

## ECONOMIC AND FINANCIAL ANALYSIS

### A. Introduction

1. Kulhudhuffushi is the administrative center and regional hub of the northern region of the Maldives, which comprises the Haa Alifu, Haa Dhaalu, and Shaviyani atolls. Kulhudhuffushi contains important infrastructure for the region, including a secondary school, a hospital, and the regional port. The project aims at strengthening the role of Kulhudhuffushi as a regional hub by increasing connectivity among islands of the region to give residents increased opportunities and access to jobs, services, health, education, and housing. The project will (i) bring efficiency gains by separating passenger, cargo, and fishing boats; (ii) improve harbor user facilities and bring safety improvements; and (iii) bring wider connectivity benefits to the population of the northern region.

2. The economic evaluation of the project was undertaken by calculating net economic costs and benefits of the project, which were compared to a without-project scenario to calculate the economic viability of the project harbor. The economic evaluation was carried out in accordance with the Guidelines for the Economic Analysis of Projects of the Asian Development Bank (ADB).<sup>1</sup>

### B. Travel Demand Analysis

3. **Population.** The population in the northern region is 45,300; 8,200 residents live in Kulhudhuffushi, which has experienced higher annual average population growth during 2006–2014 (1.7%) than the neighboring atolls of Haa Alifu and Shaviyani and the other islands of Haa Dhaalu (–0.5% to 1.5%).<sup>2</sup> The Government of the Maldives anticipates an eventual population of 50,000 for Kulhudhuffushi, but has not identified a target year for this population figure. In comparison, the population in Malé increased by an average of 5.2% per year during 1965–2014 (from 10,900 to 133,000), with a lower annual average growth rate of 2.9% during 2006–2014. It is assumed that the average annual population growth rate in Kulhudhuffushi will progressively increase to 2.0% by 2019 and 3.5% by 2029, and remain close to current levels in other islands and atolls of the northern region.

**Table 1: Population Projections, 2014–2048**

Variable	Year	Haa Dhaalu		Haa Alifu	Shaviyani
		Kulhudhuffushi	Other Islands		
<b>Annual Average Population Growth Rate (%)</b>	2006–2014	1.70	1.45	(0.5)	0.36
	2015–2019	1.70	1.37	(0.3)	0.30
	2019–2024	2.00	1.18	(0.3)	0.30
	2024–2029	2.75	1.00	(0.3)	0.30
	2029–2048	3.50	1.00	(0.3)	0.30
<b>Population (people)</b>	2014	8,200	11,000	13,400	12,700
	2019	9,000	11,700	13,100	12,900
	2029	11,900	13,000	12,800	13,300
	2039	16,800	14,300	12,400	13,700
	2048	23,700	15,800	12,000	14,100

( ) = negative.

Source: Asian Development Bank estimates.

<sup>1</sup> ADB. 1997. *Guidelines for the Economic Analysis of Projects*. Manila.

<sup>2</sup> Ministry of Finance and Treasury, National Bureau of Statistics, 2015. *Census 2014, Statistical Release I: Population and Households*. Malé.

4. **Passenger and freight data.** As the existing harbor in Kulhudhuffushi is operated with minimal supervision and harbor charges are not levied, little data is available on passenger and goods traffic, vessel arrivals, berthing and waiting times, or unloading rates at the harbor. Passenger and freight data required for the economic analysis have been inferred from national statistics and past studies.<sup>3</sup> Interviews and observations were conducted on-site to obtain relevant information and validate the inferred data derived on harbor traffic and operations.

5. **Passenger traffic.** A 2005 household survey (footnote 3) provided data on the number of (i) intra-atoll trips, (ii) inter-atoll trips, and (iii) trips between atolls and Malé made by households of the northern region. Analysis of the data provided an estimated 8.3 annual trips per household to Kulhudhuffushi Harbor, leading to a total of 50,663 annual trips in 2014 (Table 2). The figures were corroborated by interviews with ferry operators.

**Table 2: Trips to Kulhudhuffushi Harbor, 2014**

Atoll	Households	Population	Passenger Trips	Trips per person
Haa Alifu	2,235	13,412	13,859	1.0
Haa Dhaalu	1,831	10,983	27,091	2.5
Shaviyani	2,112	12,669	9,713	0.8
Total	6,177	37,064	50,663	1.4

Source: Asian Development Bank estimates.

6. **Freight traffic.** The vast majority of cargo is imported into the Maldives via the commercial harbors of Malé. In the absence of freight volume records from Malé to all other islands of the Maldives, volumes were estimated from household expenditure distribution and national trade statistics. It is estimated that 41,931 tons of cargo are transported annually from Malé to Kulhudhuffushi, with a cargo fleet of 18 vessels making 1,264 vessel calls per year, and 21,371 tons are further transported from Kulhudhuffushi to the other islands of the northern region, with 20 vessels making 1,425 vessel calls per year in Kulhudhuffushi.

7. **Growth.** The annual average gross domestic product (GDP) growth of the Maldives was 7.5% from 2005 to 2015, with an annual GDP per capita growth of 4.6% over the same period. The average annual GDP growth forecast is assumed to be 4.3% during 2015–2025 and 3.0% during 2026–2048, with a GDP per capita growth of 2.59% during 2016–2025 and 1.48% during 2026–2048. The economy strongly depends on tourism, which accounts for 29.0% of the GDP. However, with 2.3% only of the overall bed capacity in the Maldives in 2013, the northern region does not significantly benefit from tourism.<sup>4</sup> In addition, household income levels in the northern region were 2.3 times below that of Malé in 2010.<sup>5</sup> Considering the income gap and the importance of tourism, the GDP per capita elasticities of travel demand have been conservatively assumed to be 0.7 for passenger travel and 0.8 for freight demand.

8. **Generated demand.** The lack of frequent transport services is a severe hindrance in the links between Kulhudhuffushi and the other islands of the northern region. ADB and the government have taken steps to address the gap between transport supply and unrealized

<sup>3</sup> ADB. 2005. *Domestic Maritime Transport Project: Technical Assistance to the Republic of the Maldives for Preparing the Domestic Transport Project*. Manila.

<sup>4</sup> Government of the Maldives, Ministry of Tourism. 2015. *Tourism Year Book 2014*. Malé.

<sup>5</sup> Government of the Maldives, National Bureau of Statistics. 2010. *Report on Household Income and Expenditure Survey 2009–2010*. Malé.

demand, with the planned implementation of a hub-and-spoke network and the review of transport concessions to improve frequency and reliability.<sup>6</sup> The project will assist these objectives by enabling increased connectivity in the region. Based on the results of the 2005 household survey (footnote 3) conducted to assess the willingness to travel more frequently in response to improved transport connections, it is assumed that additional demand will be generated at a rate of 3 times the rate of existing demand in Haa Dhaalu and 1 time in Haa Alifu and Shaviyani.

### C. Costs

9. **Capital costs.** The project includes (i) a main harbor basin for passenger and cargo vessels, and (ii) a mooring area for smaller boats, for a total capital cost of \$7,941,673 (including physical contingencies but excluding price contingencies). All construction materials are exempt from duty, except steel, which has a 5% import duty, amounting to \$11,550 for the project. This amount was subtracted from financial costs to obtain a total economic cost of \$7,930,123. Construction is assumed to occur over a 3-year period. In addition to capital costs, the project includes \$800,000 of consulting services costs and \$200,000 of project management costs.

10. **Operating costs.** Annual operating and routine maintenance costs have been estimated at \$16,409, or 0.18% of total construction costs. These costs were estimated based on the actual expenditure of the Secretariat of the Kulhudhuffushi Council in 2015 on the existing harbor. In addition, large-scale maintenance costs, primarily for dredging, are projected to occur at 5-year intervals at a rate of \$8 per cubic meter of dredging material, or \$169,750.

### D. Benefits

11. **Time savings.** A significant amount of time is lost by travelers to and from Kulhudhuffushi because of infrequent transport services and the inability to complete return trips in a single day. The harbor will contribute to greater connectivity between the islands of the northern region, which will lead to time savings. The value of work time has been based on the average wage rate in the atolls (excluding Malé) of \$1.70 per hour.<sup>7</sup> The value of time for non-workers has been assumed at 25% of the value of work time, resulting in a weighted average value of time of \$1.00 per hour. The annual value of time lost has been quantified at \$317,810 per year in 2020. The economic benefits of generated demand were calculated as half the benefits of existing demand. These benefits, based on travel times, ferry fares, and value of time, were valued at \$235,071 per year, with a ramp-up applied during the first 4 years of operation.

12. **Operational efficiencies.** The proposed harbor will enable fishing operations to be conducted separately from cargo and passenger operations by providing distinct unloading access for fishing boats. This will deliver operational benefits by allowing fishing boats to unload their catch directly to the fish market instead of the current two-step unloading process, which involves a first unloading onto a smaller boat, and a second unloading from a smaller boat to the shore or the quay. Estimated operational efficiency gains will lead to annual economic benefits of \$77,108 in 2020, increasing during 2021–2048 at rate of 2%, in line with the average annual fish catch growth rate of 2% during 2009–2013.<sup>8</sup>

<sup>6</sup> ADB. 2015. *Maldives, Overcoming the Challenges of a Small Island State, Country Diagnostic Study*. Manila.

<sup>7</sup> Government of the Maldives, National Bureau of Statistics. 2013. *Economic Survey 2012–2013*. Malé.

<sup>8</sup> Government of the Maldives, Ministry of Fisheries and Agriculture. 2015. *Basic Fisheries Statistics 2009–2013*. Malé.

13. **Employment benefits.** A passenger terminal of 196 square meters, a retail and office building of 150 square meters, and fish and vegetable market of 300 square meters will be built with the harbor to support the fishing and produce-trading industries. Based on the creation of 36 retail and service jobs, direct employment benefits have been quantified at \$110,381 per year in 2020, increasing in line with population growth during 2021–2048 (Table 1).

14. **Safety benefits.** The project will generate safety benefits for boats, which are currently unable to berth or shelter in the existing harbor due to capacity constraints, and for passengers, who currently lack safe embarkation and disembarkation access points. Safety benefits were estimated at \$42,796 per year for boats and \$32,117 per year for passengers in 2020.

15. **Erosion protection.** The existing land reclamation is gradually being eroded by wave and current action. The project breakwater and quay will provide protection benefits of \$36,779 per year, amounting to the construction and dredging costs that would otherwise be incurred.

16. **Utilization of dredging material.** The dredging of the harbor basin will produce a surplus of 110,000 cubic meters of sand, a construction material valued at \$8 per cubic meter. Total benefits of surplus sand were estimated at \$880,000 based on the quantities of sand to be dredged during construction.

## **E. Economic Evaluation**

17. **Key parameters.** The economic analysis used the world price numeraire. A discount rate of 12% was used for the analysis. All costs and benefits were expressed in real terms as of 31 December 2015 and were discounted to 1 July 2016. Costs and benefits were evaluated over a 33-year period, with a 3-year construction period commencing on 1 January 2017 and 30 years of operation from 2020 to 2049. The residual value of the asset in the terminal year of the project has been estimated at 40% using a straight-line depreciation method, assuming a 50-year life of the harbor. A shadow wage rate of 0.75 has been calculated from employment income data and an unemployment rate of 5.2% and was applied to the wages of unskilled labor (footnote 7). A standard conversion factor of 0.943 has been calculated from the International Financial Statistics and the Government Finance Statistics published by the International Monetary Fund, and was applied to non-traded domestic costs and benefits to value them at a world price level.

18. **Results.** The results of the economic analysis (Table 3) show the economic feasibility of the project with an economic internal rate of return (EIRR) of 12.70% and an economic net present value (ENPV) of \$415,848.

**Table 3: Cash Flow Stream for Kulhudhuffushi Harbor Expansion Project**  
(\$ '000)

Year	Costs			Benefits							Net Benefits
	Construction	O&M	Total	Time Savings	Generated Demand	Employment	Operational Efficiencies	Erosion Protection & Surplus Sand	Passenger & Boat Safety	Total	
2017	976.0	0.0	976.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(976.0)
2018	2,750.7	0.0	2,750.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(2,750.7)
2019	5,146.4	0.0	5,146.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(5,146.4)
2020	0.0	16.4	16.4	324.3	239.8	110.4	77.1	212.8	75.8	1,040.2	1,023.8
2021	0.0	16.4	16.4	331.1	357.0	112.9	78.7	212.8	78.0	1,170.4	1,154.0
2022	0.0	16.4	16.4	338.0	456.5	115.7	80.2	212.8	80.2	1,283.4	1,267.0
2023	0.0	16.4	16.4	345.1	466.9	118.7	81.8	212.8	82.5	1,307.9	1,291.5
2024	0.0	186.2	186.2	352.3	477.6	122.0	83.5	212.8	84.9	1,333.0	1,146.8
2025	0.0	16.4	16.4	356.9	484.7	125.5	85.1	36.8	86.7	1,175.8	1,159.4
2026	0.0	16.4	16.4	361.6	492.0	129.3	86.8	36.8	88.6	1,195.1	1,178.7
2027	0.0	16.4	16.4	366.3	499.5	133.5	88.6	36.8	90.5	1,215.1	1,198.7
2028	0.0	16.4	16.4	371.1	507.0	137.9	90.3	36.8	92.6	1,235.8	1,219.4
2029	0.0	186.2	186.2	376.0	514.7	142.8	92.2	36.8	94.7	1,257.1	1,070.9
2030	0.0	16.4	16.4	381.0	522.5	147.8	94.0	36.8	96.9	1,278.9	1,262.5
2031	0.0	16.4	16.4	386.1	530.4	152.9	95.9	36.8	99.2	1,301.2	1,284.8
2032	0.0	16.4	16.4	391.2	538.5	158.3	97.8	36.8	101.5	1,324.0	1,307.6
2033	0.0	16.4	16.4	396.4	546.7	163.8	99.7	36.8	103.9	1,347.4	1,331.0
2034	0.0	186.2	186.2	401.7	555.1	169.6	101.7	36.8	106.4	1,371.3	1,185.1
2035	0.0	16.4	16.4	407.0	563.6	175.5	103.8	36.8	109.0	1,395.7	1,379.3
2036	0.0	16.4	16.4	412.5	572.2	181.6	105.9	36.8	111.7	1,420.7	1,404.3
2037	0.0	16.4	16.4	418.0	581.0	188.0	108.0	36.8	114.4	1,446.2	1,429.8
2038	0.0	16.4	16.4	423.7	590.0	194.6	110.1	36.8	117.3	1,472.4	1,456.0
2039	0.0	186.2	186.2	429.4	599.1	201.4	112.3	36.8	120.2	1,499.2	1,313.0
2040	0.0	16.4	16.4	435.2	608.4	208.4	114.6	36.8	123.2	1,526.6	1,510.2
2041	0.0	16.4	16.4	441.1	617.8	215.7	116.9	36.8	126.4	1,554.6	1,538.2
2042	0.0	16.4	16.4	447.1	627.4	223.3	119.2	36.8	129.6	1,583.4	1,567.0
2043	0.0	16.4	16.4	453.1	637.2	231.1	121.6	36.8	133.0	1,612.8	1,596.4
2044	0.0	186.2	186.2	459.3	647.1	239.2	124.0	36.8	136.5	1,642.9	1,456.7
2045	0.0	16.4	16.4	465.6	657.3	247.5	126.5	36.8	140.1	1,673.7	1,657.3
2046	0.0	16.4	16.4	472.0	667.6	256.2	129.0	36.8	143.8	1,705.3	1,688.9
2047	0.0	16.4	16.4	478.5	678.0	265.2	131.6	36.8	147.6	1,737.7	1,721.3
2048	0.0	16.4	16.4	485.0	688.7	274.5	134.2	36.8	151.6	1,770.8	1,754.4
2049	0.0	186.2	(2,990.5)	491.7	699.5	284.1	136.9	36.8	155.8	1,804.8	4,795.3
<b>EIRR</b>											<b>12.70%</b>
<b>ENPV @ 12%</b>											<b>\$415,848</b>

EIRR = economic internal rate of return, ENPV = economic net present value, O&M = operation and maintenance.  
Source: Asian Development Bank estimates.

## F. Sensitivity Analysis

19. Sensitivity analyses were conducted to assess the robustness of the economic viability of the project, and determine the impact of key input parameters on the EIRR. Ten cases were analyzed, which included a delay in project implementation, an increase in capital costs, a decrease in estimated travel demand, and decreases in key economic inputs (GDP, value of time, travel costs, standard conversion factor, and shadow wage rate). The results of the sensitivity analyses (Table 4) show that the EIRR is most sensitive to an unlikely scenario of an increase in capital costs, and that variations in key project parameters—including an increase in capital costs, project delays, and changes in key economic inputs—would still render the project economically viable. The results therefore show the robustness of the EIRR with regard to reasonable changes in costs and benefits. Considering the overall contribution of the project, which will promote sustainable and inclusive growth in the northern region and is expected to deliver significant wider unquantified benefits—especially regarding health, education, services, and employment opportunities—the results of the economic analysis are considered as conservative, and the integrated benefits of the project are expected to outweigh the capital costs.

**Table 4: Sensitivity Analysis Results**

<b>Sensitivity Test</b>	<b>EIRR (%)</b>	<b>ENPV (\$ million)</b>	<b>Switching Value<sup>a</sup> (%)</b>
Base case	12.7	0.42	
1-year delay in implementation	12.3	0.19	
5% increase in capital costs	12.2	0.12	6.90
5% decrease in base demand	12.3	0.16	(8.30)
20% decrease in GDP elasticities of travel demand	12.3	0.19	(37.3)
20% decrease in generated demand	12.2	0.10	(26.3)
5% decrease in standard conversion factor	11.7	(0.17)	(7.00)
10% decrease in shadow wage rate	12.6	0.35	(66.2)
10% decrease in value of time	12.5	0.31	(38.9)
10% decrease in travel costs	12.1	0.04	(11.1)
10% decrease in GDP growth	12.4	0.22	(21.7)

( ) = negative, EIRR = economic internal rate of return, ENPV = economic net present value, GDP = gross domestic product.

<sup>a</sup> The switching value is the percentage by which costs or benefits vary to result in an ENPV of \$0.

Source: Asian Development Bank estimates.

20. The primary benefit streams come from travel time savings and generated demand. The 2005 household survey (footnote 3) used as a basis to evaluate generated demand was conducted at a time when intensive development of Kulhudhuffushi was not envisaged. Therefore, considering the increased role of Kulhudhuffushi as a regional hub, and the increased frequency of ferry services to Kulhudhuffushi Harbor with the project, the survey likely underestimated the travel demand to Kulhudhuffushi. Given the current low level of demand, with an average of just 1.4 trips per person per year to Kulhudhuffushi in 2014 (Table 2), there is significant potential for increased travel.

21. Furthermore, the proposed harbor will provide greater access to Kulhudhuffushi and its services, notably to the hospital, secondary school, and regional port. The project is expected to

deliver significant wider benefits not assessed for the project, including health and education benefits, the opportunity for greater atoll integration and governance, improved connectivity for business development and operation, and improved retention of the population in the islands of the northern region who might otherwise seek employment and education opportunities in Malé.

22. Finally, there could be additional benefits in using Kulhudhuffushi as a direct import base for certain commodities. Freight is currently imported into the Maldives first through Malé and then distributed on smaller vessels to the other islands of the Maldives. Assuming that the fresh and frozen food needs of the northern region could be imported directly via Kulhudhuffushi, there would be additional fuel and time savings benefits of \$1,216,500 by the 10th year of harbor operation. These indirect benefits were not included in the economic analysis.

## **G. Financial Sustainability**

23. The project cost estimates indicate an investment plan of \$10.44 million, of which ADB will finance \$9.69 million (92.82%) on a grant basis. This project is not intended for revenue generation, even though the Secretariat of the Kulhudhuffushi Council may utilize some parts of the harbor facilities for business activities by local inhabitants on a rental basis. The proportion of the project cost for these business activities is relatively small, i.e., less than 5% of the harbor cost. Therefore, the assessment on overall harbor sustainability is based on incremental recurrent costs associated with the project only.

24. **Assessment of sustainability.** The Secretariat of the Kulhudhuffushi Council (SKC) is responsible for the cost of routine maintenance and day-to-day operation of Kulhudhuffushi Harbor. The national government allocated around Rf977 million for operations of all councils in 2015, and the budget allocated for the SKC was about Rf9.8 million. The actual expenditure incurred in 2015 for day-to-day operation and routine maintenance of the existing harbor in Kulhudhuffushi was around Rf420,000. Incremental recurrent costs associated with the project are estimated to be around Rf267,000 per year, which is 2.7% of the current allocation of the SKC, and less than 0.1% of the national budget council allocation.

25. Larger-scale maintenance for the project, which is projected to be carried out at 5-year intervals, will be the responsibility of the Public Works Services under the Ministry of Housing and Infrastructure (MHI). From 2011 to 2015, the approved national budget allocation for larger-scale maintenance of all public harbors in the Maldives was estimated at Rf95 million. The incremental recurrent cost for large-scale maintenance of the project was estimated to be around Rf2.7 million every 5 years, or 2.9% of the current approved budget. Additionally, MHI historical financial information in 2014 and 2015 shows that funds released for large-scale maintenance and upkeep have exceeded the initial budget allocations. In addition, the MHI is committed to adequately maintaining public harbors throughout the Maldives.<sup>9</sup>

26. Therefore, it is likely that the operation and maintenance of the new harbor will be sustained. Like other domestic harbors outside Malé, the proposed passenger and cargo harbor under the project will be operated free of port dues or cargo handling charges. The technical assistance attached to this project will support the government in assessing the feasibility of a harbor charging scheme in Kulhudhuffushi and preparing a related action plan in the future to help further enhance the harbor's sustainability.

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<sup>9</sup> In 2014, the actual expenditure for large-scale harbor maintenance by the MHI was around 38% higher than the budget allocation; in 2015, it was 53% higher.