embankment will be relatively small, the greatest impact coming from industrial output, loss of public infrastructure and personal property. Once the model has established the representative net benefits, these have been escalated on an annual basis in parallel with the overall economic growth rate of 2% for the first 10 years and 1.5% thereafter.

3. Ba Rai - Phu An Subproject

15. The Ba Rai - Phu An Subproject involves the construction of some 24 sluice gates to manage the movement of water given tidal influences and increasingly frequent flooding over a discrete area to be isolated by the structures. The impact area is currently planted to significant areas of fruit trees (370 ha of durians and 1,950 ha of citrus) and 1,460 ha of rice. Rice does not generate the financial returns that perennial crops can, but, given the threat of flooding that can

kill the more vulnerable fruit trees, farmers are reluctant to adopt a longer term planning perspective as gestation periods for fruit trees is between 3-7 years depending on the species, and full production might not be achieved for 10 years by which time flooding could have decimated the plantation. The models developed to measure the impact from such occurrences assume a frequency and severity of flooding with replanting being undertaken on areas destroyed. "With" the subproject, there is greater confidence to plant perennial crops and fruit trees are substituted for rice in 200 ha of former rice growing areas currently considered too risky. Two levels of flood frequency/severity are assumed with associated levels of death to trees. A significant flood is anticipated every 5 years during which 20% of planted trees die. A more severe flood event is anticipated every 15 years during which 60% of trees die. In addition to these events, a drought is anticipated every 4 years that reduces yields to 70% of the normal figure and fruit prices to 80% of the normal figure because of a reduction in quality. Under the "with" subproject scenario, such losses are avoided, providing an estimate of the incremental impact from the investment.

4. Go Cong Salinity Intrusion Subproject

16. Being relatively close to the ocean, the Go Cong area suffers from saline intrusions as brackish water extends up the drainage system into agricultural areas with two peak tides each day depressing crop yields. The nearby urban area benefits from this regular flushing, removing urban waste water out through the natural drainage lines. For the farmers in the area, they seek to retain fresh water in the rice paddies rather than have it drain out each day and face the continual threat of saline intrusion. The three proposed barrages and sluice gates will enable independent control of tidal movement and urban flushing whilst retaining additional fresh water resources in paddy growing areas. After installation, the water level in irrigation canals will be an estimated 50 cms higher that will reduce pumping costs by as much as 30%. Benefits from the investment therefore include an incremental crop yield in response to reduced saline intrusion into rice growing areas, and a reduction in water pumping costs while, for the urban inhabitants, the cost of public health care and improved labor efficiency has been estimated under the subproject.

D. Subproject Costs

17. Subproject cost estimates were prepared by contracted national consultants who prepared initial feasibility studies in each of the three participating provinces. As is the practice in Viet Nam, little flexibility is possible to the standard formats for cost estimation and also for design parameters with a dependence on Ministry of Construction cost norms as modified by provincially approved price variations to take account of inflation. Subproject cost estimates provided detailed cost estimates for civil works including materials, labor and machinery costs that formed the basis of the other associated costs - for detailed design preparation, for preparation of bidding documents, for construction supervision and for other costs - all at approved percentages of the cost of civil works. Subproject management costs are treated similarly under standard investment report formats in Viet Nam. However, subproject management costs have been estimated by costing actual management costs for the operations of provincial project management units (PPMUs) located in Departments of Agriculture and Rural Development of participating provinces allocated to subprojects on a pro-rata basis where more than one subproject is to be implemented in each province.

18. Resettlement and compensation costs have been estimated after preparing inventories of losses at the established provincial government rates. As ADB will be assuming responsibility for some 50% of resettlement and compensation costs, these estimates will need to be

confirmed according to ADB guidelines during detailed design preparation. For the purposes of this economic analysis, compensation payments constitute a transfer payment and as such cannot be considered an economic cost although the administration of resettlement estimated at 10% of compensation is included.

19. Estimates of operations and maintenance (O&M) of developed infrastructure are often overlooked in feasibility studies prepared in this manner. In each of the subproject economic analyses, O&M estimates are based on 30% of the cost of civil works every 8 years for periodic maintenance and 3% for routine maintenance every year. This amount has been phased into subprojects in year 4 of implementation and increased to 60% of the proposed level by year 6. A summary of the economic investment costs is presented in Table 1. Costs associated with national coordination and implementation technical support have not been included in the assessment of the economic impact from the Project. Similarly initiatives in support of the flood and drought early warning centre have not been assessed.

Table 1: Summary Economic Investment Costs for Selected Subprojects

	Plain of Reeds	Thuong Thoi Tien Embankment	Ba Rai - Phu An Flood Control	Co Cong Salinity Control
Cost Item				
Civil Works	9,279.81	8,059.38	11,034.40	3,697.90
Subproject Management	315.46	227.60	354.40	256.76
Construction Services	614.13	754.69	647.94	218.92
Other Costs	107.62	579.32	280.93	92.60
Resettlement and Land Acquisition	266.18	95.79	117.95	84.09
Operations and Maintenance	484.35	227.82	314.30	238.77
Total	11,067.54	9,944.60	12,749.91	4,589.03

E. Economic Analysis

1. Plain of Reeds Subproject

20. This subproject has significant resettlement costs that are not reflected in the estimation of the EIRR. In financial terms, and given the timing for incurring resettlement costs in the first year of project implementation, the impact in financial terms would reduce the financial internal rate of return to below the 12% figure. However, transfer payments are not included in the EIRR calculation. Even so, the subproject will generate a comparatively small EIRR estimated at 18.8%, suggesting that the investment will contribute positively to the economy of Viet Nam. The composition of the benefits are dominated by incremental rice production based on an average incremental yield of 0.75 t/ha over two crops throughout the entire command area. Other significant contributions to the net benefit will be derived from flood related impacts and the savings in population evacuation during flood and the damage to private houses and property. The benefits from transport remain relatively small throughout the period under assessment. The NPV of the investment is estimated at \$5.99 million (assessed at 12%) and the benefit cost ratio using discounted figures is 1.58. In economic terms, the investment is considered being well in excess of the opportunity cost of capital.

Table 2: Estimated EIRR for Plain of Reeds Subproject

Evaluation Results				ENPV	EIRR						
				(\$ million)	%						
Base Case				6.0	18.8%						
Variables	Change	NPV (base)	NPV (after)	EIRR (base)	EIRR (after)	Discount Rate	SI (NPV)	SI (EIRR)	SV (NPV)	SV (EIRR)	
Cost	10%	5.99	5.02	18.83%	17.33%	12%	1.6190	2.1967	61.77%	45.52%	
Cost	20%	5.99	4.05	18.83%	16.02%	12%	1.6190	2.0547	61.77%	48.67%	
Flood Benefit	-10%	5.99	5.33	18.83%	18.16%	12%	-1.1001	-0.9761	-90.90%	-102.45%	
Flood Benefit	-20%	5.99	4.67	18.83%	17.48%	12%	-1.1001	-0.9886	-90.90%	-101.15%	
Irrigation Benefits	-10%	5.99	5.06	18.83%	17.85%	12%	-1.5520	-1.4329	-64.43%	-69.79%	
Irrigation Benefits	-20%	5.99	4.13	18.83%	16.84%	12%	-1.5520	-1.4537	-64.43%	-68.79%	
Transport Benefits	-10%	5.99	5.94	18.83%	18.78%	12%	-0.0845	-0.0754	-1183.42%	-1325.42%	
Transport Benefits	-20%	5.99	5.89	18.83%	18.73%	12%	-0.0845	-0.0755	-1183.42%	-1324.28%	

2. Thuong Thoi Tien Town Embankment Subproject

21. The benefit from erosion prevention rarely shows the returns of an investment compared with those where commercial production is enhanced or protected. Given that the flood protection influence of the investment is minimal, benefits are generated in the immediate vicinity of the embankment and these are restricted to public infrastructure and a small level of industrial and commercial activities along the river embankment. Based on the models adopted to assess the economic benefits, the EIRR for the subproject is 12.1% and the NPV is \$0.39 million. The relatively low EIRR suggests this investment might not be a priority for the Government given limitations of investment funding and also the fact that other investments will generate a higher return. This does not imply the investment should not be undertaken as there are other considerations that might justify its implementation. Benefits are dominated by the prevention of damage from erosion along the embankment that include private land and houses, and small scale industry and commerce as the area has a small port complex and is an active trading and passenger land-water interface.

Table 3: Estimated EIRR for River Embankment Subproject

Evaluation Results				ENPV	EIRR						
				(\$ million)	%						
Base Case				0.4	12.1%						
Variables	Change	NPV (base)	NPV (after)	EIRR (base case)	EIRR (after)	Discount Rate	SI (NPV)	SI (EIRR)	SV (NPV)	SV (EIRR)	
Cost	10%	0.39	(0.48)	12.08%	11.07%	12%	22.4377	131.1574	4.46%	0.76%	
Cost	20%	0.39	(1.34)	12.08%	10.18%	12%	22.4377	123.5474	4.46%	0.81%	
Flood Benefit	-10%	0.39	(0.52)	12.08%	10.97%	12%	-23.4379	-144.7297	-4.27%	-0.69%	
Flood Benefit	-20%	0.39	(1.42)	12.08%	9.77%	12%	-23.4379	-150.1602	-4.27%	-0.67%	

3. Ba Rai - Phu An Subproject

22. The proposed subproject will isolate the area from the influences of flooding and provide improved water management control in an area where high valued crops are grown. Being dominated by fruit orchards, the area is highly productive and generates significant income for the economy. It is not surprising that the EIRR generated is highly attractive being 20.39% for the subproject. This figure reflects the high profitability of both durian and citrus production - each being able to substantiate EIRRs of 42.8% and 37.4% for unit hectare production models. The reason for the high EIRR reflects the fact that substitution from rice to higher value production is made possible by the investment. The analysis assumes a flood and drought pattern that determines the level of tree death necessitating replanting.

Table 4: Estimated EIRR for Ba Rai - Phu An Flood Control Subproject

Evaluation Results				ENPV	EIRR					
				(\$ million)	%					
Base Case				6.5	20.4%					
Variables	Change	NPV (base)	NPV (after)	EIRR (base)	EIRR (after)	Discount Rate	SI (NPV)	SI (EIRR)	SV (NPV)	SV (EIRR)
Cost	10%	6.51	5.40	20.39%	18.48%	12%	1.7046	2.2765	58.67%	43.93%
Cost	20%	6.51	4.29	20.39%	16.82%	12%	1.7046	2.1273	58.67%	47.01%
Flood Benefit	-10%	6.51	5.96	20.39%	19.86%	12%	-0.8560	-0.6302	-116.82%	-158.68%
Flood Benefit	-20%	6.51	5.40	20.39%	19.31%	12%	-0.8560	-0.6421	-116.82%	-155.74%
Durian Benefit	-10%	6.51	5.85	20.39%	19.54%	12%	-1.0162	-1.0047	-98.41%	-99.53%
Durian Benefit	-20%	6.51	5.19	20.39%	18.70%	12%	-1.0162	-1.0077	-98.41%	-99.24%
Citrus Benefit	-10%	6.51	6.12	20.39%	19.90%	12%	-0.5985	-0.5745	-167.08%	-174.05%
Citrus Benefit	-20%	6.51	5.73	20.39%	19.42%	12%	-0.5985	-0.5764	-167.08%	-173.48%
Rice Benefit	-10%	6.51	6.28	20.39%	20.10%	12%	-0.3572	-0.3386	-279.99%	-295.35%
Rice Benefit	-20%	6.51	6.05	20.39%	19.82%	12%	-0.3572	-0.3393	-279.99%	-294.72%

23. The assumption as to the exact timing of these incidences will impact upon the results obtained. The NPV of the investment is \$6.51 million and the benefit cost ratio is 1.51 suggesting the investment will generate a significant economic impact. It was observed that this area has relatively low levels of poverty even though the flooding regularly disrupts livelihood of the local inhabitants.

4. Go Cong Salinity Intrusion Subproject

24. This subproject has a potentially large impact on economic activity through the two benefits identified, irrigation efficiency and savings in health care costs from environmental improvement in the urban area nearby. The EIRR is estimated at 24.43% and the NPV is \$3.97 million at a discount rate of 12%. The reason for the high return is the potential benefit area with some 30,000 being affected plus an additional 1,075 ha of new rice production (two crops a year) that can be brought into production. The improved water management will result in higher yields for the affected area (assumed to be 40% of the command area) and will also save in pumping costs (currently VND1.8 million /crop-ha). Furthermore, the EIRR is high because the

capital cost to achieve this benefit response is relatively small involving only three barrages and sluice gates to control the movement of water and halt the saline intrusion. Benefits for the urban population are measured through the reduced cost of health services with better health because of the flushing effect made possible by the sluice gates. The health benefit is relatively small in comparison with the irrigation benefit, the latter representing 90% of the estimated benefit.

Table 5: Estimated EIRR for Go Cong Salinity Intrusion Subproject

Evaluation Results				ENPV	EIRR					
				(\$ million)	%					
Base Case				3.97	24.4%					
Variables	Change	NPV (base)	NPV (after)	EIRR (base)	EIRR (after)	Discount Rate	SI (NPV)	SI (EIRR)	SV (NPV)	SV (EIRR)
Cost	10%	3.97	3.50	24.43%	22.32%	12%	1.1765	1.6969	85.00%	58.93%
Cost	20%	3.97	3.04	24.43%	20.46%	12%	1.1765	1.5942	85.00%	62.73%
Irrigation Benefits	-10%	3.97	3.17	24.43%	22.23%	12%	-2.0158	-1.7654	-49.61%	-56.64%
Irrigation Benefits	-20%	3.97	2.37	24.43%	19.92%	12%	-2.0158	-1.8143	-49.61%	-55.12%
Health Benefits	-10%	3.97	3.91	24.43%	24.31%	12%	-0.1606	-0.0956	-622.53%	-1046.40%
Health Benefits	-20%	3.97	3.84	24.43%	24.19%	12%	-0.1606	-0.0960	-622.53%	-1041.80%

F. Sensitivity Analysis

25. Sensitivity analyses were undertaken for each subproject based on the potential risks envisaged with the investment. In each case these included cost escalation. For irrigation oriented interventions, the models were tested for sensitivity to changes in the irrigation benefit as a whole at reductions of 10% and 20%. For flood related models, sensitivities were run in the reduction of flood benefit (this included population evacuation, agricultural output, industrial output, industrial assets, public infrastructure and household assets) at 10% and 20%. Switching values were calculated by comparing the change in EIRRs and NPVs in response to each of the imposed risk factors.

26. The investments are each relatively robust to increases in investment and maintenance costs. A 10% increase in costs had the effect of reducing the EIRR by between 1-3%. However, the only one that is of concern is the Thuong Thoi Tien Embankment subproject because the base case EIRR was at such a low level. Reductions of the order suggested by the sensitivity analysis implies that considerable effort must be made to minimize cost overruns during implementation and the detailed design work must be thoroughly prepared and reviewed by the implementation consultants.

27. Not all subprojects could substantiate benefits from flood impact, and particularly all aspects that were provided in the analysis. For example, industrial output was only appropriate in the embankment subproject. Nevertheless, in some of the more flood prone areas of investment, the flood impact formed a significant part of the benefit. Even in these, the models were relatively insensitive to changes with a 10% change in the flood benefit resulting in a reduction of less than 1% of the EIRR suggesting the investments are relatively stable to this risk. Transport benefits were relatively small in the case of the two canal investments and even

though significant increases were modeled (in both road and water transport for cargo and passengers alike), the EIRRs were relatively robust to 10% and 20% reductions in the transport benefit.

28. Critical risks for most of the subprojects are those pertaining to irrigation benefits. Irrigation benefits can be compromised by not achieving the proposed incremental yield response, by not achieving the planned command area, and in the case of pumped irrigation, failing to achieve the cost savings considered achievable in design or by failing to prevent saline intrusions that impact significantly on rice yields. Of the irrigation dependent investments, Go Cong is the most vulnerable to changes in the benefits with a 3% decrease in the EIRR from a 10% reduction in irrigation benefits. In all the other subprojects, the investments are relatively robust to small changes in the level of benefits achieved.

29. With the possible exception of the Thuong Thoi Tien Town Embankment Subproject, all proposed subprojects should generate a sound economic investment with relatively small associated risk.