Qeshm Free Zone Organization
(QFZO)

Japan International Cooperation Agency
(JICA)

THE PROJECT FOR COMMUNITY-BASED SUSTAINABLE DEVELOPMENT MASTER PLAN OF QESHM ISLAND TOWARD "ECO-ISLAND" IN THE ISLAMIC REPUBLIC OF IRAN

FINAL REPORT

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Abbreviations

ASC	Aquaculture Stewardship Council
BAP	Best Aquaculture Practices
BDS	Business Development Service
BOO	Build Own Operate
BOT	Build Operate Transfer
CAD	Computer Aided Design
CAGR	Compound Average Growth Rate per year
CBD	Convention of Biological Diversity
CBO	Civil-Based Organizations
CDW	Construction and Demolition Waste
CP	Counterpart
DFR	Draft Final Report
DMO	Destination Management Organizations
DoE	Department of Environment
EAF	Ecosystem Approach to Fisheries
ECO	Economic Cooperation Organization
EIA	Environmental Impact Assessment
ERD	Energy Recovery Device
FAM	familiarization
FAO	Food and Agriculture Organization
FDI	Foreign Direct Investment
FIT	Feed-in-Tariff
FR	Final Report
FRWMO	Forests, Range and Watershed Management Organization
FYDP	Five-Year Development Plan
GBO	Global Biodiversity Outlook
GCC	Gulf Corporation Council
GCM	General Circulation Model
GGN	Global Geopark Network
GEF	Global Environment Facility
GEF SGP	Global Environment Facility Small Grants Programme
GHGs	Greenhouse Gases
GIS	Geographic Information System
HACCP	Hazard Analysis and Control Point
HBI	Hot Briquetted Iron
HOV	High Occupancy Vehicle
HRSG	Heat Recovery Steam Generators
HRWWC	Hormozgan Rural Water and Wastewater Company
HUWWC	Hormozgan Urban Water and Wastewater Company
ICCA	Indigenous Communities Conserved Areas
IcR	Inception Report
ICHTO	Iran Cultural Heritage, Handicrafts and Tourism Organization
ICM	Integrated Coastal Management
ICT	Information and Communication Technology
ICZM	Integrated Coastal Zone Management
IEE	Initial Environmental Examination
IRENA	International Renewable Energy Agency
IFO	Iranian Fisheries Organization
IGMC	Iran Grid Management Co.
IMTA	Integrated Multi-Trophic Aquaculture
IPCC	Intergovernmental Panel on Climate Change
IPDC	Iran Power Development Co.
IRR	Iranian Rial
ItR	Interim Report
IUCN	International Union for Conservation of Nature
JCC	Joint Coordination Committee
JICA	Japan International Cooperation Agency
KFZO	Kish Free Zone Organization
LCC	Low Cost Carriers
LNG	Liquefied Natural Gas
NAB	Man and Biosphere Programme
MAPNA	Iran Power Plant Project Management
METI	Ministry of Economy, Trade and Industry, Japan
MICA	Meeting, Incentives, Conferences, and Exhibitions
MoAJ	Ministry of Agriculture Jihad
MP	Master Plan
MPO	Management and Planning Organization
MSY	Maximum Sustainable Yield
MTBE	Methyl Tertiary Butyl Ether
NGO	Non-Governmental Organization
NPO	Non-Profit Organization
OECD	Organization for Economic Co-operation and Development
PCM	Project Cycle Management
PES	Payment for Ecosystems Services
PMO	Port and Maritime Organization
PPP	Public Private Partnership
PR	Public Relation
PrR	Progress Report
QFZO	Qeshm Free Zone Organization
QUC	Qeshm Utilities Company
QUITO	Qeshm Island Tourism Organization
RCM	Regional Climate Model
RCP	Representative Concentration

	Pathway
RD	Record of Discussion
SABA	Iran Energy Efficiency Organization
SDF	Skills Development Fund
SDG	Sustainable Development Goals
SDI	Spatial Data Infrastructure
SEA	Strategic Environmental Assessment
SEZ	Special Economic Zone
SME	Small Medium Enterprise
SNS	Social Networking Service
STP	Sewage Treatment Plant
SUNA	Renewable Energy Organization of Iran
SWOT	Strength, Weakness, Opportunity and Threat
TAC	Total Allowable Catch
TEK	Traditional Ecological Knowledge
TOZI	Qeshm electric power distribution company
TIES	International Ecotourism Society
TSE	Treated Sewage Effluent
TVET	Technical and Vocational Education and Training
UAE	United Arab Emirates
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNWTO	World Tourism Organization
USD	United States Dollar
WDPA	World Database on Protected Areas
WWF	World Wide Fund for Nature
WWTP	Waste Water Treatment Plant

Unit of Measurement

Area

m^2	square meter
km^2	square kilometer
ha	hectare (= 10,000 m^2)

Length

mm	millimeter
cm	centimeter
m	meter
km	kilometer

Weight

µg	micro gram
mg	milligram
kg	kilogram
t	ton (=1,000 kg)
tpa	ton per annual
MTPA	million ton per annual

Volume

l	liter
m^3	cubic meter (= 1,000 liter)
bbl.	barrel (=0.159 m^3)
BCM	billion cubic meter
mmscfd	million standard cubic feet per day
Nm^3	normal cubic meter

Time

sec, s	second
min	minute
h, hr	hour
d	day
y /yr	year

Energy

W	watt
kW	kilowatt
kWh	kilowatt-hour
MW	megawatt
GW	gigawatt
GWh	gigawatt-hour
cal	calorie
kcal	kilocalorie
J	joules (=4.18 cal)
kj	kilo joules

Other

%	percent
$	dollar
Avg	average
degree	degree celsius
dB	decibel
mil.	million
ppm	parts per million

Comparison of Persian Year and Gregorian Calendar

Persian Year	Gregorian Calendar
1369	21 March 1990 – 20 March 1991
1370	21 March 1991 – 20 March 1992
1371	21 March 1992 – 20 March 1993
1372	21 March 1993 – 20 March 1994
1373	21 March 1994 – 20 March 1995
1374	21 March 1995 – 19 March 1996
1375	20 March 1996 – 20 March 1997
1376	21 March 1997 – 20 March 1998
1377	21 March 1998 – 20 March 1999
1378	21 March 1999 – 19 March 2000
1379	20 March 2000 – 20 March 2001
1380	21 March 2001 – 20 March 2002
1381	21 March 2002 – 20 March 2003
1382	21 March 2003 – 19 March 2004
1383	20 March 2004 – 20 March 2005
1384	21 March 2005 – 20 March 2006
1385	21 March 2006 – 20 March 2007
1386	21 March 2007 – 19 March 2008
1387	20 March 2008 – 20 March 2009
1388	21 March 2009 – 20 March 2010
1389	21 March 2010 – 20 March 2011
1390	21 March 2011 – 19 March 2012
1391	20 March 2012 – 20 March 2013
1392	21 March 2013 – 20 March 2014
1393	21 March 2014 – 20 March 2015
1394	21 March 2015 – 19 March 2016
1395	20 March 2016 – 20 March 2017
1396	21 March 2017 – 20 March 2018
1397	21 March 2018 – 20 March 2019
1398	21 March 2019 – 19 March 2020
1399	20 March 2020 – 20 March 2021
1400	21 March 2021 – 20 March 2022
1401	21 March 2022 – 20 March 2023
1402	21 March 2023 – 19 March 2024
1403	20 March 2024 – 20 March 2025
1404	21 March 2025 – 20 March 2026
1405	21 March 2026 – 20 March 2027
1406	21 March 2027 – 19 March 2028
1407	20 March 2028 – 19 March 2029
1408	20 March 2029 – 20 March 2030
1409	21 March 2030 – 20 March 2031
1410	21 March 2031 – 19 March 2032
1411	20 March 2032 – 19 March 2033
1412	20 March 2033 – 20 March 2034
1413	21 March 2034 – 20 March 2035
1414	21 March 2035 – 19 March 2036
1415	20 March 2036 – 19 March 2037

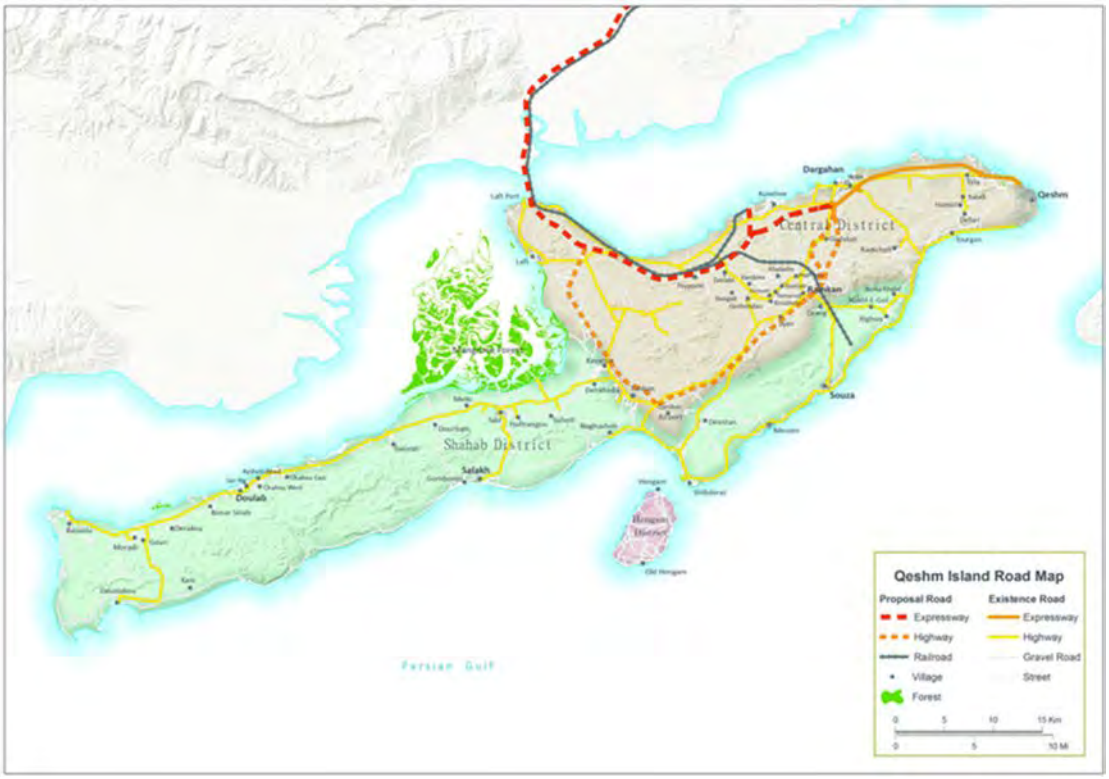
CHAPTER 7 TRANSPORT AND UTILITIES DEVELOPMENT PLAN

7.1 Transportation Development Plan

7.1.1 Road

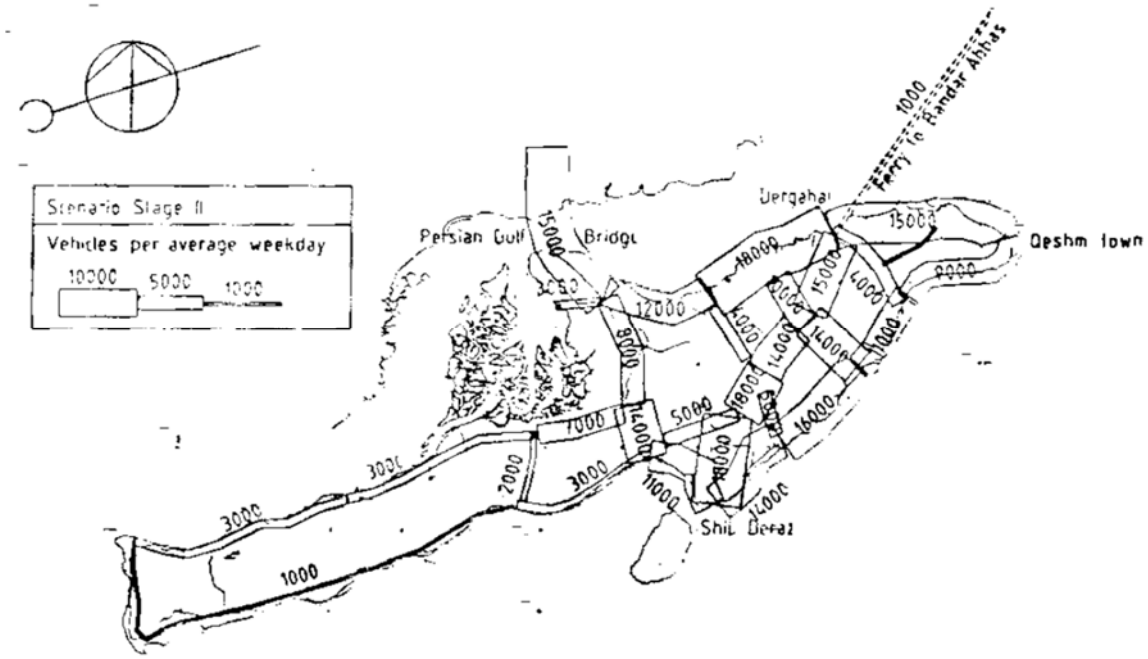
(1) Existing conditions

The existing road network and the network proposed in the SWECO Master Plan is shown in Figure 7.1.1.



Source: JICA Project Team

Figure 7.1.1 Existing Road Network and the Network as Proposed by the SWECO Master Plan

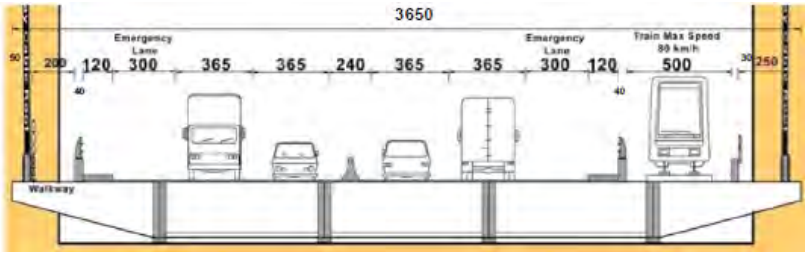


Source: SWECO Master Plan

Figure 7.1.2 Traffic Demand Forecast (2021) by SWECO Master Plan

The road network in the island is being developed in line with the SWECO Master Plan. The Dargahan-Qeshm section of the arterial network has been constructed and put into service as an access-controlled dual carriageway, while sections connecting Laft/Dargahan, Dargahan/Ramkon/ Qeshm Airport, and Laft/Qeshm Airport are also planned to be constructed with the similar standards. These sections are expected to carry heavy traffic, and the provision of sufficient capacity as scheduled timeframe will be of prime importance.

The construction of the Persian Gulf Bridge (Figure 7.1.4), which has been long-awaited by people in Qeshm and the visitors, has commenced in 2014 with the production of caisson foundations in a dry work yard. The proposed bridge is a seven-span cable-stayed bridge with caisson foundation for road and railway transport. The maximum span is 360 meters and the total length is 2,440 meters, excluding approaches[1] of 1,000 meters. The bridge is one of the four components for the transportation improvement project on Qeshm which constitutes the extension of Kouvei port, a highway (92km) and a railway (86km) from mainland to Qeshm. It has the cross section of four traffic lanes and one railway lane (Figure 7.1.3).



Source: Technical Specifications of the Persian Gulf Regional Transportation Network

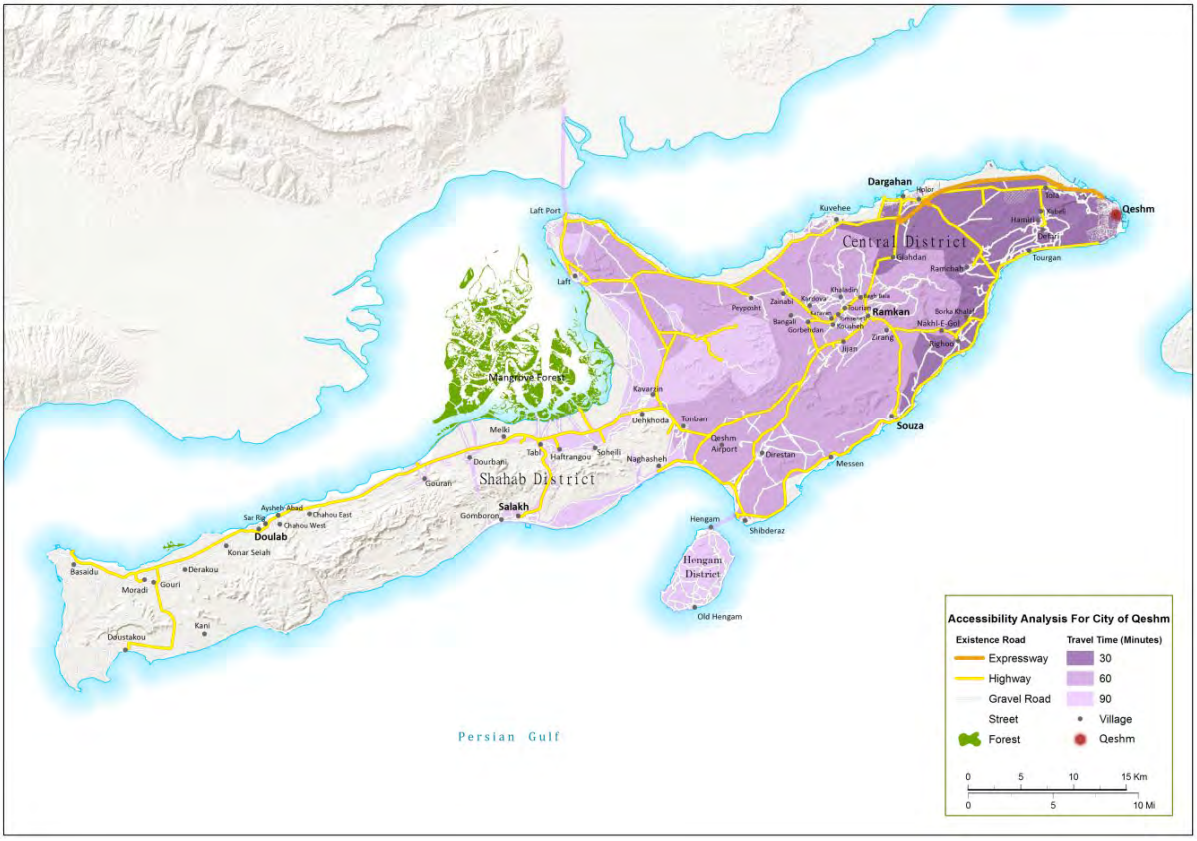
Figure 7.1.3 Cross Section of the Persian Gulf Bridge

[1] The bridge construction works, however, has been suspended after one year due to financing problems.

Source: Photograph taken by JICA Project Team

Figure 7.1.4 Signboard for the Persian Gulf Bridge

Figure 7.1.5 shows the results of an accessibility analysis based on the planned road network. Most of the towns on the eastern area will be covered within one hour of travel time from Qeshm City Center, while access to the western part of the island still require longer than 1.5 hours. Some part of the road sections in this area has not been paved, damaged by floods and require improvement.



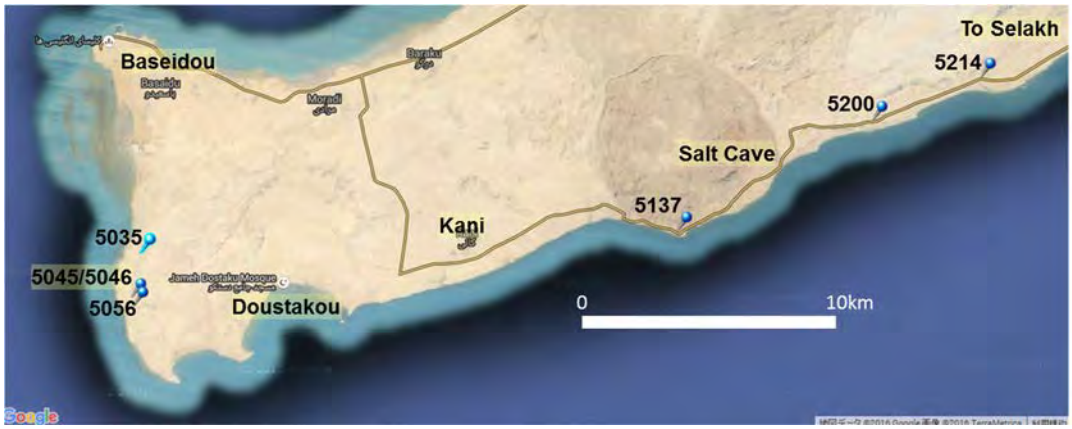
Source: JICA Project Team

Figure 7.1.5 Travel Time Required from Qeshm City Center

(2) Strategies for Improvement

Based on the existing road network condition and the review of the SWECO Master Plan, strategies for road network improvement can be summarized as follows:

(a) Improvement in the Southwest Coastal Area: Road sections in the southwest coastal area require improvement. As shown in Figure 7.1.6 and Table 7.1.7, the unpaved roads are eroded, and access to this area is not easy in this condition.



Source: JICA Project Team based on Google Map.

Figure 7.1.6 Locations of Sites Damaged by Erosion in South Area

5035 Damaged by Erosion

5045 Damaged by Erosion

Source: JICA Project Team

Figure 7.1.7 Photos of Baseidou-Doustakou Section

(b) Access Road Development in Historical Areas: Bituminous asphalt pavement could spoil the landscape of some historical areas, and measures to improve compatibility with the landscape may have to be investigated.
(c) Continuation of Planned Development: Traffic congestion is not serious now and will not be major issue in foreseeable future so long as the planned road network development is consistently be implemented.
(d) Periodical Review of Development Plan: Periodical review development plans are also necessary, because various development projects led by both public and private sectors are in progress in the industrial area and ports, as well as tourism etc. This will most likely to influence changes in traffic demand patterns, therefore continuous monitoring of traffic volume on road network will become very important to enable timely review of network development plan.

In summary, strategies for road network improvement can be categorized as follows:

(a) Provide road access to all communities
(b) Harmonize road development in historical areas
(c) Develop road network to avoid traffic congestion and to provide access to industrial areas

(3) Proposed Improvement

Development of the Southwest Coastal Sections (in reference to Strategy 1)

Although substantial length of road sections in the island are paved, mainly in the southwest coastal area, some road sections remain unpaved (Figure 7.1.8). Since the population in the southwest coastal

area is relatively low,[2] priority for improvement is relatively low now. Nevertheless, it is important to upgrade road sections for improving residents' accessibility to various services, for encouraging tourists to visit some Geopark destinations, such as the Salt Cave, and for the development of the southwest coastal area.

Source: JICA Project Team with Google Earth

Figure 7.1.8 Unpaved Road Sections in the Southwest Coastal Area

Introduction of Soil-Based Pavement (in reference to Strategy 2)

While bituminous asphalt pavement is not always compatible with the landscape of surroundings, it is often utilized due to its cost-effectiveness and popularity of the construction method. Soil-based pavement, on the other hand, has been introduced in overseas countries to address this issue. For soil-based pavement, natural soil and/or sand are used together with bonding materials such as resin, lime, cement or asphalt. While its disadvantage is a low-bearing capacity compared to normal bituminous asphalt pavement,[3] major advantages are that the pavement has a higher elasticity for shock absorption, water permeability and compatibility with the landscape. For these reasons, soil-based pavement can be used as an alternative to bituminous asphalt for road sections with relatively low traffic, and the area where aesthetic compatibility is important.

Source: http://www.pavingexpert.com/resin.htm,
http://www.dohkenkyo.net/pavement/meisyo/tutsi.html

Figure 7.1.9 Soil-based Pavement

[2] Selakh: 2,740; Gomboron: 474; Kani: 332; Doustakou: 567; Baseidou: 1,989 (according to the 2011 census).
[3] http://www.dohkenkyo.net/pavement/meisyo/tutsi.html.

Establishment of regular road development liaison (in reference to Strategy 3)

In Qeshm Island, road network has been developed based on the SWECO Master Plan, and severe road congestion has not been observed even though the master plan does not include the fully access controlled expressways. However, it is important to note that the master plan was prepared based on the traffic information available at that time, which implies that the master plan may have to be revised by reflecting recent and future land development. For this purpose, it is recommended to establish a coordinating body, which consists of the QFZO, the Department of Roads and Urban Planning and other organizations related to industrial development to follow up on the progress of road development and discuss the appropriateness of the road development plan on a regular basis. This will enable the road network development that reflects trends in the industrial and other land development.

7.1.2 Airport and air transport

(1) Existing Conditions and Issues

The Qeshm International Airport in Direston became operational in 1997. The old Qeshm City Airport was being used for only for domestic flights but closed at the same time when the new airport was open.[4] The new airport has a 4,225 m runway (see Figure 7.1.10).

Source: JICA Project Team with Google Earth

Figure 7.1.10 Qeshm International Airport in Deirestan

Table 7.1.1 presents operating flights at the Qeshm International Airport in 2018.

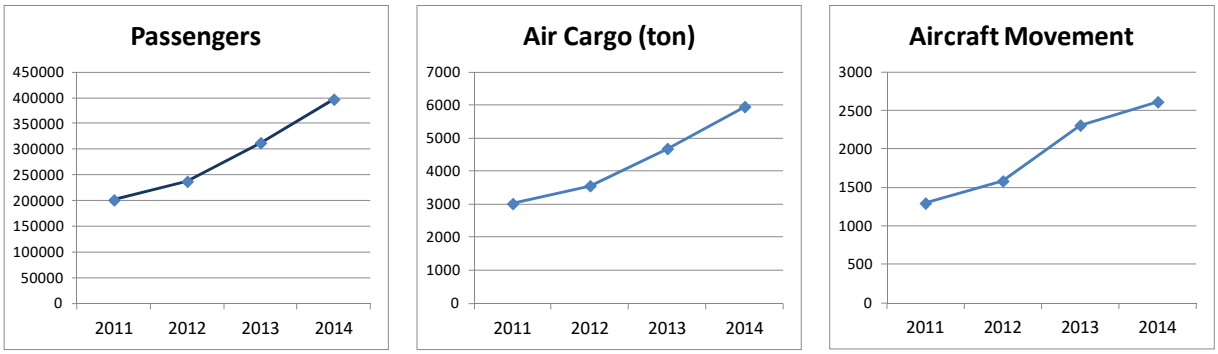
[4] In the later year, the land area used as the old airport was sold to a private developer, and being developed as residential area.

Table 7.1.1 Operating Flights at Qeshm International Airport

Item	Description
Number of airlines using Qeshm airport as their home airport	1 (Qeshm Airlines)
Number of domestic/international Airlines landing at Qeshm Airport	9
Destinations of domestic flights	Tehran (22/week), Shiraz (six/week), Mashhad (four/week), Isfahan (four/week), Kish Island, Mebrabad, Tabriz, Gorgan, Kermanshan
Destinations of international flights	Dubai (20/week)
Number of domestic flights	Approximately 40/week
Number of international flights	Approximately 30/week

Source: JICA Project Team

The number of passengers, air cargo and aircraft movement is increasing at an annual compound average growth rate (CAGR) of approximately 25% (see Figure 7.1.11). If aircraft movement increases steadily at a CAGR of 20%, aircraft movement will equate to over 100,000 by 2035. The aircraft movement capacity of one 4,000 m class runway is approximately 100,000 per year, while the aircraft movement at Qeshm International Airport, is now less than 3,000 per year, which is around 3% of capacity.

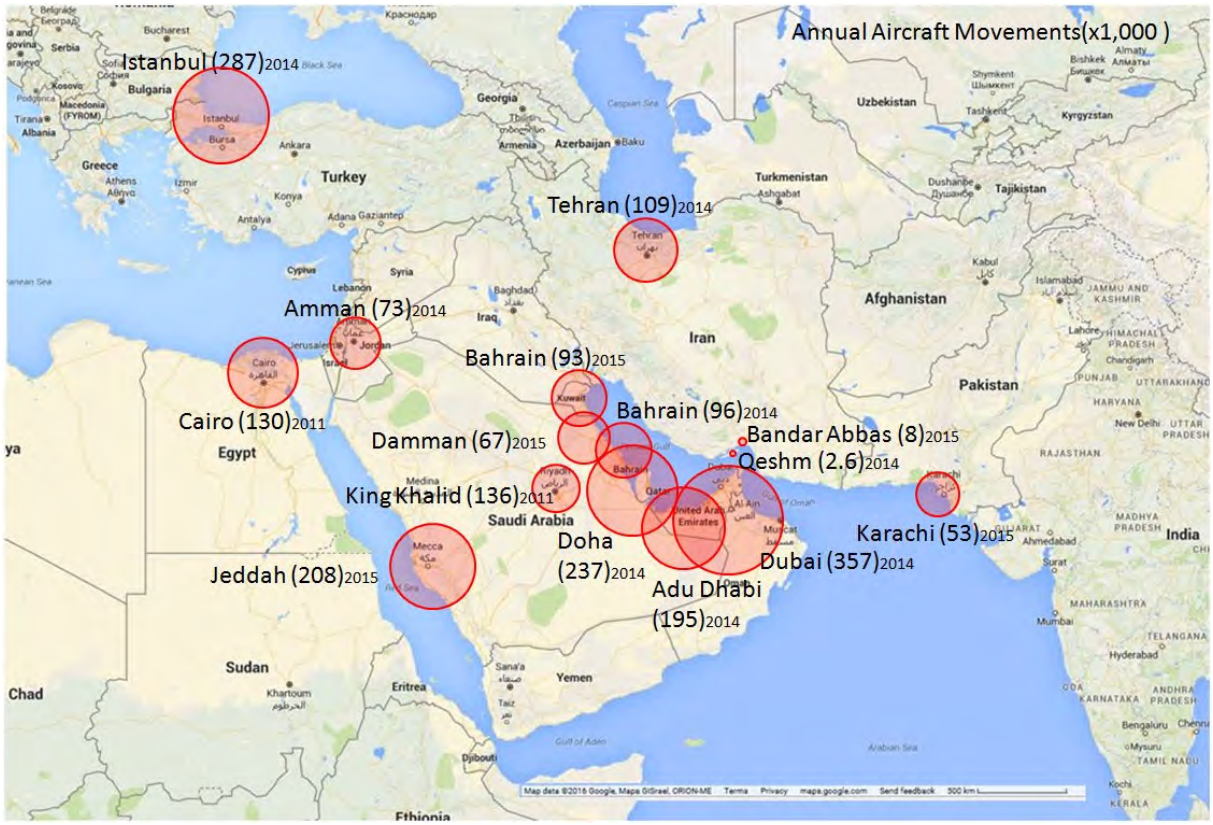


CAGR (2011-2014): 24.4% CAGR (2011-2014): 24.4% CAGR (2011-2014): 26.4%

Source: Data provided by the Qeshm Free Zone Organization

Figure 7.1.11 Air Traffic Data at Qeshm International Airport

Recently, Doha, Abu Dhabi and Istanbul Airports, which are regional hub airports, have been enhancing their competitiveness at the level of Dubai Airport. Therefore, the aviation market in the region surrounding Qeshm Island is very competitive, such that it is a challenge for Qeshm International Airport to become a regional hub airport. Figure 7.1.12 shows the arrival aircraft movement of international airports surrounding Qeshm. Dubai has the largest aircraft movement at 357,000, followed by Istanbul at 287,000.



Source: Data provided by the Qeshm Free Zone Organization and airport websites, with Google Map

Figure 7.1.12 Comparison of Annual Aircraft Movement (x1,000)

In the face of the aircraft movement at Qeshm International Airport is less than 3,000/year, which is 3% of the runway capacity, convenience and comfort to the passengers at the terminal, and access to the airport may have to be improved to meet the expected future increase of demand for tourism and industrial related traffic.

(2) Airport Improvement Strategies

In 2004, the New Zealand Airways Company investigated the expansion of the airport area from 840 to 2,000 ha, which includes the development initiatives listed below:

- Complete construction of the new tower and provide required equipment
- Complete an unfinished section of the ramp and install air bridges
- Build new terminals for passengers and cargo
- Build hotels, restaurants, coffee shops and tax-free shops
- Build a hangar for aircraft repair
- Build a parallel runway
- Build a catering building
- Build a fire station

These initiatives are appropriate, but a parallel runway may also be considered in long term.

Strategies for improving the Qeshm Airport can also be examined by comparing the Naha Aiport in Japan. Naha is the capital city of Okinawa Prefecture, which is in the southern region of Japan. Similar to Qeshm Island, Okinawa is famous for its beautiful coastlines/coral reefs, marine sports and historic buildings, along with a subtropical climate. Naha Airport has been making improvements to become a regional hub airport for tourism and air cargo. Therefore, the comparison between the Qeshm Airport and the Naha Airport is useful for developing improvement strategies for the Qeshm Airport. Table 7.1.2 summarizes the results of the comparison.

Table 7.1.2 Comparison Between Qeshm International Airport and Naha International Airport

Qeshm International Airport	Naha International Airport
	
Latitude: 25^{0}45'N (Source of map: Google Map)	Latitude: 26^{0}12'N (Source of map: Google Map)
Area of the island: 1,295 km^2	Area of the island: 1,207 km^2
Population of the island: 117,774 (2011)	Population of the island: 1.28 million (2011)
Runway: length 4,225 m, width 45 m	Runway: length 3,000 m, width 45 m
Passengers in 2014: 396,799 Air cargo in 2014: 5,952 tons Aircraft movement in 2014: 2,610	Passengers in 2014: 17.53 million Air cargo in 2013: 147,945 tons Aircraft movement in 2013: 148,480
Number of airlines using Qeshm Airport as a home airport: 1	Number of airlines using Naha Airport as a home airport: 4
Number of domestic/international airlines landing at Qeshm Airport: 9	Number of domestic airlines landing at Naha Airport: 7
	Number of international airlines landing at Naha Airport: 16
Terminal: • Domestic terminal Number of boarding gates for passengers: 2 • International terminal Number of boarding gates for passengers: 2 • Air cargo terminal: none	Terminal: • Domestic terminal Number of boarding gates for passengers: 20 • International terminal Number of boarding gates for passengers: 3 • Low-cost carrier (LCC) terminal for domestic/international flights • Air cargo terminal
Number of restaurants and shops: • Domestic terminal: 1 • International terminal: 1	Number of restaurants and shops: • Domestic terminal: 26 • International terminal: 10 • LCC terminal: 2
Airport access: • Airport taxi	Airport access: • Monorail: 12.9km to the city • Bus routes: 9 • Taxis • Rental cars
	Ongoing airport expansion project In 2008, the airport was approaching the limit of its runway capacity, with 110,000 aircraft movements. Therefore, the government decided to build a second runway, which is under construction and will be in operation from 2019. Second runway: length 2,700 m, width 60 m

Source: Data provided by the Qeshm Free Zone Organization and http://qeshmairport.ir/main/en/page,1493

(3) Proposed Improvement

Based on the above comparison, the development of the Qeshm International Airport can be phased as shown in Table 7.1.3.

Table 7.1.3 Phased Development Strategies for the Qeshm Airport

Item	Phase 1 (Short and Medium Term)	Phase 2 (Long Term)
Annual aircraft movements	Up to 100,000	Over 100,000
Priority projects	• To expand the terminals/parking and improve comfort and convenience in the terminals (USD 10-20 million) • To improve the aviation control system and safety system (USD 10-30 million) • To maintain the runway (USD 1-3 million)	• To build a second runway (USD 5-20 million) • To further improve aviation control system and safety system (USD 10-20 million) • To further expand terminals and parking (USD 5-10 million)
Other project	• To improve airport access, introducing shuttle buses, rental cars etc. (USD 3-10 million)	• To introduce a mass transit system, such as monorail and automated guideway transit (USD 100-500 million)

Note: As the rough cost estimates above are indicative amounts, they will need to be reviewed and revised through feasibility studies for each item
Source: JICA Project Team

For its locational advantages, the Qeshm International Airport has a potential to become a domestic and international hub airport. Detailed studies are required to develop strategies to capitalize its potential. Such studies must examine competitive advantages of the Qeshm Airport in comparison to the surrounding airports such as the Bandar Abbas Airport, the Dubai International Airport, and the Doha International Airport.

7.1.3 Port

(1) Existing conditions in Qeshm Island

There are total of five main ports in the Qeshm Island as follows:

Bahman Port: This port is the largest trading port in Qeshm Island, which went through the following improvements recently:

- Construction of 200 multipurpose jetty with a length of 350 m (one jetty for 10,000-ton vessels and one jetty for 5,000-ton vessels);
- Construction of a special crane for easy loading and unloading;
- Pond dredging with a depth of 9.5 m; and
- A dry dock for loading goods.

Kouvei Port: Kouvei Port: This port is one of the major industrial port in the island, and still under expansion to meet the increasing demand from the Kouvei Industrial Area.

Selakh Port: This port is an oil bunkering port near the Selakh Fishing Port.

Shahid Zakeri Ferry Port: This is a passenger ferry port East of the island, which connects Qeshm to Bandar Abbas.

- Total passengers in 2015: arriving1.29 million, departing 1.22 million

Source: JICA Project Team with Google Earth, December 2015

Figure 7.1.13 Bahman Port

Source: JICA Project Team with Google Earth, February 2016

Figure 7.1.14 Kouvei Port

Source: JICA Project Team with Google Earth, December 2015

Figure 7.1.15 Selakh Port

- The ferry operation often halts due to weather conditions because old-type ferry boats are utilized

Laft Ferry Port: This is a passenger and vehicle ferry port North of the island, and connects to Pohl and Bandar Abbas.

- Total passengers by boats in 2015: arriving 0.162 million, departing 0.161 million
- Total passengers by cars in 2015: arriving 2.06 million, departing 2.14 million
- Total vehicles (Shahid Zakeri and Laft) in 2015: arriving 694,000, departing 522,000

Table 7.1.4 shows the latest statistics on the cargo handled at the ports in Qeshm and Bandar Abbas. As it is seen in the table, cargo traffic in the island is relatively small now compared to the port in Bandar Abbas.

Table 7.1.4 Total Loading and Unloading at Ports in Qeshm and Shahid Rajaee in Bandar Abbas

(Unit: 1,000 ton)

Port	Loading		Unloading	
	Oil	Non-oil	Oil	Non-oil
Qeshm	101	3,801	0	3,692
Bandar Abbas	16,750	14,674	6,815	27,377

Note1: "Loading" and "Unloading" indicate amount of loading or unloading from vessels at the port.
Note2: "Qeshm" indicates all ports in Qeshm.
Source: Port and Maritime Organization (PMO)

Table 7.1.5, on the other hand shows types of cargo exported and imported through the ports in Qeshm.

Table 7.1.5 Total Export and Import at the Ports in Qeshm

(Unit: 1,000 ton)

Export		Import	
Construction materials	122,851	Mineral materials	150
Miscellaneous	961	Miscellaneous	85,058
Container	2,800	Container	51,173
Oil	0	Oil	0
Total	126,612	Total	136,381

Note: "Export" and "Import" indicate the amount through the custom at the port.
Source: Port and Maritime Organization (PMO)

(2) Proposals in SWECO Master Plan

The SWECO master plan defined the goals for ports and sea transport as follows:

- Construction of ports and port facilities able to handle large volumes of oversea exports and imports of raw material and products
- Improvements in the transport capacity for goods and passengers between Qeshm Island and the mainland
- Handling of large volumes of transit goods to and from mainland Iran and the landlocked countries in north of Iran

For these goals, the SWECO master plan identified following three main transport needs using the port facilities:

- Transport services related to the population of Qeshm Island;
- Transport of goods related to planned and potential new industries; and
- Transshipment of goods via a new large port on Qeshm Island.

(3) Current Status of Ports in Iran

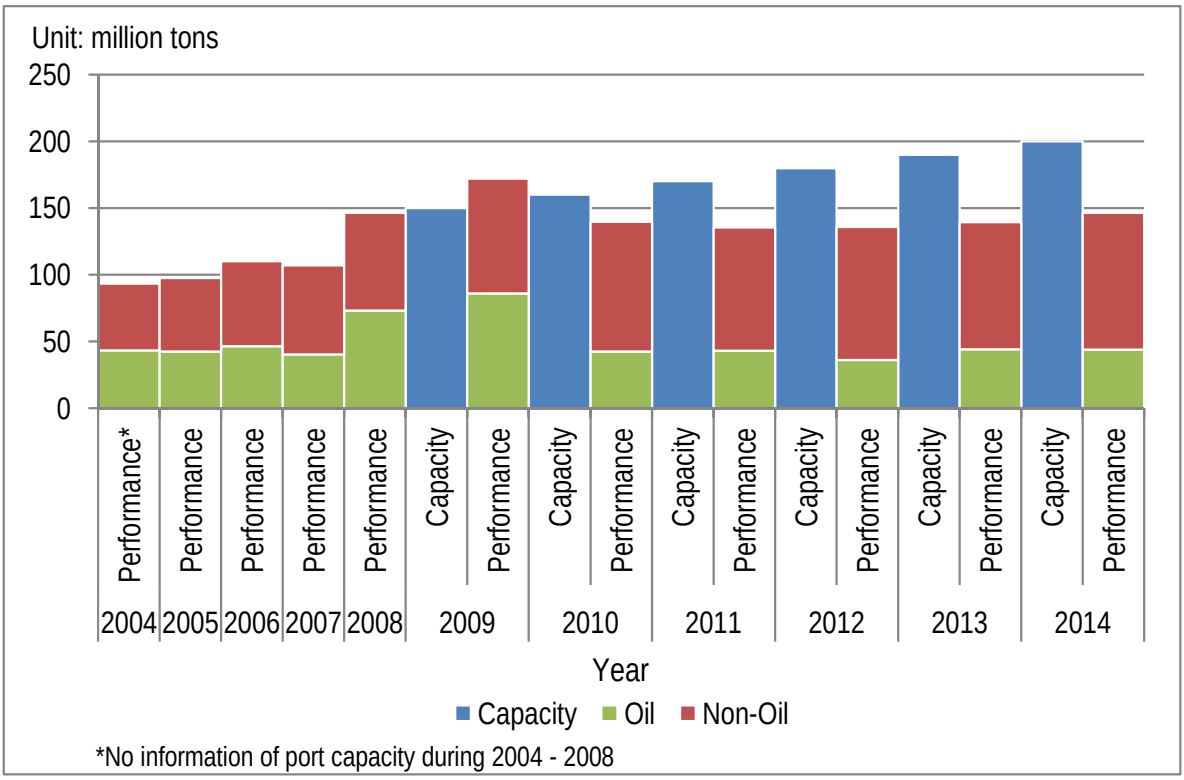
In order to examine the needs of "(iii) Transshipment of goods via a new large port on Qeshm Island", the JICA Project Team reviewed the current status of ports in Iran.

In Iran, 11 commercial ports are currently in operation. Three of these ports are located on the side of the Caspian Sea while the other ports are located on the side of the Persian Gulf and Gulf of Oman. Their locations are illustrated in Figure 7.1.16.

Source: Port & Maritime Organization (PMO)

Figure 7.1.16 Locations of the Commercial Ports in Iran

In 2016, these ports handled total of 141 million tons/year, and 2.5 million TEU/year of container traffic. Figure 7.1.17 shows the capacity and performance Iranian ports from 2004-2014.

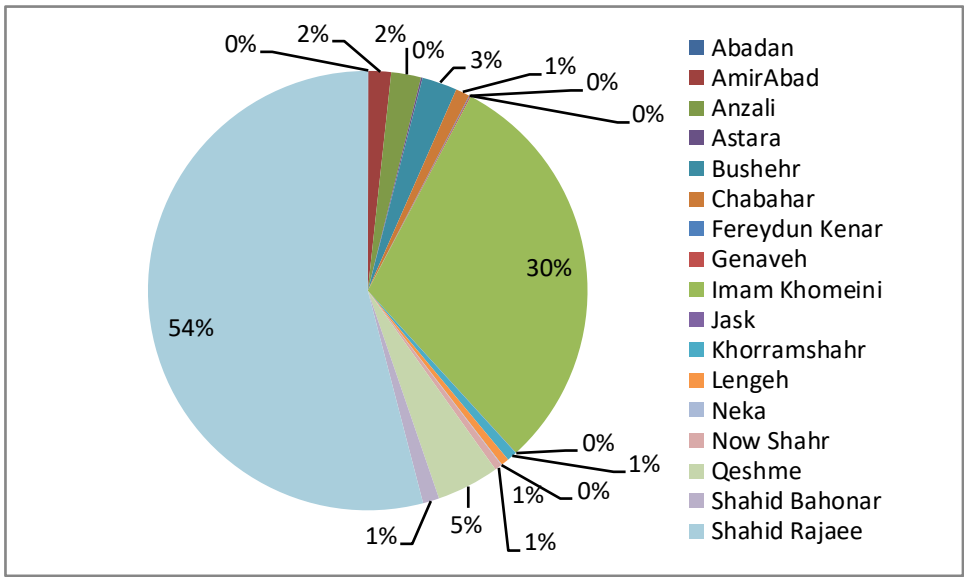


Source: Port & Maritime Organization Statistics Report (PMO)

Figure 7.1.17 Cargo Capacity and Performance of the Ports of Iran (2004-2014)

Although the capacity of Iranian ports has developed gradually, their performance has remained at approximately the same level over recent years. In 2014, port performance was proportional to about 70% of their capacity.

The share of cargo throughputs among ports of Iran in 2016 is shown in Figure 7.1.18.

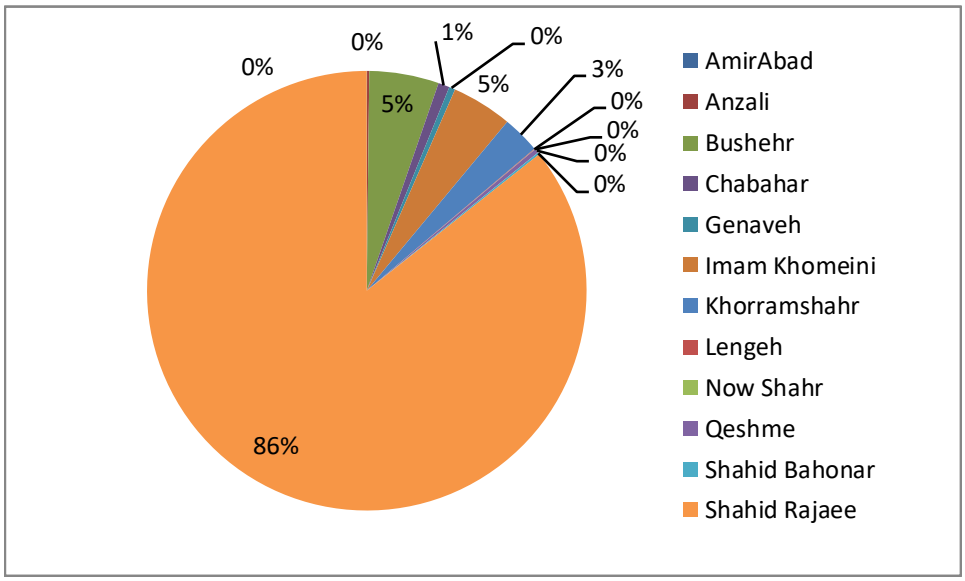


Note: Total amount of cargo throughput at 141.059 million ton
Source: PMO

Figure 7.1.18 Share of Cargo Throughput amoung the Ports of Iran (2016)

Cargo throughput of 2 major ports (Shahid Rajaee Port: 54% and Imam Khomeini :30%) accounts for 84% of total cargo throughputs. Qeshm port is the third ports among the ports and accounts for 4.6% of total cargo throughput.

The share of container throughputs among ports of Iran in 2016 is shown in Figure 7.1.19.



Note: Total amount of container throughput at 2,462,027 TEU
Source: PMO

Figure 7.1.19 Share of Container Throughput amoung the Ports of Iran (2016)

Shahid Rajaee Port (in Bander Abbas) accounts for 85.6% of the total amount of container throughput, thus it can be said that it is the main gateway port for container transactions in Iran.

(4) Current Status and Future Development Plan of Major Ports

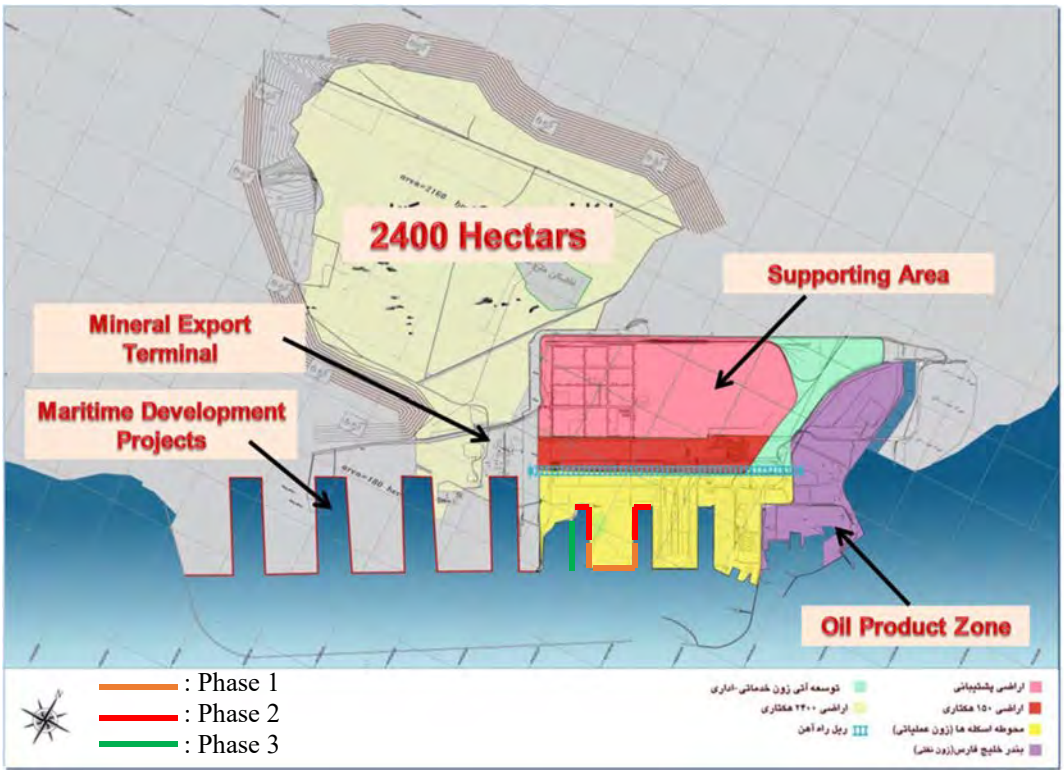
This section describes current status and future development plans for Shahid Rajaee Port and Chabahar Port. As mentioned earlier, Shahid Rajaee Port is the most important port for cargo transport in Iran. Chabahar Ports also has a plan for future development with assistance provided by India.

1) Shahid Rajaee Port

Shahid Rajaee Port commenced its operation in 1984, and was further developed in 2002. Currently, a privately held Iranian company is operating the port. Shahid Rajaee Port estimates 3 phases for its development. The 3 phases are as follows:

- Phase-I (berth length: 1,000m, depth: -17m, area: 70 ha)
- Phase-II (berth length: 2,000m, depth: -16m, area: 140 ha)
- Phase-III (berth length: 1,500m, depth: -16m, area: 55 ha)

As of today, the Phase-I and II have been completed and Phase III is under construction. Furthermore, Grain Terminal (30,000 ton) is also under construction and Logistics Centre (2,400 ha) is being planned. The future plan of Shahid Rajaee Port is shown in Figure 7.1.20.



Source: PMO Bandar Abbas Port Authority

Figure 7.1.20 Future Plan of Shahid Rajaee Port

Current capacity of the port is as follows:

- Cargo Throughput: 70 million tons (2016), performance measured 76 million tons
- Container traffic: 3 million TEU/year (2016), performance measured 2.46 million TEU

Once Phase-III is completed, it is assumed that the container handling capacity of the port will increase to 6 million TEU/year. At this stage, Shahid Rajaee Port does not have any further port development plan, as it is assumed that the completion of Phase-III will allow it to meet current demand.

In addition, a railway route connects Shahid Rajaee Port to Kazakhstan through Turkmenistan and Uzbekistan. Figure 7.1.21 shows the route of the international railway route connecting the Shahid Rajaee Port. There is a possibility that Shahid Rajaee Port can function as a transit port for cargo from CIS countries. The approximate amount for the transit cargo is 5 million tons/year.5

5 JICA Data Collection Survey for Urban Development and Transportation in Iran, 2016

Source: Economic Cooperation Organization, ECO

Figure 7.1.21 Future Railway Route Plan from Shahid Rajaee Port

2) Chabahar Port

Chabahar Port is located at the eastern end of coast along the Gulf of Oman in Iran. The current facilities of Chabahar Port include 1 jetty for container, 8 jetties for break bulk, and 1 jetty for liquid bulk. The amount of cargo traffic is relatively low at 1.4 million tons/year for cargo and 20,278 TEU/year for containers in 2016.

The Indian government and private companies have shown interest in supporting the development of Chabahar Port to assist the economic development of inland counties, especially Afghanistan. With their support, Chabahar port has produced a development plan as shown in Table 7.1.6.

Table 7.1.6 Capacity of Chabahar Port by Development Phase

	Container (TEU)	Break Bulk (ton)	Liquid Bulk (ton)	Total
Current	75,000	1,000,000	3,000,000	5,000,000
After Phase 1	740,000	1,670,000	3,000,000	20,000,000
After Phase 2	2,150,000	1,930,000	4,200,000	35,000,000
After Phase 3	4,800,000	3,100,000	8,000,000	60,000,000
After Phase 4	6,000,000	5,200,000	12,000,000	78,000,000
After Phase 5	6,000,000	10,000,000	12,000,000	100,000,000

Source: PMO

At this stage, Phases 1 and 2 are currently under implementation. Details of the implementation plan for the remaining stages has not yet been confirmed.

(5) Possibility of Cargo Port in Qeshm Island

In the SWECO Master Plan, the construction of an Industrial Zone South with general cargo and container terminal was proposed. In the following section, JICA Project Team examined the potential of cargo port in Qeshm Island by considering the current situation in Iran.

1) Type of Cargo

In general, port cargo (cargo includes both container and bulk) can be categorized into the following three types:

(a) Transshipment

(b) Domestic Import & Export
(c) Transit for Inland Countries

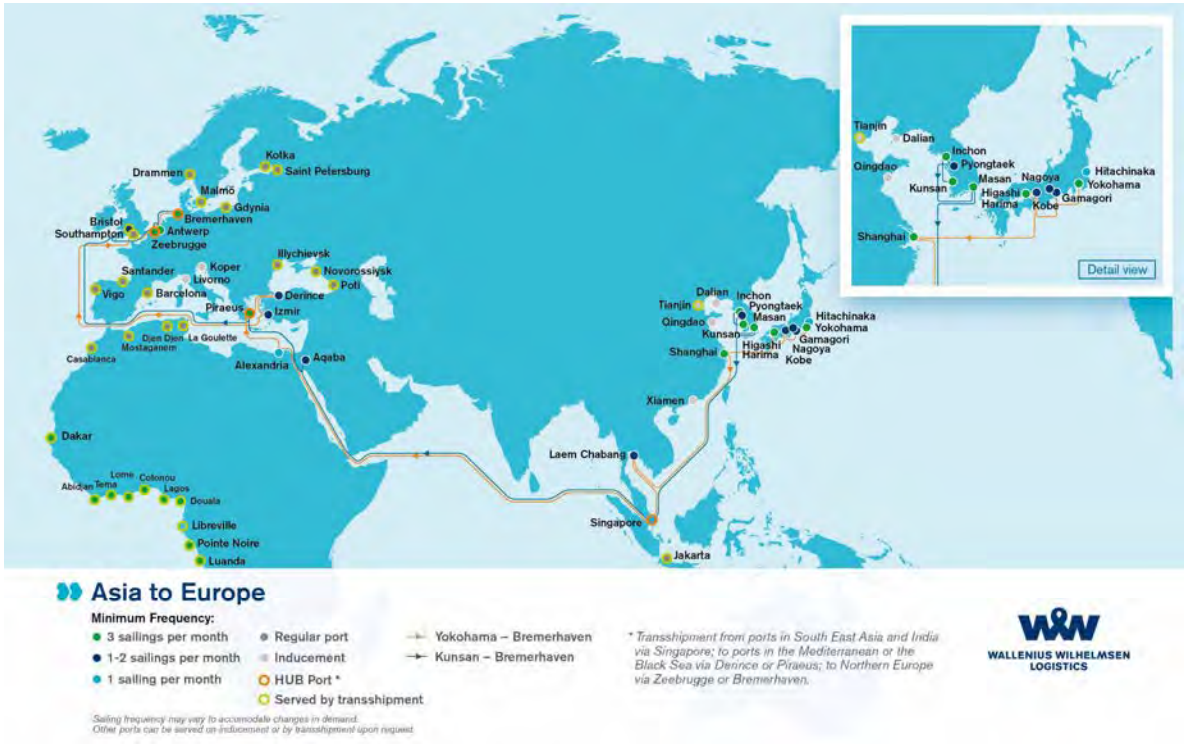
In the remaining sections, potential for major port development in Qeshm Island for the above three types of cargo will be examined.

2) Possibility of Transshipment

Transshipment generally refers to 'transfer of a shipment from one carrier, or more commonly, from one vessel to another.' If a large container vessel carries many containers for long distance, the transportation cost for each container decreases. On the other hand, the large vessel can only stop at a port with sufficient draft and well-equipped container port; i.e., hub port. In this case, the containers on the large vessel are unloaded at a hub port and reloaded onto smaller vessels. The smaller vessels then distribute the containers to nearby smaller ports. By using transshipment, long-distance transportation by a vessel can significantly reduce transportation costs. For a hub port, it is essential to have sufficient draft and also be well-equipped with container handling facilities.

From an engineering point of view, some areas of the coast in Qeshm Island have high potential for developing a hub port by assuming that enough investment can be secured. However, it is difficult to assume that a hub port in Qeshm Island could play an important role for the following two reasons:

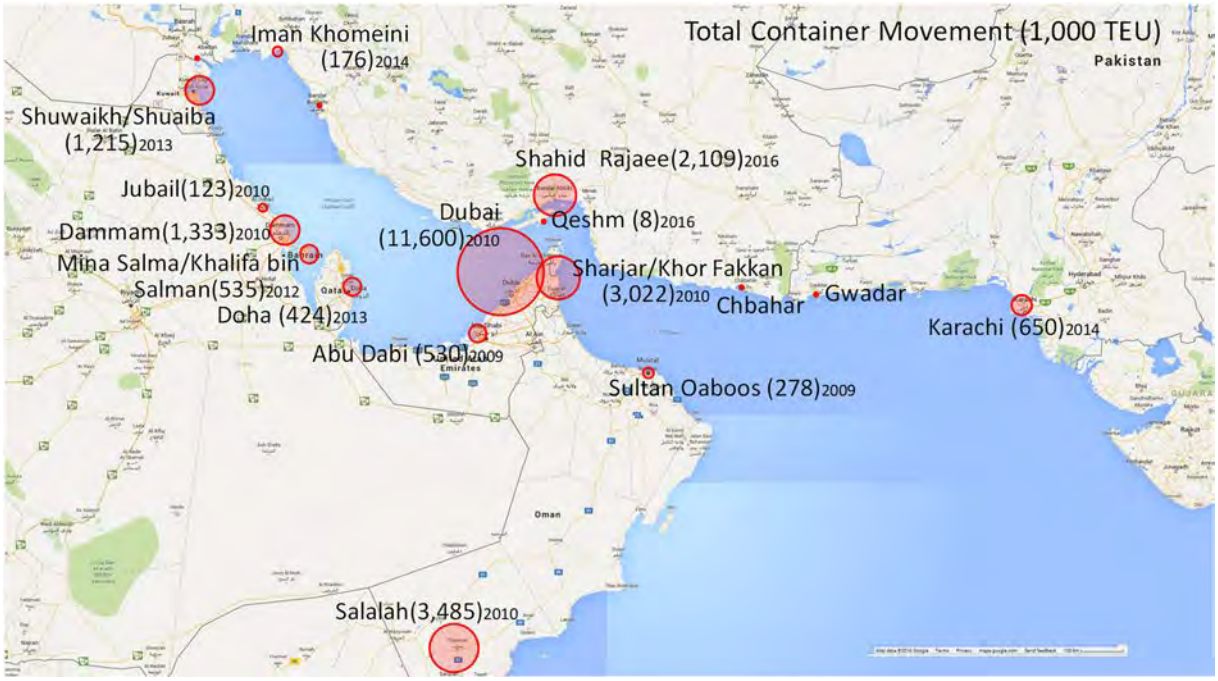
The first is locational disadvantage of the Qeshm Island. Figure 7.1.22 shows the normal transportation route by sea between Asia and Europe. The route connects Japan-China-India-Europe and is one of the busiest routes for sea transportation. Many large container vessels traverse this route. If Qeshm Island were located along this route, some of the large vessels would stop at a port on Qeshm Island and unload/load containers during their voyage between Asia and Europe. But, as Qeshm Island is located a little far from this route, it is unlikely that larger vessels would deter from the main route and stop at port in Qeshm Island.



Source: Web site of Wallenius Wilhelmsen Logistics
(http://www.2wglobal.com/globalassets/route-maps/asia-to-europe-route-map.gif)

Figure 7.1.22 Normal Sea Transportation Route between Asia and Europe

The second reason is the existence of competing ports nearby Qeshm. Figure 7.1.23 shows the total container movement of ports surrounding Qeshm Island.



Note: TEU means twenty-foot equivalent unit
Source: Containerization International Yearbook 2012 and port websites

Figure 7.1.23 Comparison of Annual Container movements Surrounding Qeshm Island

Dubai, Sharjar/Khor Fakkan and Bander Abbas deals with large volumes of container traffic near Qeshm Island. Larger vessels choose larger ports for transshipment in order to load/unload the containers efficiently. Even if large investments are made for the construction of a new port in Qeshm Island with good conditions, it would still be difficult to compete against these ports which have already established themselves and attracted many vessels. The only potential for the new transshipment port in Qeshm Island is in the cases wehre capacity of these competing ports cannot handle demand which results in many vessels waiting for loading and unloading at sea for prolonged periods of time.

Considering the above two factors, any investment for developing a deep sea transshipment port in the Island should be addressed cauciously. .

3) Possibilities of Domestic Import & Export

Figure 7.1.16 shows the cargo capacity and performance of the Iranian ports. Based on these data, cargo traffic forecast was made by using the following assumptions.

- Non-oil cargo may increase along with the development of the Iranian economy. Referring to the following forecast of GDP growth rate by international agencies, it can be assumed assumes that non-oil cargo will increase at a rate of 4.5%/year (c.f., Table 7.1.7).

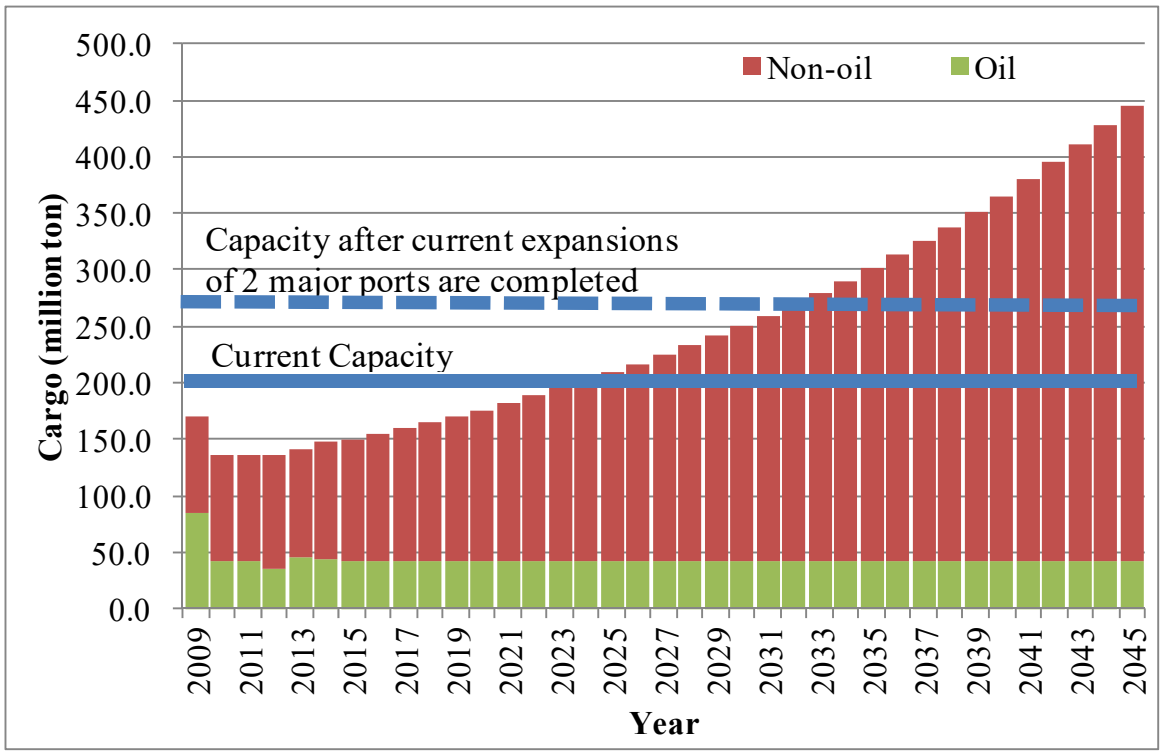
Table 7.1.7 Iranian GDP Growth Rate Forecasts by International Agencies (%)

Year	IMF[1)]	WB[2)]	EIU[3)]
2016	4.5	4.4	4.6
2017	4.1	4.9	5.4
2018	4.1	4.7	5.9
2019	4.2	-	5.2
2020	4.3	-	5.6
2021	4.3	-	5.9

Source: 1) IMF, World Economic Outlook Database, October 2016
2) World Bank, Global Economic Prospects, June 2016
3) Economic Intelligence Unit (EIU), Country Report: Iran, October 2016

- Volumes of oil cargo can be influenced by trends in the international oil trade. For this analysis, it was difficult to forecast the trends. Therefore, this analysis assumes the amount of oil cargo is the same as the average amount over the past 5 years (2012-16).
- In 2014, the total capacity of all Iranian ports was estimated as around 200 million tons/year. As mentioned in Section (4), Shahid Rajaee Port and Chabahar Port have their own development plans. Although it is expected that each port in Iran will increase its capacity, the increases in capacity of the 2 ports were considered in this analysis.
- In Shahid Rajaee Port, Phase III is underway. Once Phase-III of Shahid Rajaee Port is completed, its capacity is expected to increase by 3 million TEU/year. In this analysis, based on the statistical data of actual cargo at Shahid Rajaee Port, it was assumed that a container is equivalent to 10 tons/TEU.
- At this stage, investments sufficient to reach Phase 2 have been confirmed for Chabahar Port. When Phase 2 is completed, its capacity will increase by 30 million tons/year.

Using these assumptions, the cargo forecast was made as shown in Figure 7.1.24.



Source: JICA Project Team

Figure 7.1.24 Cargo Demand Forecast in Iran

The figure indicates that, should the current port development plan at the two ports are implemented as planned, the ports of Iran will have enough capacity to deal with the expected increases in cargo over the next 15 years. The two ports have more developments planned while the other ports may have plans to develop their capacity to a lesser extent. Consequently, under the current situation, it seems that there is no urgent need to build a new large port in Qeshm Island for imports & exports of the country.

4) Potential for Developing a Transit Port for Inland Countries

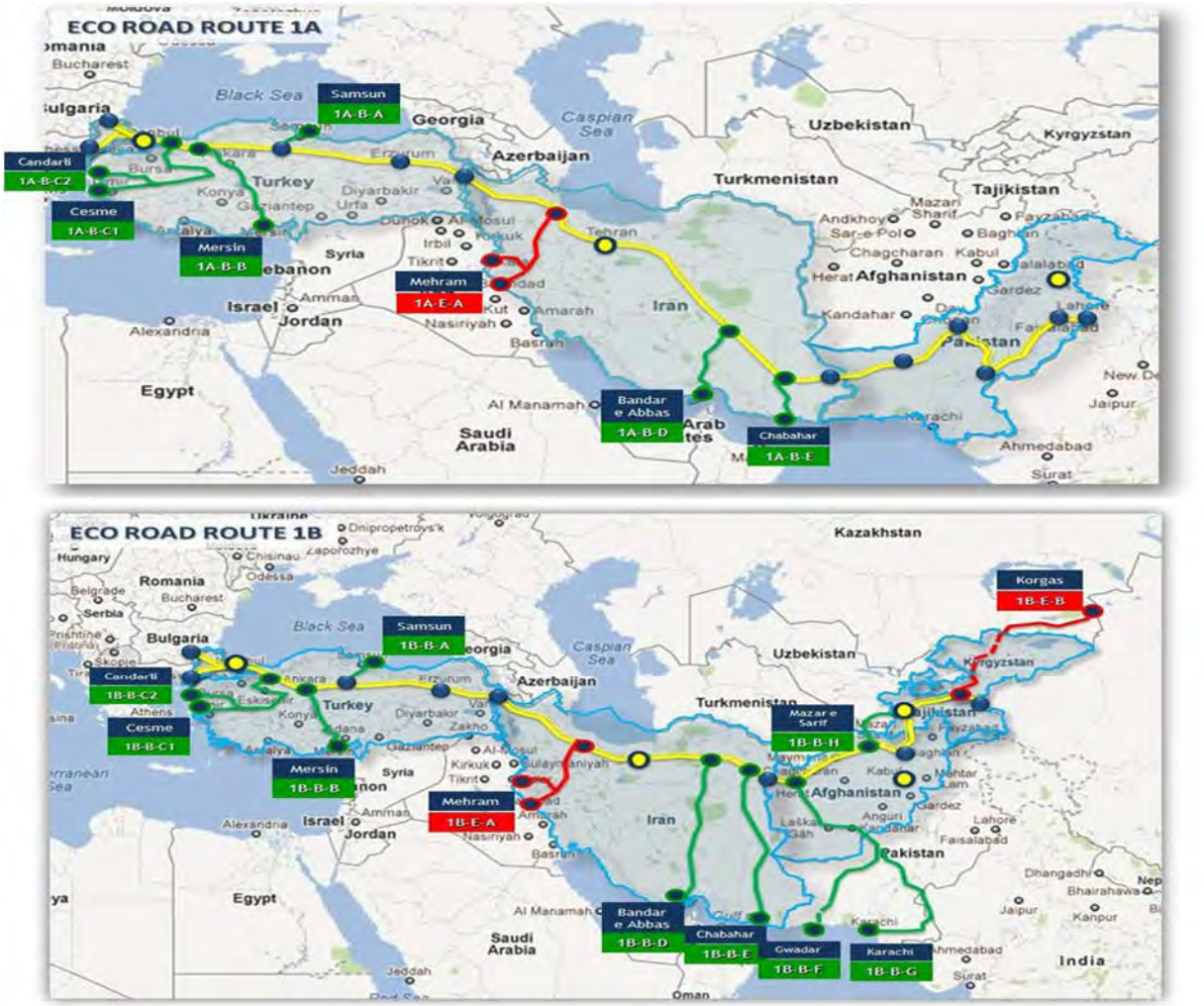
Although (as shown above) the ports of Iran have enough capacity to deal with cargo volumes under the current conditions, it should be noted that there will be requirement for transit cargo for inland countries. In 2015, transit cargo crossing Iranian borders was about 12 million tons. It is estimated that 95% of the cargo was transported by trucks. Furthermore, 30% of the cargo was transported for CIS countries through ports of Iran. In Shahid Rajaee Port, most of its transit cargo is bound for Turkey. But, when a border point to Turkmenistan for the railways began its operations, the ratio of the transit

taking place at Shahid Rajaee Port to Turkmenistan had increased.

Economic Cooperation Organization (ECO) is an intergovernmental regional organization established in 1985 by Iran, Pakistan and Turkey for the purposes of promoting economic, technical and cultural cooperation among its Member States. Currently, the number of the member states has increased to 10 countries. ECO promotes a main railway transportation network and road transport network. The railway network is shown in Figure 7.1.25 and the road network is shown in Figure 7.1.26.

Source: ECO

Figure 7.1.25 Railway Transportation Network Promoted by ECO



Legend: : Route proposed by ECO for transportation corridor
: Connection route to main ports
: Mani access route to border

Source: ECO

Figure 7.1.26 Road Transportation Network Promoted by ECO

These figures indicate that Shahid Rajaee Port is an important port not only for domestic imports and exports of Iran, but also for transit cargo of inland countires. Especially, the railway connecting Shahid Rajaee Port and Trukmenistan has huge potential. The cargo traffic via railway is increasing, but its operation is not efficient at this stage. If problems in operation can be resolved, it can be expected that the demand for transit cargo will drastically increase.

5) Assessment of a New Port Requirement in Qeshm Island

As shown above, the current situation indicates that there is no urgent need to build a new cargo port in Qeshm Island. It is expected that the existing ports in the country and their expansion could cover future demand for at least for several years. However, a new cargo port Qeshm Island may be required under the following scenario:

- Transit cargo for inland countries by railway drastically increases with the operational improvement of the railway.
- The development of Shahid Rajaee Port and existing ports cannot meet increased demand.
- Railway connects a new cargo port in Qeshm Island and the international railway network with the construction of the Persian Gulf Bridge.

Under current conditions, it is recommended that Qeshm Island carefully monitor cargo trends and

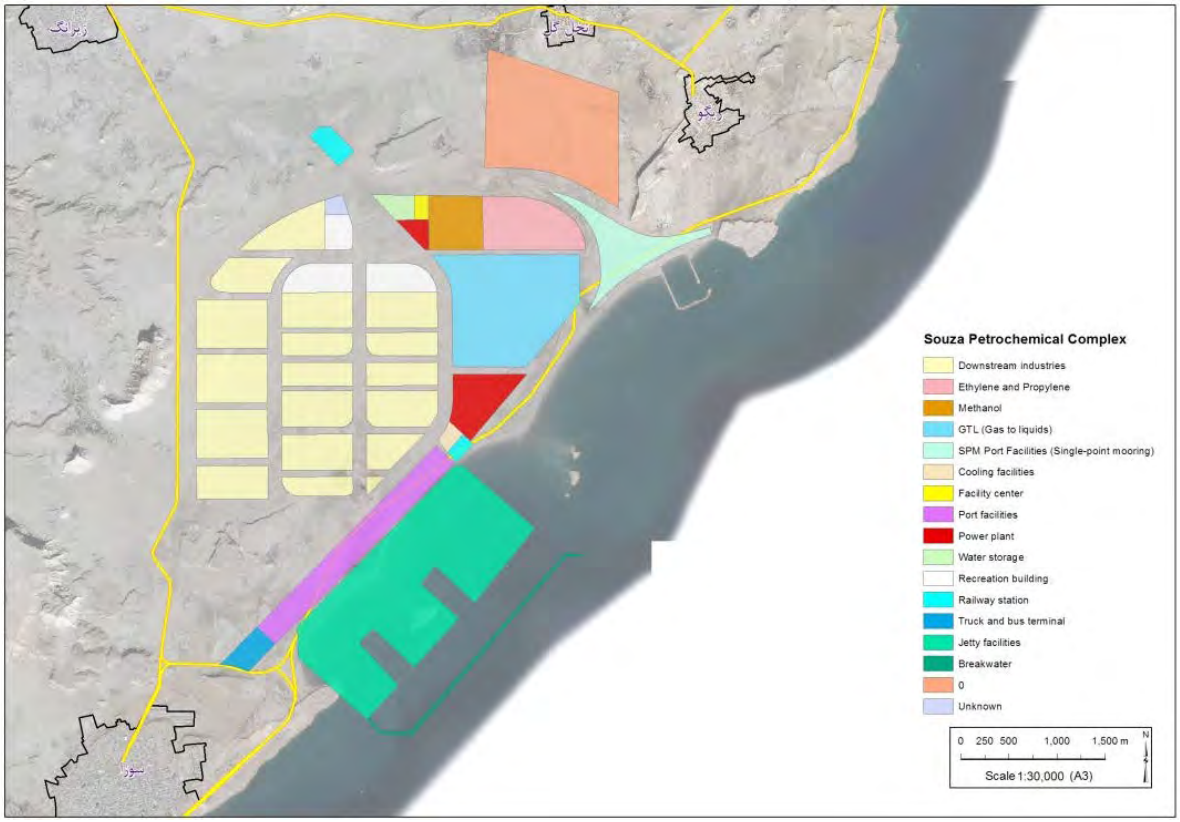
consider the construction of the new port. In practice, as an economy develops, the ratio of container traffic among the cargo will increase. Therefore, it is expected that the demand for container cargo will increase faster than bulk cargo in the future. Considering this trend, any port development plan in Qeshm should focus mainly on handling containers rather than bulk cargo.

Construction of a new port should be part of the national logistics plan based on the national strategy. In order to build a port which is in line with the national strategy, it is essential to prepare a business plan with detailed engineering and environmental reviews, sufficient communication with PMOs, and with sufficient coordination with the existing ports.

6) Consideration to a New Port Location

Location of a new port proposed by SWECO Master Plan

In the SWECO Master Plan, a western port was proposed in Industrial Zone South, near Souza. The port was expected to handle general cargo, foodstuff and grain transshipment, and a container terminal protected by breakwater. Liquid bulk port was also proposed to the east of the port. Proposed layout in this plan is shown in Figure 7.1.27.



Source: SWECO

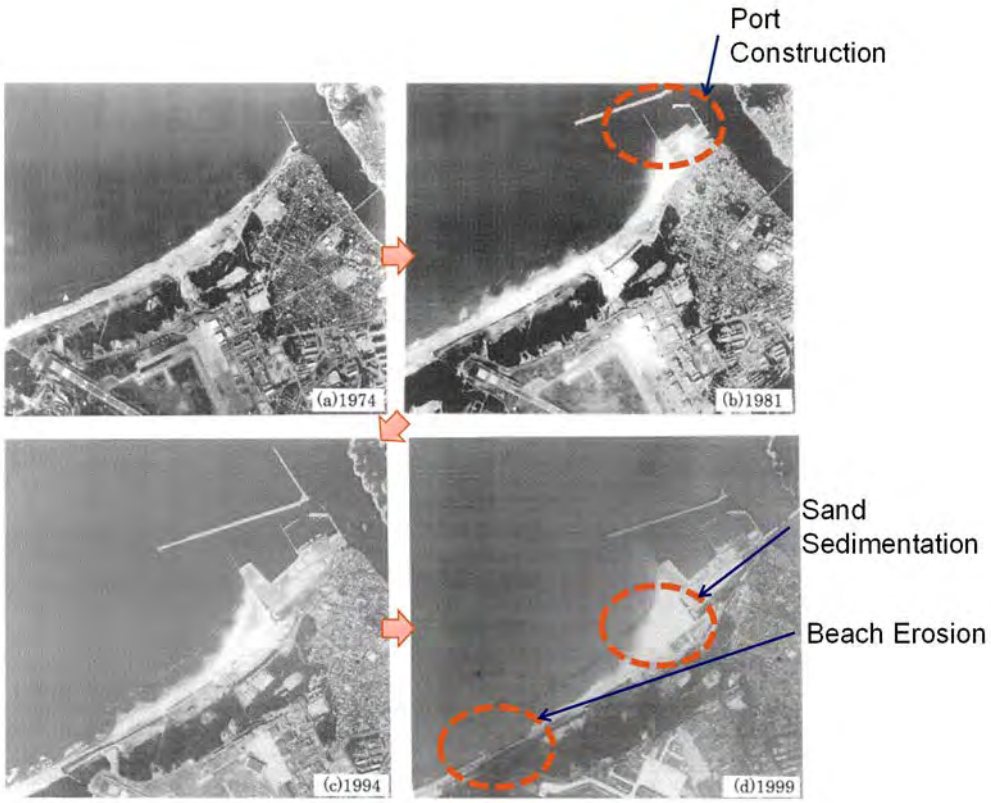
Figure 7.1.27 Proposed Port Layout Plan in Industrial Zone South

One of the problems of this plan is that the construction of a new port will negatively impact the coast. The location is close to the Nasz Island, one of the most popular tourism sites on Qeshm Island. Neighboring coast has also rich environmental resources. It is almost certain that the construction of a port with a breakwater would negatively impact the surrounding sea environment; i.e.:

(a) Disappearance of Naz Island and rich seabed by reclamation: If Naz Island is lost, Qeshm Island will lose the one of the most popular tourism resources. Furthermore, the reclamation of the port could destroy coral habitats in the area.
(b) Loss of seaweed: The loss of seaweed may not only result in the loss of environmental resources but also impose negative impacts on sea turtles and fish.

(c) Negative impact on coral habitat in wide area: The construction of ports and breakwater may affect the current and worsen water quality through port operations as well.

In the past, a port construction changed the topography and natural environment. Figure 7.1.28 shows an example of a port construction that changed the coastal topography and natural environment in Japan.



Source: Sanae Unoki, Ikuo Imokawa and Natsuko Oka, "Changes of the Topography and the Natural Environment Caused by the Construction of the Port of Ashiya on the Sandy Coast", 2007

Figure 7.1.28 Example of Changing Costal Topography and Environment in Japan

Photograph (a) taken in 1974 indicates that the area was a sand beach. As shown in photograph (b) in 1981, a port with breakwater was constructed alongside the beach. The shape of the beach gradually changed. Photograph (d) taken in 1999 indicates that the beach erosion was resulted in a part of the beach, while sand sedimentation was caused in the other part of the beach. In the end, the beach was negatively impacted from the construction of the port. Once the change happened, it became impossible to restore the beach that was heavily eroded.

These changes were caused by the fact that the port interrupts sand movement along the current. Therefore, the location and layout of the port needs to be examined very carefully, especially in cases where there is a rich environmental resource in close proximity to the planned construction site.

Alternative of the New Cargo Port

As mentioned above, the proposed port construction at Industrial Zone South, near Souza by SWECO Master Plan is not in line with the development strategy in this study. Under current conditions and given the "Eco-Island" plan, this study strongly recommends that, when it is to be built, it should be developed in Industrial Zone North, near Kuveh with the reasons shown below:

(a) From the view point of the "Eco-Island" plan, Nasz Island is one of the most important tourist destinations. Therefore, as much as possible, any development that would negatively impact the area should be avoided.

(b) Currently the Industrial Zone North is developing, but still has enough space to develop further. The SWECO plan proposed that eastern part of Qeshm Island is utilized for industrial development. But, under the current conditions, this study recommends that the industrial development should concentrate on the northern side of eastern Qeshm Island.
(c) The northern coast is located between Qeshm Island and the mainland. Because of this, wave condition of this area is more appropriate for a port development. It is expected that a breakwater may not even be necessary, which would lead to a lower construction cost and less disturbance to the coastal environment.
(d) The location will have a better access to the Persian Gulf Bridge under construction. As previously mentioned, a railway is essential for an efficient operation of a cargo port. If the port is constructed in the northern coast, construction of the railway to the south may not be necessary.
(e) For Kuveh Port operates with 18m depth without dredging, which indicates that port maintenance costs will be lower if constructed in north.

7.1.4 Railway transport

Currently, there is no railway on Qeshm Island, although the construction of the Persian Gulf Bridge with road and railway tracks, is ongoing. The railway connecting Kouvei Port with the mainland must be developed to support the expansion of the port (Figure 7.1.29). The railway will be a convenient means of transport for heavy commodities. If a steel plant is placed in the north, it will support the transport of ore and steel products.

If an industrial port is developed in the southern coastal area, however, the railway route may have to be revised as a branch line will be extended to the industrial port.

Source: Technical Specifications of the Persian Gulf Regional Transportation Network, Qeshm Free Zone Organization.

Figure 7.1.29 Proposed Route of Highway

7.1.5 Passenger transport systems

(1) Passenger Transport Systems and Traffic Condition in Qeshm

Passenger transport systems on Qeshm Island is predominantly private vehicle oriented. Share taxis and minibuses exist but they are operated without fixed routes or time schedule. As a result, in average, passengers without access to private means of transport such as commuters, tourists, residents in remote villages, are forced to spend a relatively higher cost to move around on the island.

Typical modes of transport used by residents and visitors on the island are as shown in Table 7.1.8. Most of households in eastern part of the island use their own vehicles to move within/between towns (under severe climate conditions), whereas visitors rely on taxis or other transport services included in a tour package, such as tourist buses, and rental cars. No regular scheduled bus is available on the island.

Table 7.1.8 Typical Mode of Transport by Type of User

Type of User	Main Mode of Transport
Residents	・ Private vehicles ・ Private motorbikes ・ Taxis
Visitors	・ Taxis ・ Rental cars ・ Shuttle services

Source: JICA Project Team

Currently, no significant areawide traffic congestions is observed except in localized areas such as some intersections in Qeshm and around shopping malls in Dargahan. Traffic police under Ministry of Internal Affairs, is understaffed, and as a result, parking control is not strictly enforced. It is estimated that a substantial number of drivers drive cars and motorcycles without drivers' license, and the fatality rate from traffic accidents are one of the highest in the region. Improvement to passenger transport systems in Qeshm is essential to secure sustainable development of the island and to increase attractiveness of the island to potential investors and tourists. In addition, awareness for the need of environmentally friendly transport systems is increasing, which will contribute sustainable development the eco-island.

(2) Key Issues and Strategies for Improvement

Key issues to be addressed in the passenger and urban transport sector in Qeshm include the following:

(a) Absence of public transport systems for commuters, tourists, and remote villagers
(b) Requirement for improved taxi systems
(c) Requirement for a better traffic management
(d) Requirement for road user facilities

Recommended strategies and policy measures to address above issues include the following:

(a) Introduction of Public Transport Systems and Other Relevant Facilities
(b) Enhancement of Taxi and Rental Car Industry
(c) Introduction of Various Traffic Management Measures and Vehicle Emission Control
(d) Construction of Roadside Resting Area

Each of these measures are described in detail in the following sections.

(3) Introduction of Public Transport Systems and Other Relevant Road User Facilities

Car ownership of Qeshm residents are relatively high, but there are certain number of residents who do not own or drive a car, which gives rise to the requirement of considerations to the public transport systems in various areas, for example, within major cities, between cities, in tourism, airport access, and connection to remote villages in the western area of the island. Background and potential bus route and characteristics are described in the following sections.

Introduction of Scheduled Buses in Qeshm City

For residents and tourist without access to their own cars, taxi is the most popular means of travel inside/outside the Qeshm City. This mode of transport serves almost door to door and convenient and is available relatively easily as there are many of them waiting at taxi stands and in the city. Cost of travelling with taxis, however, is relatively expensive as compared to travelling with, for example, BRT or underground rail systems in Teheran. Taxi costs 60,000 IRR (1.43 USD) with non-sharing and 10,000 IRR (0.24 USD) with sharing per ride within the city. Taxi sharing is only available in major streets where there are some other passengers, but it is not available when you call a taxi to pick you up at residence or any other specified locations. In combination to this taxi system, introduction of a regular bus service with a comfortable and environmentally friendly vehicle should be considered. This will be preferable from traffic management point of view as well. One bus could carry up to 50 to 60 passengers while one taxi around 3 to 4. A successful introduction of buses will contribute to the reduction of traffic congestion in the city.

Figure 7.1.30 shows an example electric bus that can be introduced for inner city bus routes. Electric buses are environmentally friendly, emit no harmful exhaust, quiet, yet have sufficient speed (maximum around 70 km/h) and acceleration to safely/comfortably maneuver within the city. The vehicle can be operated up to about 200km if the battery is fully charged. Such vehicle is usually user friendly with low floor height, large windows, air-conditioning, e-ticketing, and in-vehicle information.

Source: Mitsui Trading Company, Japan

Source: Mitsui Trading Company, Japan

Figure 7.1.30 Example Electric Bus for serving Urban Area

Possible circular bus route inside Qeshm City is shown in Figure 7.1.31. Buses will originate from the ferry terminal area and travel anti-clockwise to the South and come back to the origin. The service can be only one direction as the paralleling streets north and south are relatively close, hence maximizing the cost of operation. As the route length is relatively short, total fleet of two to three vehicles could provide a 15-minute or 10-minute interval operation during peak hours. Introduction of e-ticketing could enable a driver-only operation and minimize the operation cost.

If bus stops are carefully planned, such service will provide convenient means to travel within the city for the residents and tourists.

Source: JICA Project Team

Figure 7.1.31 Potential Circular Bus Route in Qeshm City

Introduction of Shuttle Bus Service between Qeshm and Dargahan

Large number of traffic exist between Qeshm and Dargahan. Distance between these two cities is around 20 km. For residents living in Dargahan regularly commute to Qeshm but, for those without access to a car, by using expensive taxis (around 250,000 IRR or 5.95 USD one way). Large number of tourists and shoppers arriving at the ferry terminal also travel to Dargahan for shopping, who commonly use shared taxis or minibuses. Cost may be reasonable, but, with absence of a proper traffic management, these taxis and minibuses are creating serious traffic congestion in Dargahan shopping area. Introduction of a shuttle bus service (see Figure 7.1.32) between these two cities could potentially overcome these issues

Type of vehicles suited for such shuttle service could be medium to large size and should have baggage storing space. All the passengers have to be seated as the speed of buses could reach around 100 km along this corridor.

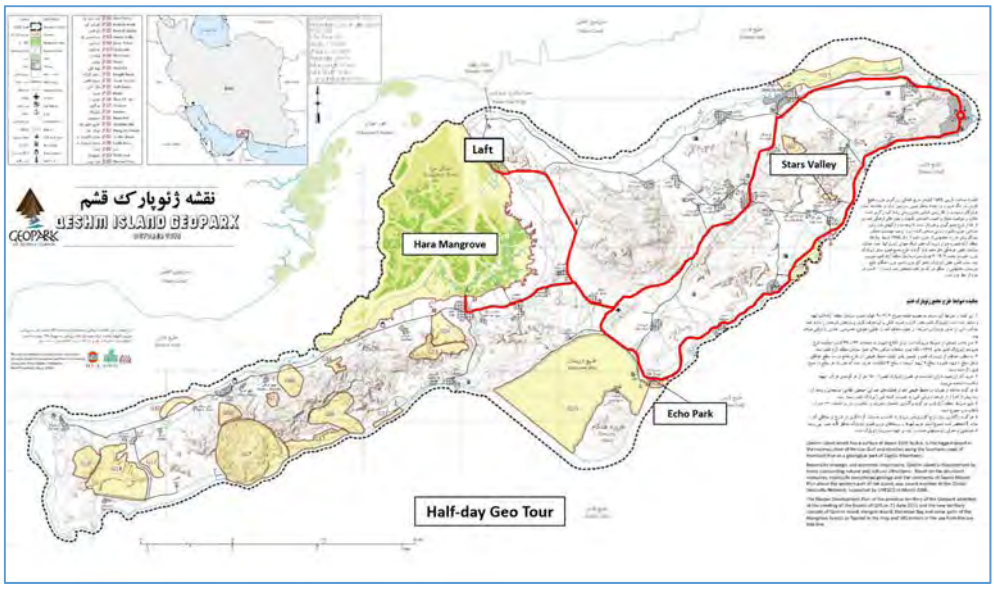
Source: JICA Project Team

Figure 7.1.32 Intercity Shuttle Bus Service (Qeshm and Dargahan)

Introduction of Tourist Buses

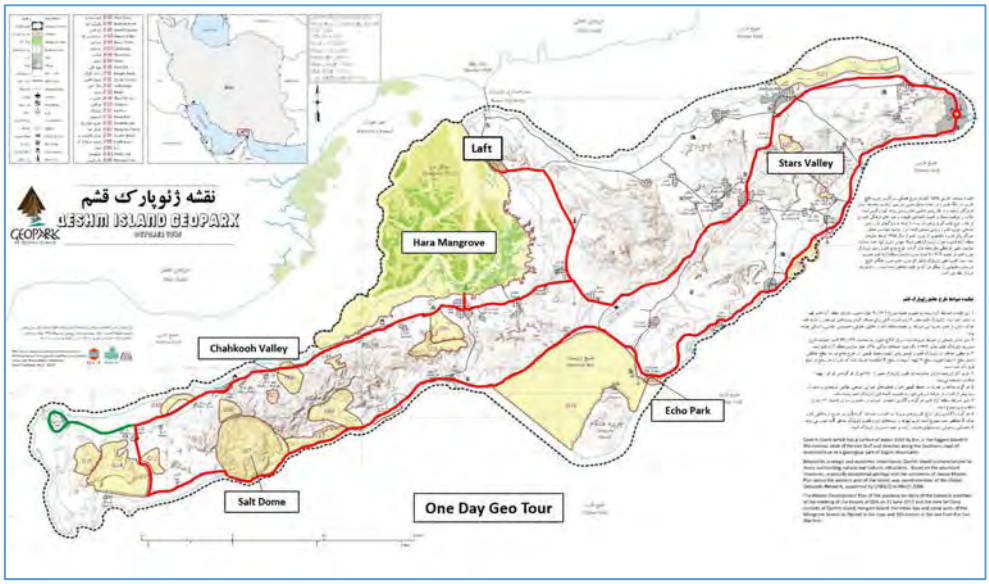
There are a few dozens of Geo-tourism destinations within Qeshm Island (see Chapter 6 of this report), but there are no regular tourist buses which are widely used by tourist in many other countries. Local tour operator arrange transport for visiting those sites based on the customer requirement. Taxis and rent-a-car are also used for some tourists. In average a 4WD rent-a-car costs 2,000,000 IRR (47.62 USD) for a half day, and 3,000,000 (71.43 USD) IRR for a full day. In all these cases price need to be negotiated in advance.

QFZO, for example, could be involved in organizing regular tourist buses which will operate under listed prices. Operating entities can be QFZO themselves or private operators who agree to provide standardized tours with agreed prices. Leaflets introducing the Geo Park and the regular bus service can be pretend and distributed at key places such as airport, ferry terminals, hotels and guesthouses. Sample tour bus routes are presented in Figure 7.1.33, and 7.1.34 for a half-day tour and a full-day tour.



Source: JICA Project Team

Figure 7.1.33 Tourist Bus Route for Visiting Geo Park Sites (Half Day Tour)

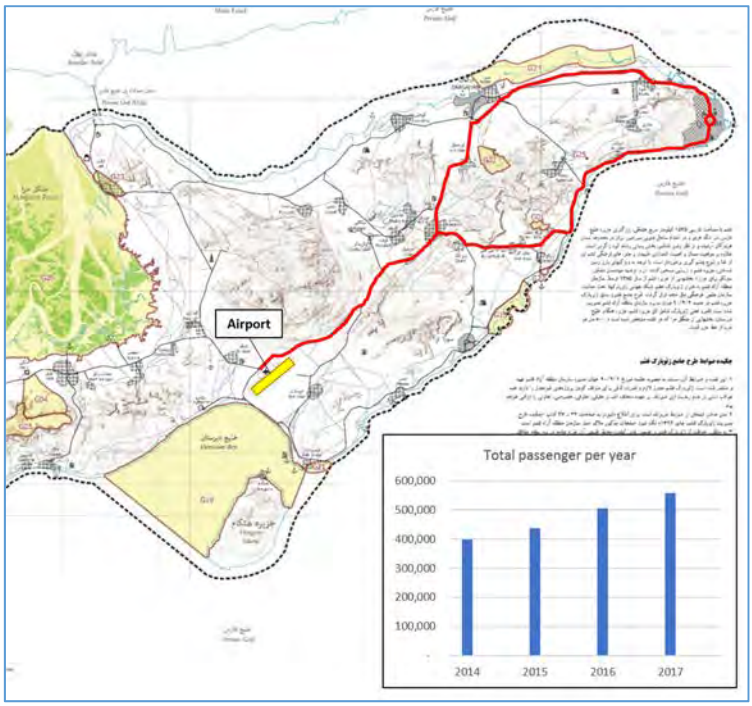


Source: JICA Project Team

Figure 7.1.34 Tourist Bus Route for Visiting Geo Park Sites (Full Day Tour)

Introduction of Airport Limousines

Airport in Qeshm is located in the center of island about 50 km away from the city. Taxi only is available for visitors arriving at the airport and intend to travel to/from the city center. Cost of taxi is about 350,000 IRR (8.33 USD) one way. Introduction of Airport Limousines could substantially enhance the convenience of the visitors. Such service could pick up or drop the visitors at major hotels and other key location within the city for a reasonable price (see Figure 7.1.35). Vehicles to be used should have space for storing luggage, which are loaded/unloaded by the driver or conductor.



Source: JICA Project Team

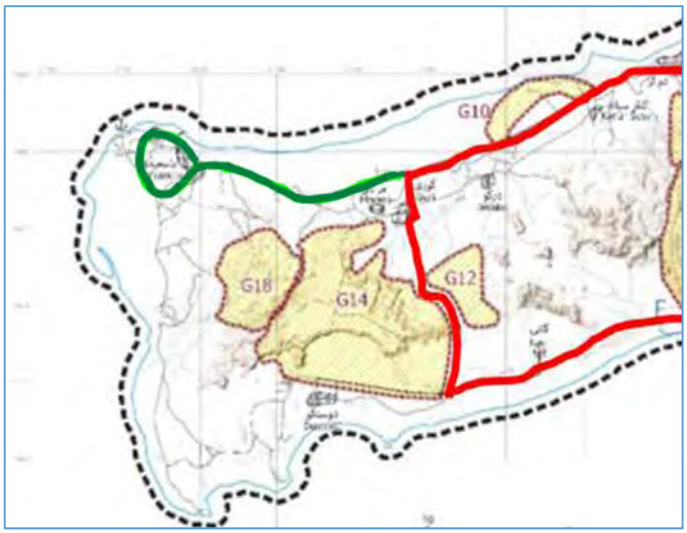
Figure 7.1.35 Airport Limousine Service

Introduction of Public Transport System Serving Remote Villages in the Western Area

There are many villagers live in the western part of the island, who, time to time, have to travel to/from Qeshm City where essential services such as, municipal office, hospitals and others are located. The area is relatively underdeveloped, and the average household income is low. These villages include Baseidou, Selakh, and Tabl. Distance between Baseidou[6] and Qeshm City is about 120 km. Some of these villagers have access to cars but majority of others do not, who have to hire taxis or some other car owners to take him/her to/from the city area. Cost of such travel is usually very high, and the bill could easily reach to 1,500,000 IRR (35.7 USD) for a round trip. Ideally, regular (or demand driven) bus service with more reasonable cost should be introduced to improve the situation. This kind of transport service, however, may face difficulty in securing operation cost which depends only by fare revenue. One possibility is that vehicles are leased free of charge to a locally organized community group who will form an association and maintain/ operate the service. For this purpose, a small size vehicle, e.g., a box wagon with seating capacity of 6, may be sufficient at an early stage of operation.

There are two options for running such service; one is to operate directly between the western area and Qeshm City, and another to connect to the nearest Geo-tour Bus Routes explained above (see Figure 7.1.36). The first option is convenient for villagers as it could potentially provide a door to door service, but the running cost could still remain high. The second option may be more realistic as the distance for the community operated buses remain substantially shorter and could take advantage of regular tour bases with reasonable fare level. However, time required to travel to reach to the desired destinations may get longer, and the villagers may not be able to complete the round trip in one day.

[6] One of the western villages with population of just over 2,000.



Source: JICA Project Team

Figure 7.1.36 An Option for buses connecting Western Part of the Island and the Qeshm City by the use of Geo-tour Bus Routes

Improvement to Pedestrian Environment and Provision of Bus Stops with Shelter

In relation to the introduction of public transport systems in Qeshm, pedestrian environment has to be further improved. Pedestrian footpath exists in most of the main streets in the city, but it is not always pedestrian friendly; e.g., height of the footpath is a little too high, continuity is often disrupted by trees and illegally parked cars, and pedestrian crossing is not clearly marked. Driver behavior may also have to be improved to give pedestrians priority when there are crossing the streets.

Regular buses proposed above are expected to pick up/drop passengers at specified location where bus stops with appropriately designed shelter provided. Though their numbers are limited, there are attractive bus stops already constructed at a few locations in the city area. Lay-bys at the bus stops will also be necessary to minimize the impact on general traffic due to the bus users getting on and off from the buses. Public transport users have to wait at bus stops, therefore, seats and shelter should be available at the waiting area.

Requirement for Further Studies

This section presented potential of introducing public transport services within the city, between the cities and villages, and for promoting tourism in the island. Additional studies required to introduce public transport systems include the following: (i) detailed estimation of patronage; (ii) examination of fleet characteristics by route; (iii) user willingness to pay; (iv) financial viability; (v) forms of operating entities by service type; (vi) stakeholder analysis, particularly taxi and rent-a-car industries; (vii) review of passenger transport laws and regulations; and (viii) role of QFZO in providing public transport services in Qeshm.

(4) Enhancement of Taxi and Rental Car Industry

Taxi services are a major transport option for people without vehicles on Qeshm Island. Therefore, better taxi services will lead to improved transportation, especially for visitors. The key elements for good taxi services are summarized below.

- Clear tariff system
- Availability/accessibility
- Communication
- Payment system
- Maintained vehicle
- Advices for trip

The first element is a clear tariff system. In the current situation, taxi fares are mostly negotiated between the driver and customer prior to the ride. The negotiation system requires good communication between them, but it is difficult for many visitors due to language barriers. The introduction of a metered fare system, which displays a tariff depending on the journey distance and/or journey time, is a solution for a clear taxi fare system. A payment system is also an important aspect for foreign travelers, since they often do not have enough local currency for a taxi, especially just after arrival. Acceptance of credit cards would offer an alternative payment method for this purpose. The availability of taxis at various locations is also an element by which to determine accessibility on the island. Taxis are available for trips from major origins such as the airport and Qeshm City, whereas passengers find it difficult to hail taxis from minor origins due to a lack of standby taxis. The use of well-maintained vehicles provides passengers with comfort and reliability, as well as results in higher satisfaction levels among users. Aside from facilities and equipment, the quality of drivers determines good transportation by taxi as well. In particular, communication skills, including language and the provision of trip advice (i.e., restaurants nearby, travel schedules and relevant information on destinations) will be invaluable to visitors.

In order to address some of the challenges above, taxi dispatch control systems using smartphones have been introduced in many cities and towns all over the world. These systems allow passengers with smartphones to submit a trip request, which is then routed to registered taxi drivers (c.f., Figure 7.1.37). Some of the systems also have the functions by which fares are calculated, similar to metered taxis, and payment is automatically completed using the customer's pre-registered credit card at the end of their trip. The rating system for drivers helps to improve the quality of drivers as well. Thus, the introduction of taxi dispatch control systems may result in the improvement of the taxi industry.

Source: Uber Newsroom1

Figure 7.1.37 Uber Interface on Smart Phone

In addition to taxis, rental cars also offer a flexible transport option for visitors, which can be used to travel anywhere at their own convenience. However, the rental car industry has not flourished on the island and the availability of rental cars was very limited as of April 2016. One of the reasons why rental car firms are hesitant to launch their businesses on the island is that there is a relatively low demand for rental cars to date, while profitability cannot be ensured. However, if rental cars are to be a major transport alternative[7], especially for visitors, facilitation measures may be effective in order to induce expansion of the industry. For instance, tax benefits and provision of advantageous locations, such as at the airport, seaports and in central Qeshm City, are considered.

(5) Introduction of Various Traffic Management Measures and Vehicle Emission Control

1) Traffic Management

Al though majority of household own cars, in Qeshm island, traffic congestion is not an issue now. Dargahan shopping area, however, is facing very serious traffic congestion all day long. There are many illegally parked vehicles, and many vehicles looking for car parks. There is a shortage of car parks in the area, but no effective measures and enforcement exist at the moment. It is recommended that the authority regulating the development of the area should introduce compulsory parking space requirement when constructing large scale shopping malls. During the New Year period, large number of families visit Qeshm by car, which gives rise to the requirement of a proper traffic management measures such as, parking management, and encouragement of carpooling, to ease traffic congestions.

[7] On Okinawa Island in Japan, the size of which is similar to that of Qeshm Island, a variety of rental car firms are active, with rental cars being the most popular transport mode for visitors.

As a measure of traffic demand management, a carpooling scheme (as well as ride-sharing) has been introduced in cities with high road traffic demand. At present on Qeshm Island, these measures are not necessarily required; however, carpooling can have a positive impact on the environment and is a good behavior to promote in advance of increasing traffic demand in the future. With carpooling, emissions per passenger are reduced. For its implementation, the establishment of regulation and promotion schemes are indispensable towards ensuring the legal status and understanding by road users.

2) Promoting the Use of Bicycles

Bicycles are one of the most environmentally friendly modes of transport, with effectively no carbon footprint, enabling users to appreciate views and scenery at their own pace. To encourage the use of bicycles for visitors, some tourist destinations, including the surrounding islands, provide rental bicycle services. Due to the short trip lengths involving bicycles, the services are basically offered in densely populated areas, such as towns and tourism spots. In consideration of the climate conditions on Qeshm Island, the usage of bicycles may be limited to between November and March, when the temperatures are relatively low and it may be acceptable for bicycle users to ride outside.

3) Vehicle Emission Control

In the 1980s and 1990s, the Tokyo sky was a filled with smog, mostly due to emissions from the large number of vehicles. However, air pollution has been improved following the implementation of the stringent regulations on particulate matter in 2003. The regulations stipulate limits on emissions; where vehicles cannot accept these limits, they must be replaced or retrofitted with a filter to reduce emissions to acceptable levels. As a result, emissions were reduced by 49% by 2004 compared to 2002. These regulations might be required in Qeshm as the number of vehicles increases.

(6) Construction of Roadside Resting Area (Michinoeki)

Provision for the movement of passengers should be promoted, as well as the provision of rest areas and opportunities for exploring tourism spots, while local products should be promoted as well. Such areas would likely create development opportunities for residents in those areas.

Roadside stations are one such alternative to meet these objectives. Stations for road users should be equipped with parking lots, public toilets, rest spaces including food and drink services, information centers for visitors (tourism spots, access, regional history etc.), and shops for local products, as shown in Figure 7.1.38.

On the island, a transport node between the western and eastern sides (e.g., at Tabl, Doulab, Selakh and Laft) is a candidate location for a roadside resting station, since the traffic demand on the eastern side is generally higher than that on the western side due to its respective land use intensity and population. Between the routes with different levels of service, a transport hub shall be developed for passengers to comfortably spend their waiting time. The roadside station may also have gateway functions for the western area by providing information on the geosites (i.e., name, location, must-see items, access and history) and a rest area, including public toilets and food/drink facilities before/after exploring the geosites. In addition, the station can be used for introducing local cultures and products, which facilitates regional development.

To develop the roadside station, the following topics are to be further examined: (a) candidate locations, (b) required functions (i.e., public toilets, food/drink facilities, tourist information and local introduction), (c) participation by local residents, (d) assessment of impact in terms of traffic, natural environment and living environment for residents, and (e) design of the facilities.

Source: Roadside Station (2013), Ministry of Land, Infrastructure, Transport and Tourism of Japan

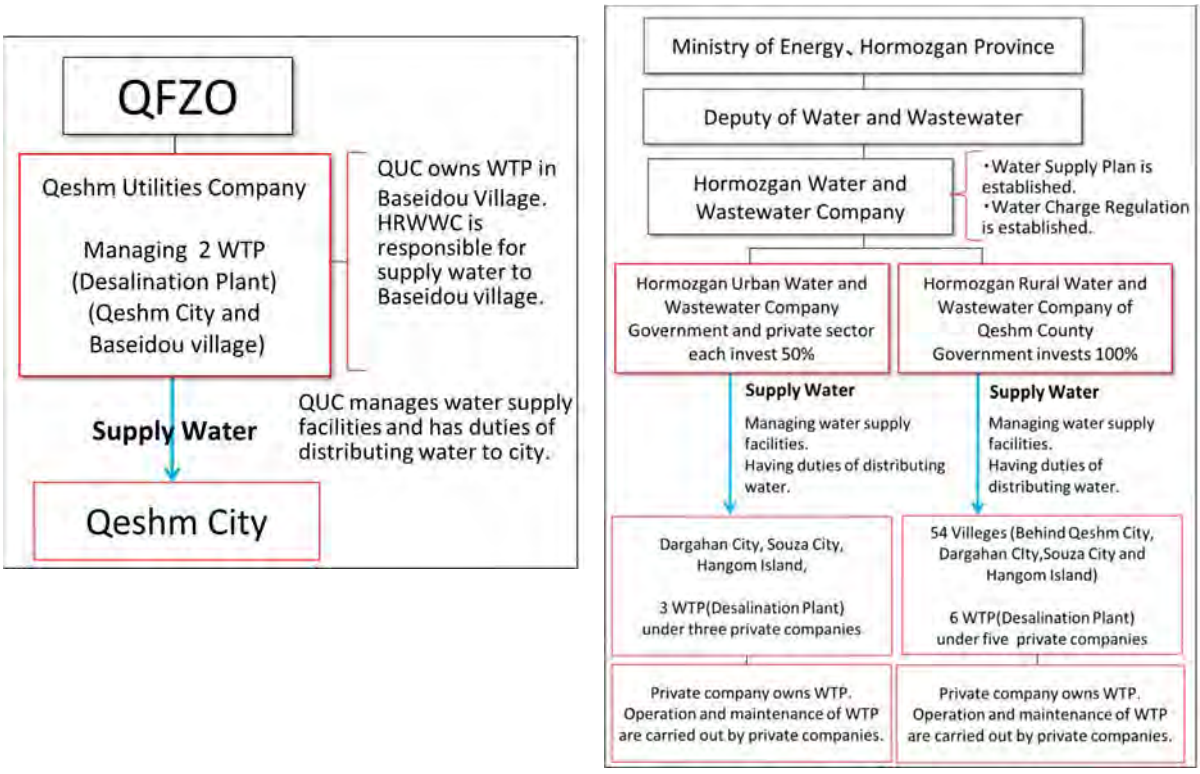
Figure 7.1.38 Concept of a Roadside Station

7.2 Water Supply

7.2.1 Existing conditions

(1) Responsible organization for water supply

Water supply facilities on Qeshm Island are managed by three companies: the Qeshm Utilities Company (QUC), the Hormozgan Urban Water and Wastewater Company (HUWWC), and the Hormozgan Rural Water and Wastewater Company (HRWWC). Water supply facilities on Hangom Island are managed by the HUWWC. The QUC is affiliated with the QFZO. The HUWWC and the HRWWC are under the management of the Hormozgan Water and Wastewater Company, which is under the Deputy of Water and Wastewater of the Ministry of Energy, Hormozgan Province. The organizational structure of the water supply on Qeshm Island, including these companies, is shown in Figure 7.2.1.



QUC HUWWC and HRWWC

Source: JICA Project Team

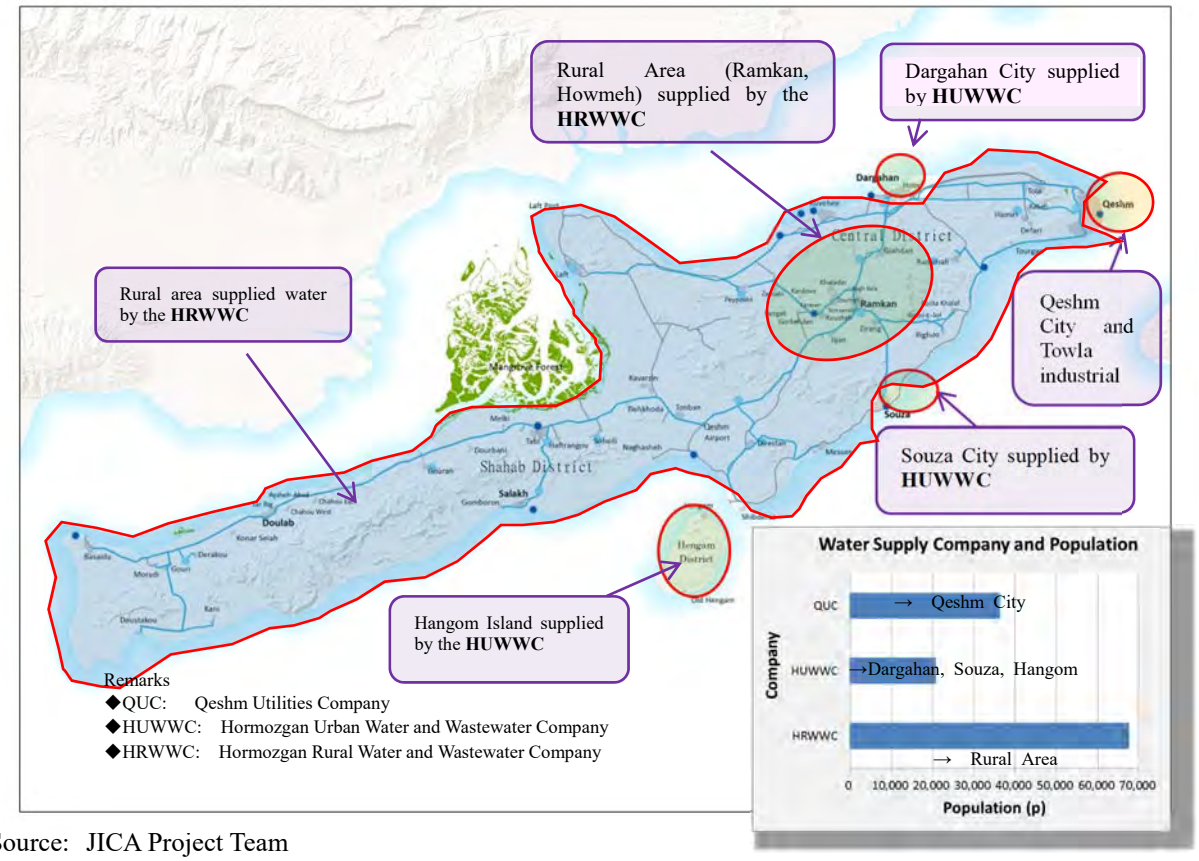
Figure 7.2.1 Organizational Structure of Water Supply on Qeshm Island

Table 7.2.1 presents an overview of the three water supply management companies. Figure 7.2.2 shows the location of the responsible areas for the three companies.

Table 7.2.1 Water Supply Management Companies

No.	Item	Unit	QUC	HUWWC	HRWWC
1	Parent organization	-	QFZO	Hormozgan Province	Hormozgan Province
2	Investors	-	100% government owned	50% private sector owned	100% government owned
3	Number of staff	Person	110	12	4
4	Area managed by water supply company	-	Qeshm City, Towla industrial Park, Towla Village	Dargahan City, Souza City, Hangom Island, Lara Island, Hormuz Island	Rural area on Qeshm Island
5	Population in the managed area	Person	46,552	26,575	68,669
6	Number of desalination plants	Unit	2	3	6
7	Designated capacity of all desalination plants	m^3/d	19,000 (RO) +3,000 (MED) +3,500 (MSF)	8,395 (RO)	7,100 (RO)+18,000 (MED)
8	Total volume of practical treated water	m^3/d	15,050	7,550	16,650

Note: RO = reverse osmosis; MSF = multi-stage flash; MED = multiple-effect distillation
Source: JICA Project Team



Source: JICA Project Team

Figure 7.2.2 Water Supply Management Area for Each Company

(2) Existing water demand

As described in Chapter 2, the current household water demand is estimated at 24,315 m^3/day. using the daily average water demand per capita at 200 litter/day/person for urban population and 150 litter/day/person for rural population respectively. The maximum water consumption in Towla industrial park is about 380 m^3/day. No desalinated water is consumed for irrigation because the treated wastewater in sewage treatment plant is reused for irrigation water. The total water demand becomes 24,695 m^3/d. However, desalination plants produce fresh water of 39,250 m^3/day according to the result of field survey. This difference reveals that the real daily average water demand per capita is approximately 277 litter/person/day (≒39,250m^3/day/141,796 people) in the island, or the large amount of fresh water is lost by leakage in the water distribution network.

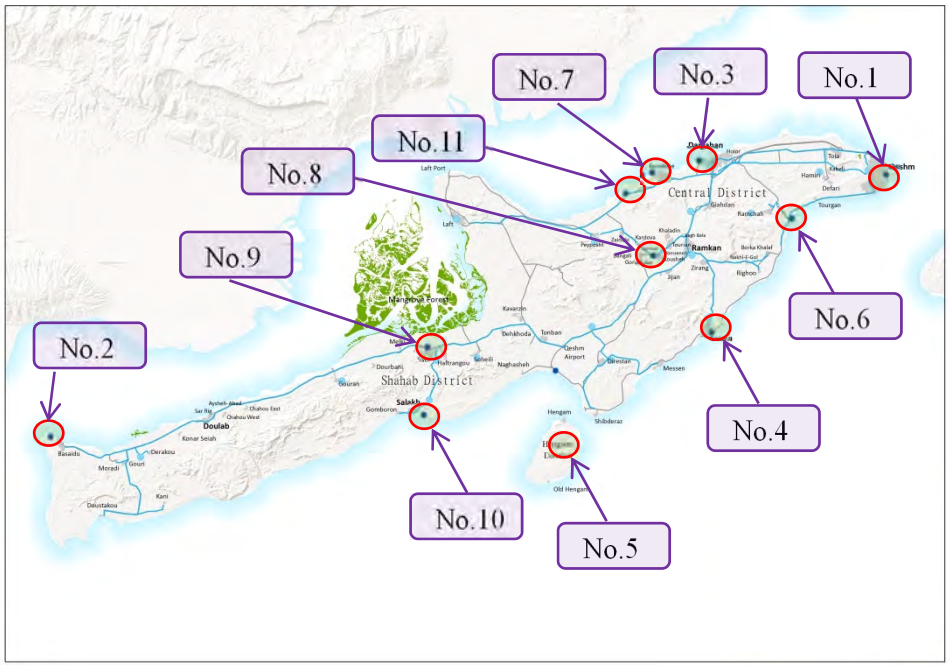
(3) Existing water supply facilities

There are 11 desalination plants operating on Qeshm Island as of 2016, as listed in Table 7.2.2. The QUC manages two desalination plants, while a private sector business owns and operates another three desalination plants under the supervision of the HUWWC. Another private sector business owns and operates the other six plants under the supervision of the HRWWC. The location of 11 desalination plants is shown in Figure 7.2.3.

Table 7.2.2 Desalination Plants and Capacity

No.	Location of desalination plant	Desalination system	Designated capacity (m^3/d)	Water demand (m^3/d)	Water-supplied population (p)	Supervising company
1	Qeshm City	RO, distillation (MSF,MED)	17,500+3,000+3,500	14,500	46,552	QUC
2	Baseidou	RO	1,500	550	10,591	QUC
3	Dargahan	RO	6,500	6,000	20,353	HUWWC
4	Souza	RO	1,350	1,000	5,707	HUWWC
5	Hangom	RO	545	550	515	HUWWC
6	Ramchah	RO	1,200	1,000	3,681	HRWWC
7	Kouvei	RO	4,000	5,000	4,243	HRWWC
8	Karavon	RO	400	200	3,145	HRWWC
9	Tabl	RO	250	450	4,069	HRWWC
10	Selakh	RO	1,250	1,000	3,679	HRWWC
11	Mapna Plant	Distillation (MED)	18,000	9,000	39,261	HRWWC
-	Total	-	58,995	39,250	141,796	-

Source: JICA Project Team



Note: Numbers on the map refer to the plant numbers in Table 7.2.2.
Source: JICA Project Team

Figure 7.2.3 Desalination Plants on Qeshm Island

The total water supply capacity is 58,995 m^3/d. The current capacity of the desalination plants generating freshwater exceeds the water demand. In fact, the Mapna plant has the capacity to produce 18,000 m^3/d of desalinated water; however, the volume of supplied water is only 9,000 m^3/d in accordance with the contract between the Mapna Qeshm Water and Power Cogeneration Company and the HRWWC. This is because the HRWWC does not have a water demand that is sufficient in terms of meeting the designated capacity of the Mapna plant. The Mapna plant has significant capacity to supply freshwater.

As for water charges for households in rural areas, the HRWWC collects 5% to 50% of water purchase costs from the desalination plant-managing companies, while the remaining portion (95% to 50%) is covered by subsidy. If the HRWWC purchases desalinated freshwater at IRR 30,000/m^3, it collects water charges within a range of IRR 1,450/m^3 to IRR 15,000/m^3 from households.

Water charges for large-scale users, such as plants, are decided in relation to the purchase cost from desalination plant-managing companies and the maintenance cost of water distribution facilities. They are between IRR 40,000/m^3 to IRR 45,000/m^3.

According to the baseline survey results, the access rate to desalinated freshwater via the water supply network or water tank trucks is 92.8% in rural areas. The remaining 7.2% of the population use deep-well water or rainwater.

The ratio of those who use desalinated freshwater from the water supply network is 13.6%, while 79.2% use desalinated water carried by another method (e.g., water tank trucks). Although more than 90% of island residents have access to desalinated freshwater, most of them have the water carried by water tank trucks, with only 10% having access to the water supply network.

The construction work of the water distribution and supply pipe in each village is already completed in all villages. However, since the connection between the main distributing water pipe and each village has not been completed yet, the water supply network cannot be used in some villages. The most of main distributing water pipe has been already installed up to Baseidou, but water supply from Gouron to the west area has not been established because the piping construction of two pumping station at Gouron and Derakou is in progress. These works will be completed in 2017. Once completed, most residents in Qeshm Island, including rural area, will be able to access desalinated fresh water from the

water supply network. In addition, water supply facilities in rural areas are operated and managed by two private companies delegated by HRWWC.

7.2.2 Issues to be tackled

Although the designated capacity of desalination plants satisfies the water demand, water shortages still occur in rural villages. It is assumed that such water shortages are mainly caused by the insufficient installation of distribution pipes and the shortage of water trucks in rural areas. It is necessary to clarify the causes of water shortages. Therefore, surveys, analysis and confirmation of the soundness of water supply facilities, such as transferring pipes, distributing pipes, booster pumps and service reservoirs, are required to be carried out in the near future.

Water leakages should be investigated, including leakages due to facility degradation. Moreover, it is also necessary to study whether the total volume of treated water in desalination plants is supplied to users without water loss (non-revenue water). The survey regarding water leakages and the non-revenue water rate should be carried out in the near future. From the viewpoint of operation and maintenance of the water supply system, it is necessary to study the current situation regarding water management facilities, including their operation and maintenance and the capacity of their staff in this regard. Furthermore, it is also necessary to study whether the wastewater (brine water) from desalination plants is discharged appropriately into the sea, and whether the brine water has significant affected the local fishing industry and marine ecosystem.

Regarding RO plants, there are some plants that do not reuse the pressure from brine water in rural area though the RO plants are equipped with the energy recovery device (Turbo ERD) in urban area. From the point of view of improving energy efficiency, it should be studied whether an energy recovery device (ERD) could be installed in the existing plants in rural area.

Current water supply services in rural areas and issues related to them are summarized below.

Table 7.2.3 Current Situation and Issues in Rural Area

No.	Current situation	Issues
1	Dissatisfaction with water supply services in rural areas is not negligible	Insufficient water distribution system, even though water is desalinized (water distribution network is yet to be developed and there are not enough water tank trucks)
2	Water distribution network is not developed in rural areas	Water distribution facility plan and its implementation in rural areas lag behind the construction of desalination plants
		Human resource shortage in the HRWWC
3	Uncontrolled discharge of concentrated seawater from desalination plants	Impacts of concentrated seawater discharged in surrounding coasts and waters are not considered

Source: JICA Project Team

7.2.3 Objectives and development target

The objectives and development target for the water supply are as below:

(a) To improve the access rate to desalinated freshwater from 93% in 2016,
(b) To improve the access rate to the water supply network from 13.6% to 90% by promoting the construction of water supply facilities,
(c) To improve the installation rate for water meters to 90% in whole Qeshm Island,
(d) To reduce the total amount of subsidy to three water companies (QUC, HUWWC, HRWWC) by rationalization of water tariffs, and
(e) To improve method to reduce concentration of discharged saline water into the sea in cooperation with DoE.

7.2.4 Development plan

(1) Water demand forecast

The daily average water demand forecasts for domestic use, as estimated for 2036 using the daily average water demand per capita of 200 litter/person/day (for urban area) and 150 litter/person/day (for rural area) and the planned population, are shown in Table 7.2.4 below. It is assumed that the daily average water demand per capita will not change even after twenty years.

Table 7.2.4 Domestic Water Demand Forecast for 2036 (for Domestic Use)

No.	Location	Planned Service Population (person)	Maximum Required Produced Water Forecast (m^3/d) <A>*1	Current water desalination capacity (m^3/d) <B>	Water supply capacity –required Produced water (m^3/d) (B-A)	Remarks
1	Qeshm City	91,273	31,946	24,000	-7,946	Urban area
2	Baseidou	15,140	4,542	1,500	-3,042	Rural area
3	Dargahan	39,853	13,949	6,500	-7,449	Urban area
4	Souza	13,247	4,636	1,350	-3,286	Urban area
5	Hangom	1,089	327	545	218	Rural area
6	Ramchah	4,909	1,473	1,200	-273	Rural area
7	Kouvei	5,547	1,664	4,000	2,336	Rural area
8	Karavon	4,614	1,384	400	-984	Rural area
9	Tabl	6,374	1,912	250	-1,662	Rural area
10	Selakh	5,666	1,700	1,250	-450	Rural area
11	Shibderaz New Town	20,351	6,105	0	-6,105	Rural area
12	Mapna Plant	62,357	18.761	18,000	-761	Rural area
-	Total	270,600	88,399	58,995	-29,404	-

*1: A (m^3/d) = population x 0.2 (m^3/person/day) x 1.4 x 1/(1-0.2) (for Qeshm City, Dargahan, Souza as urban)
A(m^3/d)=population x 0.15(m^3/person/day) x 1.4 x 1/(1-0.3) (for other location as rural)
1.4: Maximum daily water demand factor
0.2: Leakage rate in urban area is 20%
0.3: Leakage rate inn rural area is 30%

Source: JICA Project Team

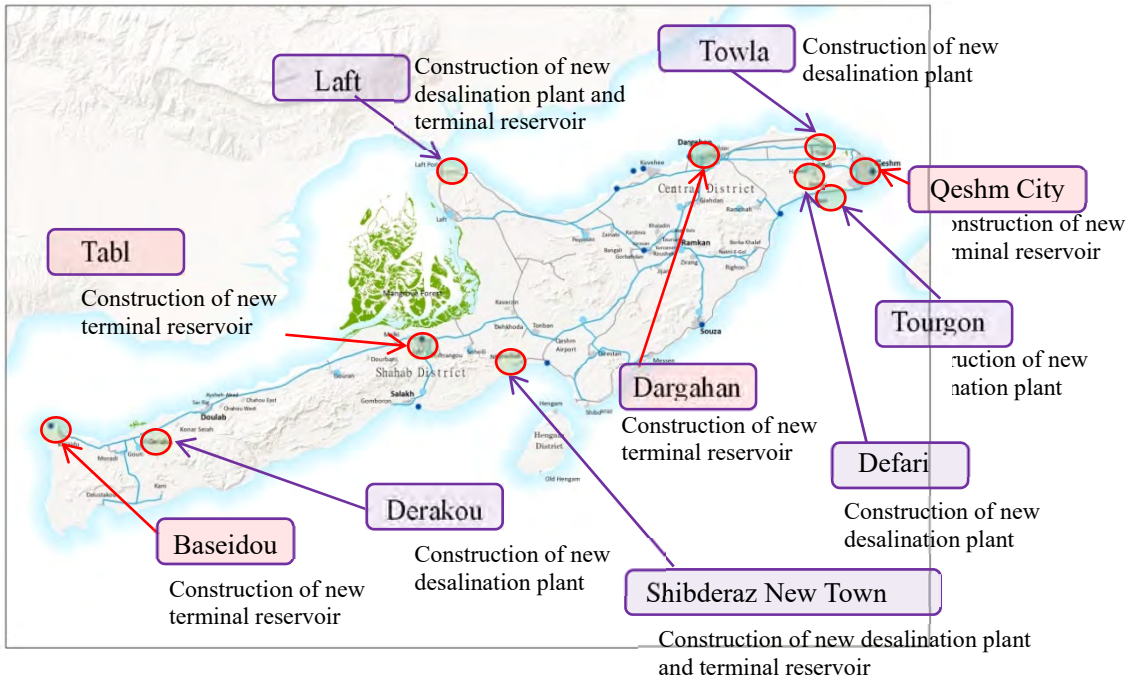
(2) Renovation and new construction of desalination plants

The expected domestic water demand for 2036 in Qeshm City will not be satisfied even if the current desalination plants are rehabilitated, such that all of them will be operational. They need to expand the treatment capacity and need to be renovated step by step in advance of 2036 because some plants have already become old, meaning that it will be difficult to use them for another 20 years. Renovation requires the installation of energy-efficient desalination plants, including the installation of energy recovery units and RO membranes with a high recovery rate.

As for other cities and villages except Hangom and Kouvei, existing desalination plants need to expand the treatment capacity because the expected domestic water demand for 2036 will not be satisfied. The current plant capacity of Hangom and Kouvei is estimated to meet water demand for households with the current desalination capacity. However, as is the case for Qeshm City, some equipment and pipes in the plants have corroded, so it will be difficult to use the plants for another 20 years. It is necessary to renovate them gradually and also install energy-efficient desalination plants, including the installation of energy recovery units with RO membranes with a high recovery rate on renovation.

New desalination plants need to be constructed in other areas as water demand increases. In Shibderaz New Town, Doulab, Laft, Holor and Towla, in particular, where population increases are estimated to exceed 5,000 by 2036, new desalination plants need to be constructed to supply water to these places, while Holor will be covered by the existing desalination plants in Dargahan of which the treatment capacity will be expanded after the rehabilitation. New desalination plants need to be constructed in Towla, Laft and Shibderaz New Town. Towla especially needs a plant with a capacity to manage the water demand for industrial use as it is an industrial zone. The construction of new plants in Laft is not

appropriate because of environmental protection in the Hara protected area. The east side of the Persian Gulf Bridge is suitable for the new plants, although the wastewater may cause influence to some extent. In the past, the desalination plant was operated there. Distribution pipes and facilities from Mapna Plant to Laft and a terminal reservoir in Laft are under construction. QUC plans to construct a new desalination plant with the capacity of 10,000 m^3/day near Tourgan village. QUC has another plan to construct a new terminal reservoir having storage capacity of 10,000 m^3 in Qeshm City. HRWWC plans to construct two new desalination plants in near Defari and Derakou. The capacity of Defari plant is 2,300m^3/d and another one is 2,000m^3/d. Location of new desalination plants and new reservoir are shown in Figure 7.2.4. Specification of new desalination plants and new reservoir are shown in Table 7.2.5.



Source: JICA Project Team

Figure 7.2.4 New Desalination Plant and Water Reservoir Construction

Table 7.2.5 Capacity of New Desalination Plants and Terminal Reservoir

No.	Location Name	Capacity	Basis of Numerical Values
New Desalination Plant (Total: 23,700m^3/day)			
1	Tourgon	10,000m^3/day	・Construction is already planned by QUC
2	Defari	2,300m^3/day	・Construction is already planned by HRWWC
3	Derakou	2,000m^3/day	・Construction is already planned by HRWWC
4	Towla	1,000m^3/day	・Assuming it will be two or three times the current maximum water used volume:380m^3/day.
5	Laft	2,200m^3/day	・0.15 (m^3/person/day) x 7,210 (people) x 1.4 x 1/0.7 ≒3,000(m^3/day)
6	Shibderaz New Town	6,200m^3/day	・0.15(m^3/person/day)×20,351(people)×1.4×1/0.7 ≒6,200(m^3/day)
New Terminal Reservoir (Total: 14,500m^3)			
1	Qeshm City	10,000m^3	・Construction is already planned by QUC
2	Dargahan	6,000m^3	・0.2(m^3/person/day)×39,853 (people) ×1.4 × 1/0.8 ≒14,000(m^3/day), ・14,000(m^3/day)×12h/24h＝7,000m^3 ・7,000 - 1,000 (Existing volume)=6,000m^3
3	Baseidou	2,400m^3	・0.15(m^3/person/day)×15,140(people) ×1.4 × 1/0.7 ≒ 4,500(m^3/day) ・4,500(m^3/day)×12h/24h≒2,400m^3 ・The capacity of one unit shall be 600 m^3, and the total capacity shall be 2,400 m^3 for 4 units
4	Laft	600m^3	・0.15(m^3/person/day)×7,210(people)×1.4×1/0.7 ≒2,200(m^3/day) ・2,200(m^3/day)×12h/24h＝1,100m^3 ・1,100 - 500 (Existing volume)=600m^3
5	Shibderaz New Town	3,100m^3	・0.15(m^3/person/day) × 20,351(people) × 1.4 × 1/0.7 ≒ 6,200(m^3/day) ・6,200(m^3/day)×12h/24h＝3.100m^3≒3,100m^3
6	Tabl	1,000m^3	・0.15(m^3/person/day)×6,374(people) ×1.4 × 1/0.7 ≒ 2,000(m^3/day) ・2,000(m^3/day)×12h/24h＝1,000m^3

Source: JICA Project Team

If the maximum use of industrial water is estimated to be 2,000m^3/d, water demand on the entire island will be as shown in Table 7.2.6 below.

Table 7.2.6 Water Demand Forecast for 2036

	Required production quantity (m^3/day)	Remarks
Domestic demand	88,399	・200 litter/person/day x 1.4 x 144,373 x 1/(1-0.2) =50,531 m^3/day (Urban area) ・150 litter/person/day x 1.4 x 126,227 x 1/(1-0.3) =37,868 m3/day (Rural area)
Industrial demand	2,000	-
Total	90,399	-

Note: Maximum daily water demand factor at 1.4
0.2: Leakage rate at Urban area is 20%
0.3: Leakage rate at Rural area is 30%

Source: JICA Project Team

If the current capacity of 58,995 m^3/day for the desalination plant persists, there will be a shortage in the water supply of 31,404 (90,399-58,995) m^3/day by 2036. The water supply is likely to be insufficient, particularly in Towla, where nearby plant construction and industrial development are expected. Desalination facilities, with a capacity of more than 1,000 m^3/day, need to be constructed

in the Towla region. Desalination facilities are required with the capacity of 6,200 m^3/day in Shibderaz New Town and 2,200 m^3/day in Laft, corresponding to the population growth. The total capacity of new desalination plant is estimated at 23,700 m^3/day including the new desalination plants in Tourgon (10,000 m^3/day), Defari(2,300m^3/day) and Derakou(2,000m^3/day). One terminal reservoir with the storage volume of 6,000m^3 is required in Dargahan City and four terminal reservoirs are required in Baseidou village and the neighboring villages. Each reservoir has the storage volume of 600m^3. One terminal reservoir with the storage volume of 600m^3 is required in Laft. One terminal reservoir with the storage volume of 3,100m^3 is required in Shibderaz New Town and one terminal reservoir with the storage volume of 1,000m^3 is required in Tabl. The total storage volume of new terminal reservoirs is amounted to 23,100 m^3 including the terminal reservoir in Qeshm City (10,000 m^3). A new desalination plant must be planned to ensure the conditions as specified in Table 7.2.7.

Table 7.2.7 Requirement for New Desalination Plant Construction

Category	Location conditions of desalination plant	Target facility
Coastline	Not for swimming, not used as recreational facilities	Intake/discharge facility
Ocean/coastline	Not fishing grounds, no farming activities of seaweed, oysters etc.	Intake/discharge facility
	Not a nature reserve, tourist coral reef destination etc.	Intake/discharge facility
Ocean	Low habitat density of creatures	Intake/discharge facility
	Stable water quality, no influx of organic matter or wastewater	Intake facility
	No high waves, low heaves	Intake/discharge facility
Land	Near places with large water demand (densely populated area, industrial park)	Desalination facility
	Power can be supplied for commercial use	Desalination facility
	Developed access roads are present	Desalination facility

Source: JICA Project Team

(3) Improvement in desalination plant energy efficiency

The energy efficiency of desalination plants needs to be improved in order to decrease energy consumption (electric power and heat source). To this end, the following measures are introduced:

(a) Adoption of low-pressure RO membranes to reduce the required water pressure for the water supply in the desalination process.
(b) Installation of a concentrated seawater pressure ERD to recover and recycle the surplus energy in the desalination process with RO methods.
(c) Adoption of an improved water recovery system in the entire plan to reduce the volume of wastewater.
(d) Adoption of a low-pressure desalination plant. Wastewater is treated by the RO process. The concentrated water from the sewage treatment plant is mixed with raw seawater for industrial use. This process keeps the salt concentration of raw water low; desalination is enabled under low pressure. Thus, electricity consumption is reduced.

	
Source：FEDCO website ERD (Turbo ERD) for Small Treatment Capacity	Source : Energy recovery website ERD (PX Pressure exchanger) for Large Treatment Capacity

Figure 7.2.5 Energy Recovery Device

(4) Water supply network and distribution facility development in rural areas

Water supply and distribution zones on the entire island, excluding the city areas, are divided by distribution reservoirs. Water is supplied from the desalination plants to the distribution reservoirs via water pipes and then supplied to users from the reservoirs via the water distribution pipes. It is planned that the distribution facilities will be capable of supplying the necessary amount of water from the reservoirs to users. It is also planned that the reservoir capacity will retain water for over six hours to keep the water volume balance in the distribution reservoirs (daily maximum supply volume) and the distribution volume balance from the reservoirs (hourly maximum supply volume). Newly installed distribution pipes and booster pumps have multiple systems for tiered distribution in accordance with water demand.

(5) Installation of water meters

Water meters are installed at water supply points and branch points of the distribution network so that water use can be managed. The water charge system will be changed from a flat-rate system to a strict pay-as-you-go system to improve the non-revenue water rate. The change will encourage consumers to save water, while the desalinated water production volume will decrease, which should see an improvement on the HRWWC's balance sheet. This will result in a subsidy decree.

(6) Improvement in the maintenance capacity of water supply and distribution facilities in rural areas

The operation and maintenance of desalination plants in rural areas are entrusted to private company operators. The facilities that distribute water from each plant to users are also managed by two private companies designated by HRWWC. However, the leakage rate of water supply network in rural areas is expected to be approximately 30%, it is higher than the rate in urban areas. Partly because of the HRWWC's limited human resources, there is concern over the ability to manage private companies. The water supply service capacity of the private companies and HRWWC needs to be improved in terms of quality and quantity.

7.2.5 Proposed projects and cost estimates

The estimated construction cost of the above development plan is as shown in Table 7.2.8.

Table 7.2.8 Estimated Cost

No.	Item	Estimated cost (IRR)	Remarks
1	Renovation of existing desalination plants	2,078,500,000,000	Total performance of existing plant and rehabilitated: 66,699 m^3/day
2	Construction of new desalination plants	1,461,200,000,000	Total performance of new plant :23,700 m^3/day
3	Construction of distribution reservoirs	277,200,000,000	Total volume of water distribution reservoir : 23,100 m^3
4	Construction of water distribution network	90,000,000,000	Length of φ500 internal surface coating steel pipe: 40km
5	Technical support for improvements to operation and maintenance capacity	60,000,000,000	-

Source: JICA Project Team

(1) Phasing and priority project

Construction of the water supply network in rural areas should be a priority in the short and medium terms until 2026. Rehabilitation of the water distribution network will be carried out and water meter will be comprehensively installed, while non-revenue water reduction measures will be implemented in the cities and rural areas.

In the long term after 2027, upgrading and expanding existing desalination plants will be carried out, with a new desalination plant to be constructed in order to cope with the population growth and the deterioration of existing desalination plants. Stable desalinated freshwater production must be secured.

Table 7.2.9 shows necessary actions for water supply development.

Table 7.2.9 Necessary Actions for Water Supply Development

Phase	Qeshm City and other cities	Rural areas
First	・ Survey of the current water distribution network in the city (survey for rehabilitation and expansion of the water distribution network) ・ Survey of additional ERD installation of desalination units (estimation of the replacement in electricity consumption to be reduced on introduction) ・ Rehabilitation of the water distribution network ・ Technical support for anti-leakage measures (technical support for leakage detection and non-revenue water)	・ Survey of the current conditions of water distribution and supply facilities ・ Survey of additional ERD installations in desalination units (estimation of the replacement in electricity consumption to be reduced on introduction) ・ Technical support for anti-leakage measures (technical support for leakage detection and non-revenue water) ・ Capacity building for operation and maintenance of the water distribution facilities ・ Improvement in the concentrated water discharge facility of desalination plants
Second	・ Upgrading and expansion existing desalination plants	・ Technical transfer from urban area to rural area (Especially, regarding to business management and revenue improvement of water supply business) ・ Upgrading and expansion existing desalination plants ・ New desalination plant construction

Source: JICA Project Team

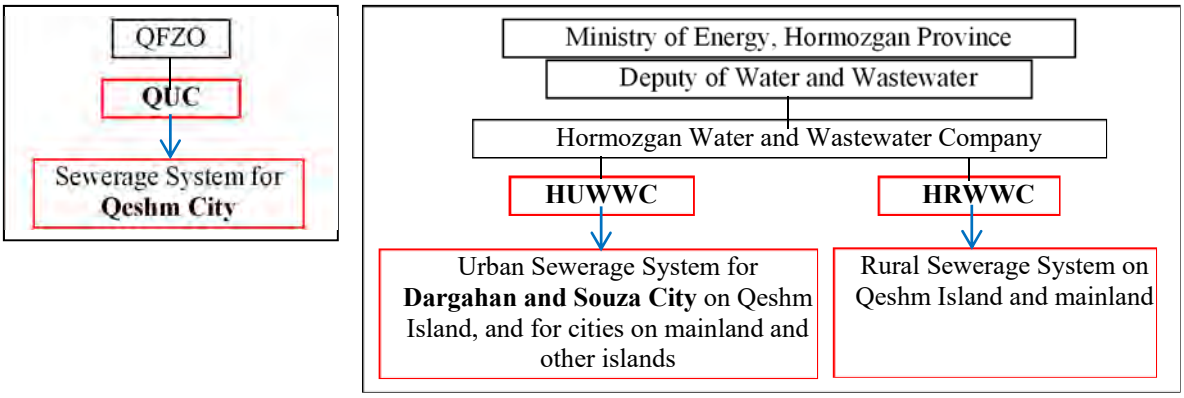
7.3 Sewage Treatment

7.3.1 Existing conditions

(1) Responsible organization for sewage treatment

Sewage treatment systems on the Qeshm Island and Hangom Island are managed by three companies: the QUC (Qeshm Utilities Company), the HUWWC (Hormozgan Urban Water and Wastewater Company) and the HRWWC (Hormozgan Rural Water and Wastewater Company). The QUC is affiliated with the QFZO, while the HUWWC and the HRWWC are under the management of the Hormozgan Water and Wastewater Company, which is an organization overseen by the Deputy of Water and Wastewater in the Ministry of Energy, Hormozgan Province.

The QUC, under the QFZO, manages the sewerage system of Qeshm City while the HUWWC is responsible for the sewerage system of Dargahan City and Souza City. The HRWWC is responsible for the sewerage systems in rural areas on Qeshm and Hangom Island. Of course, both HUWWC and HRWWC are responsible for the sewerage systems on the mainland and other islands. (Refer to Figure 7.3.1).



Source: JICA Project Team

Figure 7.3.1 Organizational Structure of Sewage Treatment on Qeshm Island

Table 7.3.1 shows an overview of the three water and wastewater management companies.

Table 7.3.1 Overview of Water and Wastewater Companies

	QUC	HUWWC	HRWWC
Parent organization	QFZO	Hormozgan Province	Hormozgan Province
Investors	100% government owned	50% government and 50% private sector owned	100% government owned
Number of staff	110	300 (Qeshm Branch 12)	235 (Qeshm Branch 5)
Number of engineer	25	200	123
Area covered by the company	QFZO area	Mainland and Islands except QFZO and KFZO* area	Mainland and Qeshm Island except QFZO area
Sewage treatment area on Qeshm Island managed by the company	Qeshm City and some nearby villages	Dargahan City, Souza City and some housing complexes	Rural area on Qeshm Island except QFZO area
Number of sewage treatment plants in Hormozgan Province	2 STPs in operation	3 STPs in operation 3 STPs under construction 2 STPs construction suspended	1 STP under construction
Number of sewage treatment plants on Qeshm Island	2 STPs in operation	1 STP in operation 2 STPs construction suspended	

Note: KFZO is the abbreviation of Kish Free Zone Organization which covers Kish Island.
One STP is in operation in Kish Island under KFZO.
Source: JICA Project Team

(2) Existing condition for sewage treatment in Hormozgan Province

HUWWC has been actively promoting sewerage system development for major cities in Hormozgan Province, as shown in Table 7.3.2. Currently the sewerage system for Bandar Abbas City is in operation while the sewerage systems for Minab, Roudan and Jask City are under construction. The construction of sewerage system for Dargahan City and Holor Village has been suspended, which are described in the following section. HUWWC also launched the PFI project for sewerage system in some housing complexes, as shown in Table 7.3.2. Besides this, HUWWC has embarked on another PFI project for selling treated wastewater, and is constructing the facility in the Bandar Abbas STP.

Table 7.3.2 Current Status of Sewerage System Development by HUWWC

Name of City/Area	Location	Population* (people)	Planned capacity (m^3/d)	Current status
Bandar Abbas	Mainland Capital of Province	680,366	144,000 (7,200 in operation)	In operation
Minab	Mainland	259,221	22,860	Under construction
Roudan	Mainland	124,522	10,887	Under construction
Jask	Mainland	58,884	6,533	Under construction
Dargahan and Holor	Qeshm Island	20,353	6,097	Construction suspended
Dargahan Maskan Mehr (PFI project)	Qeshm Island		335	In operation
Towla Housing Complex (PFI project)	Qeshm Island		250	Construction suspended
Abu Musa (PFI project)	Abu Musa Island		1,200	In operation

Note: Population data is based on census in 2016.
Source: JICA Project Team

HRWWC has been developing a rural sewerage system in Tiab Village in Minab County, Hormozgan Province, which is currently under construction. The current plan of the sewerage system consists of a 2 km Trunk sewer and an 18 km branch sewer, with the STP having a capacity of 15L/sec which services 5,400 people.

Two STPs have been constructed by QUC and are being operated in Qeshm City on Qeshm Island, these are described in the next section.

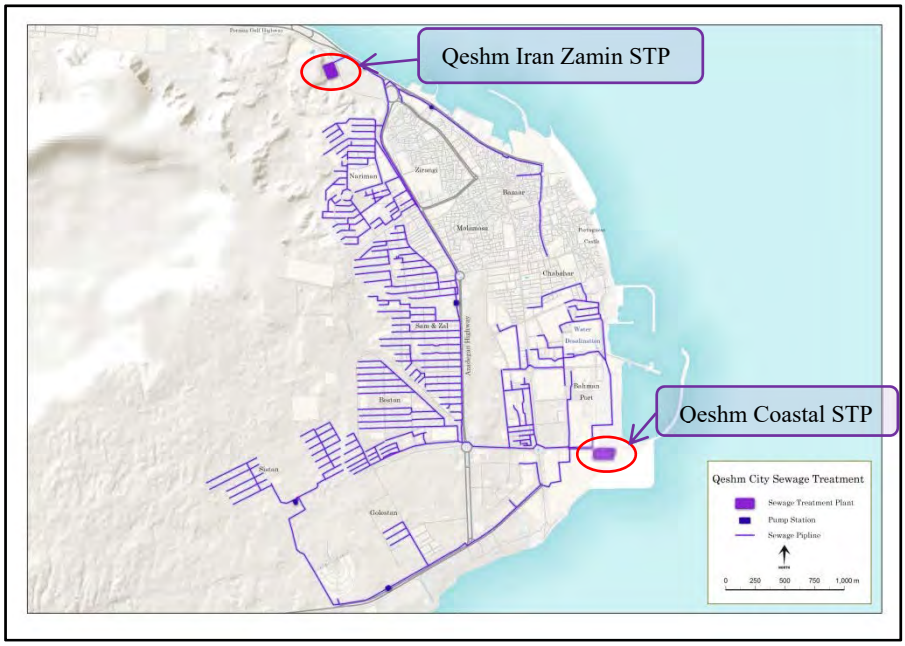
Regarding Qeshm Island, the master plan of the sewerage system has already been created for Qeshm City and Dargahan City, but not for Souza City. In 2016, the population on Qeshm Island and Hangom Island was estimated to be 141,796 people, inclusive of 40,678 people in Qeshm City, 14,525 people in Dargahan City and 5,707 people in Souza City.

(3) Qeshm sewerage system

The QUC has adopted the Qeshm Sewerage Development Plan, covering approximately 1,000 ha of sewage treatment area in Qeshm City, with the target year of 2025. The plan and existing sewerage system of Qeshm City are outlined as follows:

Sewer network

The total sewer network length of the overall sewerage plan in Qeshm City will be 285 km by 2025, which will cover approximately 1,000 ha. The existing sewer length is 185 km, which covers approximately 750 ha of the sewage treatment area; meaning that currently, sewers cover almost 75% of the area of Qeshm City. The sewer network and sewage treatment area are shown in Figure 7.3.2.



Source: JICA Project Team

Figure 7.3.2 Sewer Network in Qeshm City (Tentative)

STPs

The total sewage flow outlined in the overall sewerage plan of Qeshm City is 6,000 m^3/day, which is to be treated by two STPs, each with a capacity of 3,000 m^3/day. The total capacity of the two STPs currently in operation is 3,000 m^3/day (2,000 m^3/day for Qeshm Coastal STP and 1,000 m^3/day for Qeshm Iran Zamin STP). Expansion is ongoing for each of the two STP facilities towards an additional capacity of 1,000 m^3/day. The outline of the two STPs is shown in Table 7.3.3, while photos of the facilities are shown in Figure 7.3.3.

Table 7.3.3 Outline of Sewage Treatment Plants in Qeshm City

	Qeshm Coastal STP	Qeshm Iran Zamin STP
Location	South end of Bahman Port (26°56'29"N 56°16'48"E)	Beside the coastal park between Shahid Zakeri Jetty and Hamoon Jetty (26°58'14"N 56°15'24"E)
Year of commencement	2011	2012
Capacity of overall plan	3,000 m^3/day	3,000 m^3/day
Capacity of existing facility	2,000 m^3/day	1,000 m^3/day
Current amount of treated sewage	around 2,000 m^3/day (increasing)	around 1,000m^3/day (increasing)
Capacity extension	1,000 m^3/day (under construction)	2,000 m^3/day (of which 1,000 m^3/day is under construction)

Source: JICA Project Team

Note: From top left to bottom right: general view, aeration tank, final sedimentation and watering tanker loading treated sewage water
Source: JICA Project Team

Figure 7.3.3 Qeshm Coastal STP

The treatment process of the STPs is as follows:

- Sewer inlet: two sewer lines for Qeshm Coastal STP (one line is at a high elevation and the other line is at a low elevation), and one sewer line for Qeshm Iran Zamin STP.
- Pretreatment: screening for garbage removal → pump well → pumping up → sand separation.
- Sewage treatment (Recycled nitrification denitrification process): anoxic tank with agitation equipment → aeration tank with aeration equipment to final sedimentation tank.
- Treated sewage reuse process: filtration → disinfection → storage → watering by tanker.
- Sewage sludge treatment: excess sludge → dewatering by drying bed → disposal.

The entire treated sewage effluent from the two STP, after additional treatment of filtration and disinfection, is used for watering the street trees and green spaces in the city. Along with an expected increase in sewage influent in the future, the reuse of treated sewage will expand to other forms of use, such as industrial water.

Sewage sludge drying beds are in operation in the Qeshm Coastal STP. In addition other drying beds for septage from the septic tanks and leaching pits are in operation in the corner of the municipal waste disposal sites for disposal or for greenery.

(4) Dargahan sewerage system

The HUWWC has already concluded the Dargahan Sewerage Development Study, covering 1,073 ha in the areas of Dargahan City, Holor Village and Azad University, which estimates the population to be 37,400 people by 2041. As of 2016, the area contains an estimated population of 19,300. There is a need to develop a sewerage system in these areas due to the dense population and problems caused by odors, since sewage does not infiltrate into soil at the leaching pit due to soil conditions and the high groundwater level.

Regarding the sewer network of Dargahan's sewerage system, an interceptor, which is 3 km in length, was constructed along the coastline in 2013 to 2014. Several branch sewers with a total length of a few kilometers were also constructed in the Delbari area, close to Maskan Mehr, which is a housing complex.

In the area of Dargahan's sewerage system, the Maskan Mehr STP, a small-scale STP with an existing capacity of 335 m^3/day, which is as per the capacity in the overall plan, became operational in September 2014. The treated sewage effluent is sold and reused under PFI project by the management of the HUWWC.

(5) Rural sewerage and sanitary system

Bonyad Maskan (Housing Foundation of Islamic Republic of Iran) manages the rural development plan for 57 villages on Qeshm and Hangom. The HRWWC creates water supply plans for villages, but has not created a sewerage plan yet for villages on Qeshm and Hangom.

In general, the sanitary facilities in rural areas function as a system to guide human waste and greywater to a single pit, which allows leaching of each liquid portion. When the pit is filled, the next pit will be dug, meaning that withdrawal of septage will not be performed. On the other hand, in an urbanized area, it is necessary to withdraw septage regularly from the pit due to limited land availability.

A rural sewerage system is under construction in Tiab Village in Minab County, but not on Qeshm Island, this is because the former faces the sea and underground water levels are high, which does not allow for leaching from the pit. Some of the villages on Qeshm and Hangom are also facing the same problem. In addition, demands for improvements to the living and water environments have been vocalized by some of the villagers. Therefore, such rural sewerage systems are required on Qeshm and Hangom.

(6) Industrial wastewater management

Industrial wastewater in the Industrial Park shall be treated by the individual or collective wastewater treatment plants (WWTPs) in compliance with the criteria for discharge into public water bodies (surface water). For this purpose, the following regulatory and monitoring organizations concerning industrial wastewater discharge have a role as stated below:

- Environment Department of the QFZO: verification (cross-check) of the data report submitted by factories every three months.
- Standards Department of the QFZO: implementation of a random check regarding compliance with national standards etc.
- Medical and Health Department, Ministry of Health: monitoring of hazardous substances in industrial wastewater discharge as related to public health.
- QUC: monitoring wastewater effluent from factories into sewers in the sewage treatment area, as well as monitoring treated sewage effluent from the STP.

In reality, the above monitoring system is operating below necessary capacity, due to a shortage of staff and an insufficient monitoring system. Currently, most industrial workshops do not produce a significant amount of "industrial wastewater". The exception being the Zinc Extraction Company, where the wastewater treatment facility is operating and the treated wastewater is utilized for washing and cooling purposes. The industrial workshops and companies in the industrial parks normally collect "domestic wastewater" in septic tanks or leaching pits, and the septage will be transferred to the disposal site by tankers.

(7) Wastewater discharge standards

Following legislation of the Water Pollution Prevention Act, Wastewater Discharge Standards were published based on the act. The standards are provided in relation to: i) the discharge into surface waters, ii) the discharge into absorption wells and iii) Irrigation and agricultural use, as shown in Table 7.3.4.

Table 7.3.4 Wastewater Discharge Standards

Unit: mg/l

No.	Contaminants		Discharge into surface waters	Discharge into absorption wells	Irrigation and agricultural use
1	Silver	Ag	1	0.1	0.1
2	Aluminum	Al	5	5	5
3	Arsenic	As	0.1	0.1	0.1
4	Bromine	B	2	1	1
5	Barium	Ba	5	1	1
6	Beryllium	Be	0.1	1	0.5
7	Calcium	Ca	75	-	-
8	Cadmium	Cd	0.1	0.1	0.05
9	Chlorine	Cl	1	1	0.2
10	Chloride	-Cl	600 (Note 1)	600 (Note 2)	600
11	Formaldehyde	CH2O	1	1	1
12	Phenyl	C6H5OH	1	Negligible	1
13	Cyanide	CN	0.5	0.1	1.0
14	Cobalt	Co	1	1	0.05
15	Chromium	Cr6+	0.5	1	1
16	Chromium	Cr3	2	2	2
17	Copper	Cu	1	1	0.2
18	Fluoride	F	2.5	2	2
19	Iron	Fe	3	3	3
20	Mercury	Hg	Negligible	Negligible	Negligible
21	Lithium	Li	2.5	2.5	2.5
22	Magnesium	Mg	100	100	100
23	Manganese	Mn	1	1	1
24	Molybdenum	Mo	0.01	0.01	0.01
25	Nickel	Ni	2	2	2
26	Ammonium	NH4	2.5	1	-
27	Nitrite	NO2	10	10	-
28	Nitrite	NO3	50	10	-
29	Phosphate	-	6	6	-
30	Lead	Pb	1	1	1
31	Sodium	Se	1	0.1	0.1
32	Sulfide	SH2	3	3	3
33	Sulfite	SO3	1	1	1
34	Sulfate	SO4	400 (Note 1)	400 (Note 2)	500
35	Vanadium	V	0.1	0.1	-
36	Zinc	Zn	2	2	2
37	Oil		10	10	10
38	Detergents	ABS	1.5	1.5	0.5
39	BOD (Note 3)	BOD5	30 (50 instantaneous)	30 (50 instantaneous)	100
40	COD (Note 3)	COD	60 (100 instantaneous)	60 (100 instantaneous)	200
41	Dissolved oxygen	DO	2	-	2
42	Total dissolved solid matter	TDS	(Note 1)	(Note 2)	-
43	Total suspended solid matter	TSS	40 (60 instantaneous)	-	100
44	Sediments	SS	0	-	-
45	pH	pH	6.5-8.5	5-9	6-8.5
46	Radioactive materials	-	0	0	0
47	Turbidity	-	50	-	50
48	Color	-	75	75	57
49	Temperature	T	Note 4	-	-
50	Total intestinal coliform (no. in 100 ml)	MPN	400	400	400
51	Total coliform (no. in 100 ml)	MPN	1,000	1,000	1,000
52	Parasite eggs	-	-	-	(Note 5)

Note 1: The discharge of effluents with contaminant concentrations higher than the standards presented in the table above is only permissible if it does not increase the chloride, sulfate and dissolved matter concentrations of the receiving waters in a radius of 200 m by more than 10%.

Note 2: The discharge of effluents with contaminant concentrations higher than the standards presented in the table above

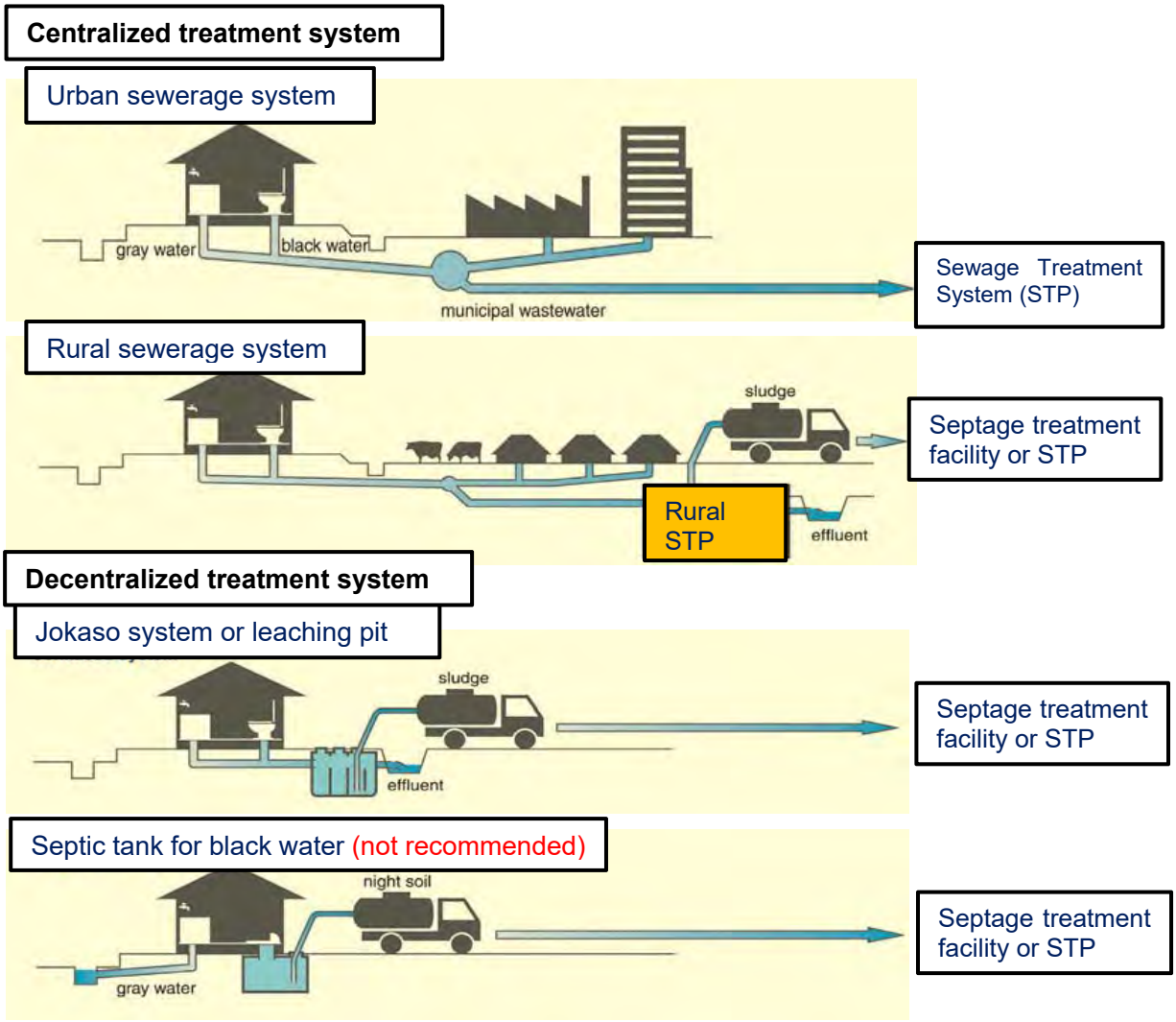
is only permissible if the chloride, sulfate and dissolved matter concentrations of the discharged effluent is up to 10% higher than those of the receiving waters.
Note 3: Existing industries are authorized to reduce COD and BOD5 concentrations by at least 90%.
Note 4: The discharged effluent must not change the temperature of the receiving waters in a radius of 200 m by more than 3oC.
Note 5: The number of parasite eggs (nematodes) in treated municipal effluent used for the irrigation of agricultural produce consumed in their raw state must not exceed one egg/l.
Source: Table 4-5, Pages 277-279, of Human Environmental Laws, Regulation, Criteria and Standards, Department of Environment

7.3.2 Issues to be tackled

In the field of sewage management, there are several issues to be discussed for a community-based development of the islands of Qeshm and Hangom. For this discussion, the concept and methodology of sewage management are described as follows:

Centralized or decentralized treatment system

A domestic sewage treatment system is classified as either a centralized or a decentralized treatment system (refer to Figure 7.3.4). In a centralized treatment system, there is an urbanized sewerage system and a rural sewerage system. The centralized sewerage system consists of a sewer network with a pump station and a sewage treatment plant. The decentralized treatment system consists of an on-site treatment facility within the household, which is either a Jokaso system or a leaching pit for human waste (black water) and greywater. The Jokaso system is made of concrete or fiber-reinforced plastic and equipped with a compact sewage treatment facility, as well as requires regular sludge removal. The leaching pit is a septic tank with an infiltration mechanism, which is not suitable for soils with no infiltration capacity, such as clay, areas with high underground water levels and areas where there is a risk of groundwater contamination. In addition, a septic tank, which can only be utilized for black water, is not recommended because greywater will not be treated. Either a centralized or decentralized treatment system shall be adopted in consideration of factors, such as beneficiaries, investment cost, improvement to the water environment and other incentives.



Source: JICA Project Team, with reference to a figure of the "Night Soil Treatment and Decentralized Wastewater Treatment Systems in Japan (Ministry of Environment, Japan 2013)

Figure 7.3.4 Centralized and Decentralized Sewerage Systems

Issues to be tackled

The following summarizes the issues to be tackled by reviewing the existing conditions for sewage treatment:

- To improve sanitary conditions, especially in the areas where infiltration capacity of the leaching pit is not sufficient,
- To develop a modern centralized sewerage system in a densely populated and urbanized area to improve the living environment and water environment,
- To promote the reuse of treated sewage effluent and appropriate sewage sludge disposal/use,
- To consider the institutional and financial systems needed to develop and manage such a sewerage system, especially in rural areas, and
- To strengthen the monitoring system with regard to wastewater discharge standards, especially for industrial wastewater.

7.3.3 Objectives and development target

The following objectives and development targets are raised in the field of sewerage management in the context of this Project:

To achieve a "National Minimum" in basic human needs:

- All of the residents in the urbanized area to be covered by sewerage service.
- All of the residents in the rural area to be provided with a sewerage service or an on-site treatment facility with a sanitary toilet.

To conserve the water environment of the islands:

- All of the sewage in the urbanized area to be treated at an STP.
- All of the sewage, including greywater in rural areas, to be treated by a rural STP or on-site treatment facility.
- All of the industrial wastewater to be treated by an individual or collective industrial WWTP and monitored.

To promote the reuse of treated sewage effluent and appropriate sewage sludge disposal/utilization:

- All of the treated sewage effluent to be reused for watering or irrigation.
- All of the sewage sludge from the sewage treatment plant to be disposed or utilized appropriately.

7.3.4 Development plan

A future plan for the sewerage system will be created based on the city/rural master plan and the development plan for the whole of Qeshm Island, including both the urbanized and rural areas. The sewage flow will be calculated based on i) the planned population and ii) the designated water consumption. The planned population and designated water consumption will be estimated based on the city/rural master plan and the development plan. It should be noted that sewage problems may occur when the water supply system is expanded to rural areas due to the leaching capability of pits. The overall cause in such a scenario will be the fact that the amount of water consumption will increase compared to that of the water tanker service.

(1) Urban sewerage system

It is necessary to develop a modern centralized sewerage system in a densely populated and urbanized area to improve the sanitary condition, living environment and water environment. A sewerage development plan has been examined in three cities of Qeshm, Souza and Dargahan. The current status of each sewerage development plan is as follows;

Qeshm Sewerage Development Plan

The overall sewerage plan for Qeshm City indicates that by 2025, there will be a total sewer network length of 285 km, which will cover approximately 1,000 ha of the sewage treatment area. The total sewage flow of the overall sewerage plan of Qeshm City is estimated to reach 6,000 m^3/day, which will be treated by two STPs, each with a capacity of 3,000 m^3/day.

The Qeshm sewerage system already covers almost 75% of the planned sewage treatment area, while the total existing capacity of the two STPs in operation is 3,000 m^3/day for the total sewage flow, half of the overall sewerage plan's 6,000 m^3/day. The Qeshm sewerage system has been expanding in terms of the treatment area, along with sewer construction, as well as in terms of the capacities of the two STPs, with a total increase of 2,000 m^3/day under construction.

Souza Sewerage Development Plan

The Department of Urbanism and Architecture of the QFZO has stated that the draft of the Souza Master Plan is not yet approved and that the Souza Sewerage Development Plan is not included in the draft. The Souza Sewerage Development Plan should be considered after authorization of the Souza Master Plan. Therefore, the development of Souza's sewerage system is premature.

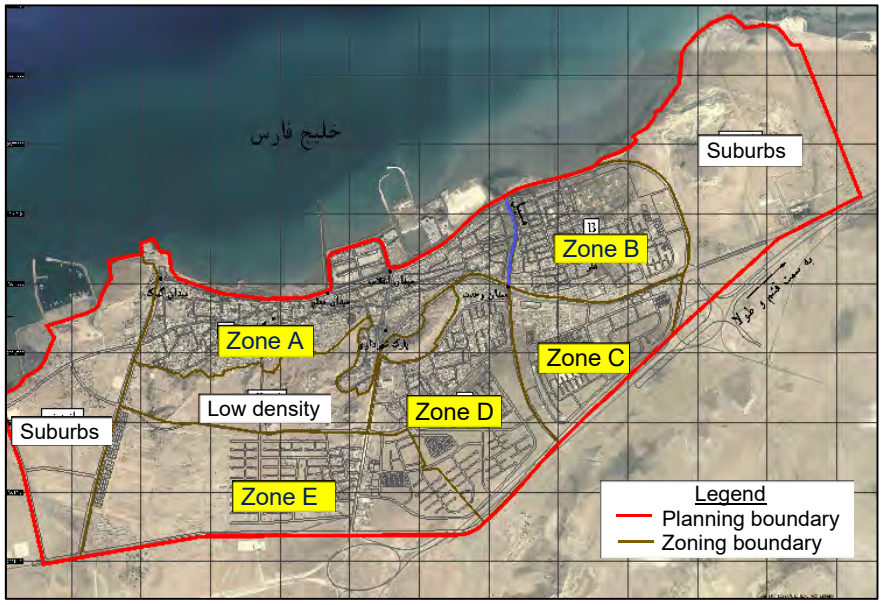
Dargahan Sewerage Development Plan

There is a need to develop a sewerage system in the areas of Dargahan City and Holor Village for the

increasingly dense population and sanitary/odor problems caused by high underground water levels. The HUWWC has already concluded the Dargahan Sewerage Development Study in respect of the areas of Dargahan City, Holor Village and Azad University covering 1,073 ha, for which the population is expected to grow to 37,400 by 2041; part of the interceptor was constructed in 2013 and 2014.

Thus, Dargahan's sewerage development is the first priority for the urban sewerage systems in the above three cities.

The sewerage development plan for Dargahan City and Holor Village prepared by HUWWC is shown in the following figure and table. The planning boundary and sewerage zoning areas (Zone A to E) are shown in Figure 7.3.5, and the area and population of sewerage development plan are shown in Table 7.3.5. Zones A, D and E belong to Dargahan City, while Zones B and C belong to Holor village.



Source: Dargahan Sewerage Development Study

Figure 7.3.5 Dargahan Sewerage Development Area

Table 7.3.5 Dargahan Sewerage Development Plan

Zone name	Area (ha)	Population in 2041 (people)
Zone A (Dargahan City)	150	12,100
Zone B (Holor Village)	106	6,900
Zone C (Holor Village)	85	5,500
Zone D (Dargahan City)	125	6,800
Zone E (Dargahan City)	201	6,100
Sewerage Zones' Total	667	37,400
Suburbs & Low population density	406	-
Total	1,073	37,400

Source: Dargahan Sewerage Development Study

(2) Rural sewerage system

1) Framework of the rural sewerage system

The outline of the rural sewerage system is shown in Figure 7.3.4 above. In this system, domestic sewage (which includes both black water and greywater) is collected from each house and conveyed to a centralized STP by a sewer network. The sewage is treated in the STP, with the treated sewage being discharged or reused. The sewage sludge generated in the STP is generally taken to the centralized sludge treatment facility.

Either a centralized or decentralized treatment system in rural areas shall be adopted by consideration of various factors, such as beneficiaries, investment cost and other incentives. Such factors shall be raised in consideration of the development priority classifications regarding rural sewerage development. In general, it is necessary to develop a centralized sewerage system in densely populated villages to achieve improvements in sanitary conditions, the living environment and the water environment.

The factors to be considered for rural sewerage development are described as follows;

- Cost benefit comparison: comparison of beneficiaries (population) and investment cost,
- Effect of development: improvements in sanitary condition, living and water environment,
- Application of treated sewage effluent,
- Timing and period of development,
- Needs and mindset of villagers and;
- Characteristics of the village: infiltration capacity of soil, availability of STP site and so on,

2) Development of the rural sewerage system

The rural sewerage system will be developed based on the rural development plan for 57 villages on Qeshm and Hangom managed by Bonyad Maskan. In actuality, the rural development plan and/or land use plan for 47 villages was under preparation from 2002 to 2014 by the Bonyad Maskan and QFZO; however, more than half of those plans were made before 2005 and are almost useless for sewerage development.

Therefore, the development plan for rural sewerage systems were formulated based on the available land use maps as well as the present and future population data for 2016 and 2036. Table 7.3.6 shows the formulated rural sewerage systems based on the expected population in 2036.

- The average daily flow is calculated from domestic sewage flow based on the unit domestic sewage flow which is assumed to be 150 Lpcd (liter per capita per day) and commercial/institutional sewage flow to be 20% of domestic sewage flow.
- The sewer length is calculated based on the sewer density which is assumed to be 140m/ha at the village with population 500 or more and 100 m/ha with population under 500. The sewer densities are calculated statistically from the measurement of tentative sewer network of 18 model villages.
- Finally, rough tentative cost estimation is listed in the Table 7.3.6, showing the initial cost for sewerage development of 57 villages including sewer cost and STP cost, which are estimated by quoting performance of Qeshm Sewerage. In addition, the cost performance of sewerage development among 57 villages can be compared with the initial cost per capita.

Table 7.3.6 Formulation of Rural Sewerage System

SN	Rural District	Village Name	Sewer District Area	Future Population (2036)	Population Density (2036)	Average Flow (2036)			Daily Peak	Sewer Length	Sewer Density	Sewer Cost	STP Cost (Average)	Total Initial Cost	Total Initial Cost per Capita
						Domestic	Commercial Institutional *(20%)	Total							
			(ha)	(person)	(Pers/ha)	(m3/d)	(m3/d)	(m3/d)	(m3/d)	(m)	(m/ha)	(Million USD)	(Million USD)	(Million USD)	(103USD/cap)
	SHAHAB DISTRICT														
	Doulab Rural District														
1	DOU-01	Baseidou	109.3	3,405	31	511	102	613	920	15,298	140	3.06	1.18	4.24	1.25
2	DOU-02	Derakou	23.7	838	35	126	25	151	227	3,323	140	0.66	0.44	1.11	1.32
3	DOU-03	Doustakou	30.2	995	33	149	30	179	269	4,233	140	0.85	0.49	1.33	1.34
4	DOU-04	Kani	23.8	429	18	64	13	77	116	2,383	100	0.48	0.32	0.80	1.86
5	DOU-05	Konar Sia	20.5	497	24	75	15	90	135	2,054	100	0.41	0.34	0.75	1.52
6	DOU-06	Gouri	41.5	1,283	31	192	38	230	345	5,809	140	1.16	0.57	1.73	1.35
7	DOU-07	Moradi	21.2	574	27	86	17	103	155	2,967	140	0.59	0.36	0.96	1.67
8	DOU-08	Tomgez	16.6	332	20	50	10	60	90	1,660	100	0.33	0.30	0.63	1.89
9	DOU-09	West Chahou	30.2	783	26	117	23	140	210	4,227	140	0.85	0.42	1.27	1.62
10	DOU-10	East Chahou	24.7	1,376	56	206	41	247	371	3,458	140	0.69	0.59	1.29	0.93
11	DOU-11	Doulab (Doulow)	84.7	2,243	26	336	67	403	605	11,865	140	2.37	0.84	3.22	1.43
12	DOU-12	Sar Rig	78.2	2,236	29	335	67	402	603	10,944	140	2.19	0.84	3.03	1.36
13	DOU-13	Aysheh-Abad	6.3	149	24	22	4	26	39	627	100	0.13	0.24	0.37	2.46
	Subtotal		511.0	15,140		2,269	452	2,721	4,085						
	Souza Rural District														
14	SOU-01	Shibderaz	44.6	802	18	120	24	144	216	6,238	140	1.25	0.43	1.68	2.09
15	SOU-02	Mesen	103.6	3,240	31	486	97	583	875	12,323	119	2.46	1.13	3.60	1.11
16	SOU-03	Borka Khelaf	26.2	528	20	79	16	95	143	3,664	140	0.73	0.35	1.08	2.05
17	SOU-04	Rigoo	39.9	718	18	108	22	130	195	5,584	140	1.12	0.41	1.52	2.12
18	SOU-05	Zirong	78.1	2,088	27	313	63	376	564	10,940	140	2.19	0.80	2.99	1.43
19	SOU-06	Nakhl Gol	21.4	454	21	68	14	82	123	2,139	100	0.43	0.33	0.76	1.67
20	SOU-07	Direston	120.2	2,819	23	423	85	508	762	19,348	161	3.87	1.01	4.88	1.73
	Subtotal		433.9	10,649		1,597	321	1,918	2,878						
	Selakh Rural District														
21	SAL-01	Dehkhoda	29.7	945	32	142	28	170	255	4,156	140	0.83	0.47	1.30	1.38

SN	Rural District	Village Name	Sewer District Area	Future Population (2036)	Population Density (2036)	Average Flow (2036)			Daily Peak	Sewer Length	Sewer Density	Sewer Cost	STP Cost (Average)	Total Initial Cost	Total Initial Cost per Capita
						Domestic	Commercial Institutional *(20%)	Total							
			(ha)	(person)	(Pers/ha)	(m3/d)	(m3/d)	(m3/d)	(m3/d)	(m)	(m/ha)	(Million USD)	(Million USD)	(Million USD)	(103USD/cap)
22	SAL-02	Sohli	80.4	2,806	35	421	84	505	758	11,254	140	2.25	1.01	3.26	1.16
23	SAL-03	Haft Rangou	46.9	1,078	23	162	32	194	291	5,532	118	1.11	0.51	1.62	1.50
24	SAL-04	Dourbani	30.8	1,035	34	155	31	186	279	4,560	148	0.91	0.50	1.41	1.36
25	SAL-05	Gomboron	35.7	866	24	130	26	156	234	4,320	121	0.86	0.45	1.31	1.52
26	SAL-06	Gouron	59.1	2,210	37	332	66	398	597	7,504	127	1.50	0.84	2.34	1.06
27	SAL-07	Melki	20.4	408	20	61	12	73	110	2,040	100	0.41	0.32	0.72	1.78
28	SAL-08	Tabl (Towl)	182.1	6,374	35	956	191	1,147	1,721	25,496	140	5.10	1.98	7.08	1.11
29	SAL-09	Selakh	113.6	4,800	42	720	144	864	1,296	16,022	141	3.20	1.58	4.79	1.00
30	SAL-10	Noghasha	31.6	474	15	71	14	85	128	3,666	116	0.73	0.34	1.07	2.25
	Subtotal		630.3	20,996		3,150	628	3,778	5,669						
	Hangom Rural District														
31	HEN-01	New Hangom	53.2	1,064	20	160	32	192	288	7,448	140	1.49	0.51	2.00	1.88
32	HEN-02	Old Hangom	9.8	25	3	4	1	5	8	980	100	.0.20	0.21	0.40	16.14
	Subtotal		63.0	1,089		164	33	197	296						
	Sub Total		1,638.2	47,874		7,180	1,436	8,616	12,924						
	CENTRAL DISTRICT														
	Howmeh Rural District														
33	HOW-01	Ramchah	129.1	4,909	38	736	147	883	1,325	18,073	140	3.61	1.61	5.23	1.06
34	HOW-02	Tourgon	16.5	124	8	19	4	23	35	1,650	100	0.33	0.24	0.57	4.57
35	HOW-03	Kouvei	158.5	5,547	35	832	166	998	1,497	25,358	160	5.07	1.80	6.87	1.24
36	HOW-04	Giadon	148.2	4,545	31	682	136	818	1,227	20,752	140	4.15	1.51	5.66	1.25
37	HOW-05	Tonbon	86.2	1,688	20	253	51	304	456	12,062	140	2.41	0.69	3.10	1.84
38	HOW-06	Kovarzin	81.7	2,552	31	383	77	460	690	15,352	188	3.07	0.94	4.01	1.57
39	HOW-07	Laft	206.0	7,210	35	1,082	216	1,298	1,947	28,840	140	5.77	2.16	7.93	1.10
40	HOW-08	Holor	216.8	9,451	44	1,418	284	1,702	2,553	30,354	140	6.07	2.56	8.63	0.91
41	HOW-09	Hamiri	38.6	221	6	33	7	40	60	3,860	100	0.77	0.26	1.04	4.69
42	HOW-10	Defari	37.6	1,117	30	168	34	202	303	5,261	140	1.05	0.52	1.58	1.41
43	HOW-11	Towla	272.2	11,251	41	1,688	338	2,026	3,039	38,105	140	7.62	2.82	10.44	0.93
44	HOW-12	Kabeli	25.3	59	2	9	2	11	17	2,530	100	0.51	0.22	0.72	12.26

SN	Rural District	Village Name	Sewer District Area	Future Population (2036)	Population Density (2036)	Average Flow (2036)			Daily Peak	Sewer Length	Sewer Density	Sewer Cost	STP Cost (Average)	Total Initial Cost	Total Initial Cost per Capita
						Domestic	Commercial Institutional *(20%)	Total							
			(ha)	(person)	(Pers/ha)	(m3/d)	(m3/d)	(m3/d)	(m3/d)	(m)	(m/ha)	(Million USD)	(Million USD)	(Million USD)	(103USD/cap)
	Subtotal		1,416.6	48,674		7,303	1,462	8,765	13,149						
	Ramkon Rural District														
45	RAM-01	Bangali	7.0	140	20	21	4	25	38	700	100	0.14	0.24	0.38	2.71
46	RAM-02	Jijiyon	40.9	1,044	26	157	31	188	282	5,730	140	1.15	0.50	1.65	1.58
47	RAM-03	Gorvodon	70.9	1,579	22	237	47	284	426	9,928	140	1.99	0.65	2.64	1.67
48	RAM-04	Peyposht	102.5	3,477	34	522	104	626	939	14,959	146	2.99	1.20	4.19	1.21
49	RAM-05	Khaladin	57.1	2,003	35	300	60	360	540	7,995	140	1.60	0.78	2.37	1.19
50	RAM-06	Zeinabi	78.8	2,256	29	338	68	406	609	11,030	140	2.21	0.85	3.06	1.35
51	RAM-07	Karavon	43.0	1,436	33	215	43	258	387	6,019	140	1.20	0.61	1.82	1.26
52	RAM-08	Kousha	77.1	3,178	41	477	95	572	858	15,727	204	3.15	1.12	4.26	1.34
53	RAM-09	Kardova	18.5	277	15	42	8	50	75	1,847	100	0.37	0.28	0.65	2.34
54	RAM-10	Bagh Bala	21.8	482	22	72	14	86	129	2,180	100	0.44	0.34	0.77	1.60
55	RAM-11	Tomsenati	9.5	489	51	73	15	88	132	954	100	0.19	0.34	0.53	1.09
56	RAM-12	Tourion	143.7	3,983	28	597	119	716	1,074	25,151	175	5.03	1.35	6.38	1.60
57	RAM-13	Ramkon	282.0	9,686	34	1,453	291	1,744	2,616	39,480	140	7.90	2.60	10.49	1.08
	Subtotal		952.8	30,030		4,483	895	5,378	8,067						
	Sub Total		2,369.4	78,704		11,786	2,357	14,143	21,216						
	Total		4,007.6	126,578		18,966	3,793	22,759	34,140						

Peak factor (Daily peak/Average)	1.5	Assumed sewer density***	140	m/ha for population 500 persons or larger	
Unit flow (lpcd**)	150		100	m/ha for population smaller than 500 persons	
Commercial/institutional (%)	20	Sewer cost	200	USD/m	Qeshm Sewerage
		STP cost	2,000	USD/m^3/d at 500m^3/d	ditto
			1,800	USD/m^3/d at 1,000m^3/d	ditto
			1,600	USD/m^3/d at 1,500m^3/d	assumed

Note: * Commercial/Institutional sewage flow is 20% of domestic sewage flow.
** Lpcd is "liters per capita per day".
*** The sewer densities are calculated statistically from tentative sewer network of 18 model villages.
Source: JICA Project Team

(3) Industrial wastewater treatment control

Quantities of industrial wastewater will increase in the future as Qeshm Island's economic development continues. Industrial wastewater in the Industrial Park should be treated by an individual or collective WWTP in compliance with the criteria for discharge into public water bodies. Therefore, strengthening the monitoring system for industrial wastewater is strongly urged. Specifically, in accordance with the increase in the number of factories, it is required to increase the number of DOE staff, attain complete reporting obligations, and strengthen the authority such as on-site inspection etc.

Industrial wastewater in the sewage treatment area can be discharged into the sewer under the dedicated "Discharge Criteria to the Urban Sewerage System", then treated at the STP. Currently, there are no monitored factories in the service area of the Qeshm sewage treatment system.

Water recycling is promoted in the manufacturing process of the factory, while reuse of treated wastewater is also recommended in the factory.

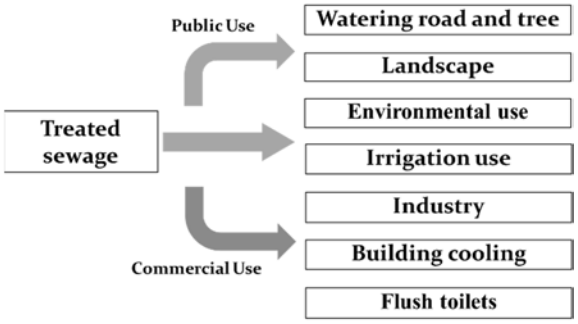
(4) Reuse of treated sewage effluent (TSE)

TSE is a precious water resource, particularly in arid regions. Demand for TSE will increase with the progress of urbanization on Qeshm Island. The entirety of TSE production is already being used for watering the street trees and green spaces in the Qeshm City.

1) Reuse of TSE

TSE can be used for public, agricultural, industrial and other non-potable purposes, as per below (refer to Figure 7.3.6):

- Public use: watering for street trees/public parks, street cleaning, landscaping, groundwater recharging and river flow augmentation.
- Commercial use: irrigation for agriculture, industrial water, cooling water for buildings and non-potable uses, e.g., toilet flushing, household gardening.



Source: JICA Project Team

Figure 7.3.6 Reuse of Treated Sewage Effluent

2) Regulation of water quality for TSE reuse

Relating to the reuse of TSE, it is necessary to regulate the water quality of TSE and to comply with the Wastewater Discharge Standards for Discharge into Surface Waters (a), Discharge into Absorption Wells (b), and Irrigation and Agricultural Use (c), respectively, depending on specific purpose of reuse (refer to Table 7.3.4). Which set of standards are applicable for each classification of TSE reuse is shown below.

Table 7.3.7 Wastewater Discharge Standards applied to each Classification of Reuse

Classification of TSE reuse	Wastewater Discharge Standards to apply
Watering for street trees/public parks (green areas)	(c) Irrigation and agricultural use
Landscaping (fountain, pond, stream in public park)	(b) and/or (c)
Groundwater recharging	(b) Discharge into absorption wells
River flow augmentation	(a) Discharge to surface waters
Irrigation for agriculture (farm areas)	(c) Irrigation and agricultural use
Irrigation for orchard (fruit gardens)	(c) Irrigation and agricultural use
Industrial water	(a) Discharge to surface waters
Cooling water of buildings	(a) Discharge to surface waters
Non-potable use for toilet flush	(a) Discharge to surface waters
Non-potable use for household gardening	(c) Irrigation and agricultural use

Source: JICA Project Team, Hearing from DOE, QFZO

In cases of reuse for greenery or farm areas, the standards regarding irrigation and agricultural use (c) are applied; for industrial water or toilet flushing in buildings, the standards regarding discharge into surface waters (a) are applied.

- Health effect index (2): total intestinal coliform, total coliform
- Groundwater contamination index (3): NH4, NO2, NO3
- Treatment capability index (6): temperature, pH, BOD5, COD, TSS, DO
- Ditto complementary index (4): oil, ABS, turbidity, color
- Treatment capability for reuse index (5): Cl, TDS, -Cl, SO_4, phosphate

For certain purposes, high-quality TSE are sometimes required; in other cases, the influent quality may be regulated. In the case of commercial use: i) technical, ii) customer, iii) financial and iv) commercial/contractual investigations are required.

3) Investigation for commercial use of TSE

In the case of commercial uses, the following investigations are required:

- Technical: Reuse target, water quality target, planning reuse system, capital and O&M cost
- Market/Customer: Scope of users, initial and future demand
- Financial: Financial source, user charge, allocation to owner/operator
- Institutional/Contractual: Relationship among owners, operators and customers, risk allocation, regulatory framework

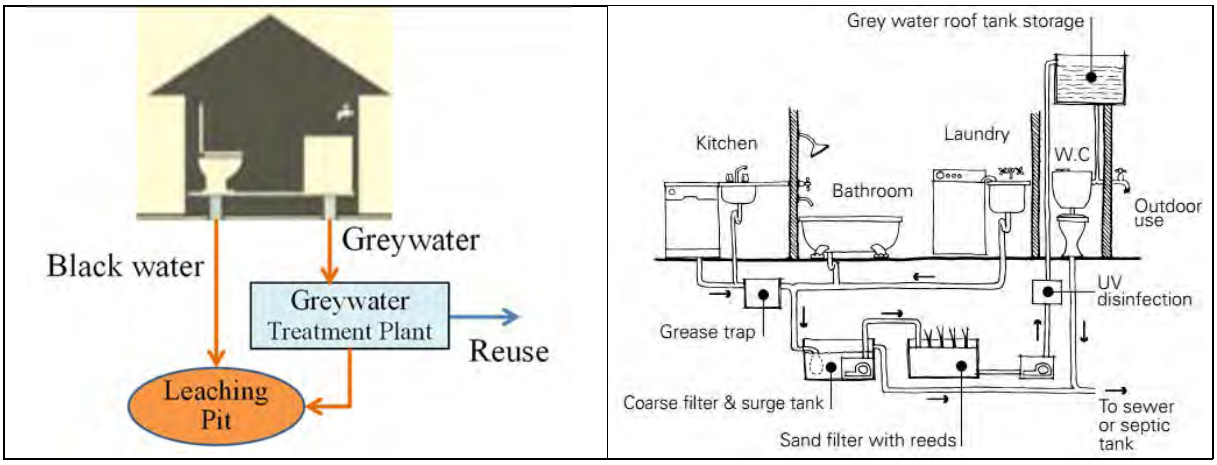
4) Treated greywater reuse in rural area

The reuse of treated greywater is more widely accepted than the reuse of TSE for religious reasons in Qeshm and Hangom Islands. It may become more prevalent in rural areas than in urbanized areas. Here, the greywater refers to all domestic wastewater that is discharged from a house, excluding black water (toilet water). This includes water from showers, bathtubs, sinks, kitchen, dishwashers, laundry tubs, and washing machines.

There are two types of "Treated Greywater Reuse", one is on-site reuse and the other is off-site reuse, described as follows:

- On-site reuse: greywater is recycled with treatment or without treatment inside the house.
- Off-site reuse: greywater from several houses is collected by pipes and treated in a treatment plant outside the house, and then recycled under the "Sewage Discharge Standard" established by DOE.

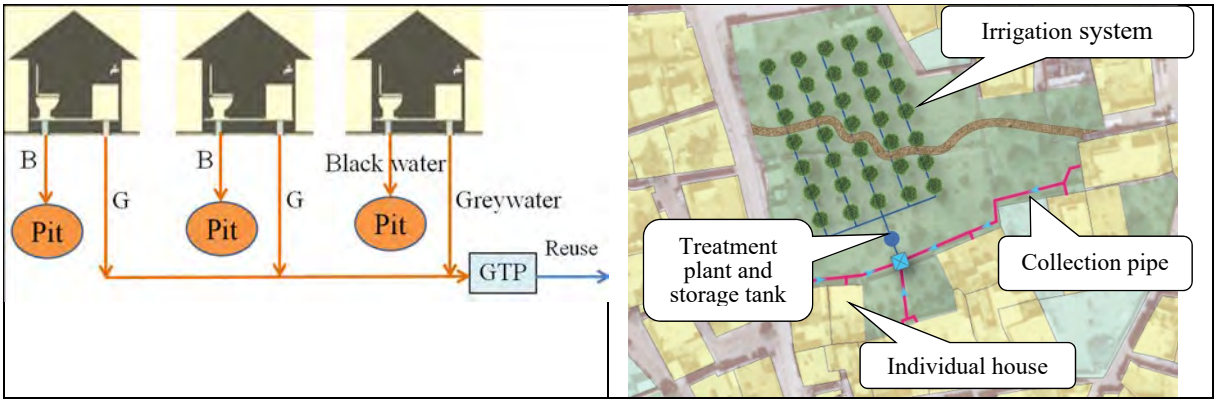
The both images of on-site and off-site treated greywater reuse system are shown in Figure 7.3.7 and 7.3.8, respectively. In this case the off-site reuse system is similar to the rural sewerage system in Figure 7.3.4, but the black water is still treated at the leaching pits in individual houses.



Source: JICA Project Team

Source: Commonwealth of Australia (2005)

Figure 7.3.7 Image of On-site Treated Greywater Reuse System



Source: JICA Project Team

Figure 7.3.8 Image of Off-site Treated Greywater Reuse System

5) Demand for treated greywater reuse in rural area

Demand survey on the treated greywater reuse in villages was conducted in five villages by means of interview method, as follows:

- Objectives of the survey: to grasp the demand for treated greywater reuse in rural area
- Survey area: five villages of Direston, Derakou, Giadon, Bagh Bala and Ramkon which were chosen from the viewpoints of water supply situation, reuse potential, population size, etc.
- Interviewees: ten villagers in total per one village including the Mayer and the representative of Council

The levels of demand for the treated greywater reuse vary among these five villages, as shown in Table 7.3.8, which display the results of the demand survey. From this survey, a weak demand for the treated greywater reuse was recognized for which the major reuse is garden and agriculture irrigation. Although the Direston and Derakou have displayed relatively strong demand compared to other villages, actual demand for development of treated greywater reuse system is low in Direston and there is almost no willingness to pay for treated greywater reuse in Derakou. In addition, almost all villagers in the five villages chose the answers, "Pay if less than water tariff" or "Do not pay" for the question of "Willingness to pay for treated greywater reuse".

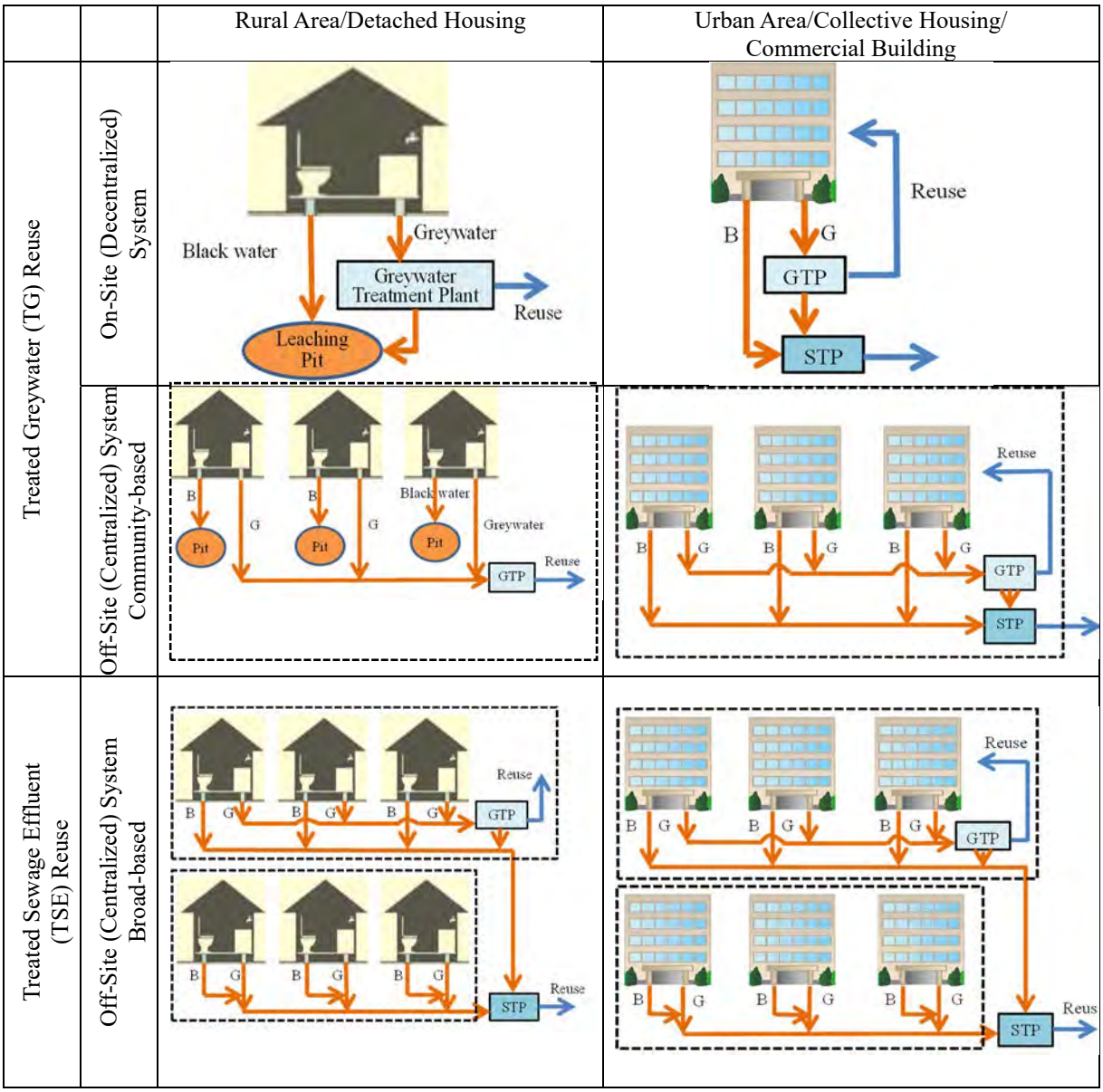
Table 7.3.8 Demand Survey on Treated Greywater Reuse

Name of Village	Direston	Derakou	Giadon	Bagh Bala	Ramkon
Population (people)	1,764	780	3,135	300	4,500
Water supply (%)	100	0	100	100	100
1. Demand on GWR (people)					
Strong/Modest/Weak demand	5/0/2	6/0/3	0/2/4	0/0/3	0/0/5
No demand	3	1	4	7	5
2. Interest in GWR system (ppl)					
Strong/Modest/Weak demand	4/0/2	6/0/2	1/3/2	1/4/2	2/3/3
No demand	4	2	4	3	2
3. Development of GWR system (ppl)					
Actual demand/ Future possibility	1/5	5/5	2/8	2/8	2/8
No demand	4	0	0	0	0
4. Willingness to pay for GWR (ppl)					
Pay even more than water tariff	1	0	0	3	1
Pay if the same as water tariff	0	1	0	0	1
Pay if less than water tariff	5	0	8	2	4
Do not pay	4	9	2	5	4

Note: GWR: Greywater Reuse
Source: JICA Project Team

6) Reuse pattern of treated sewage effluent and treated greywater

The reuse of treated sewage effluent (TSE) is more practical and economical than treated greywater (TG) reuse in the areas where STPs are already developed, this is because TSE can be easily achieved with some additional treatment of filtration and disinfection within a STP. On the other hand, TG reuse is discussed above and is more readily-accepted than TSE reuse in rural areas (due to religious reasons) where no sewerage systems exist yet. Figure 7.3.9 shows typical TSE and TG reuse patterns related to sewerage systems divided into in rural areas and urban areas. On-site reuse of greywater can be performed individually at detached houses with or without in-house treatment; commercial reuses of greywater can be done in collective housing/commercial buildings in urban areas. Off-site greywater reuses can be carried out at the individual level in a group of detached houses (community-based) within a rural area for agricultural irrigation use; while a group of (community-based) collective housing/commercial buildings in urban areas can derive commercial reuses. On the other hand, off-site reuses of TSE can be carried out for the entire sewerage service area in the rural or urban area for public and/or commercial use.

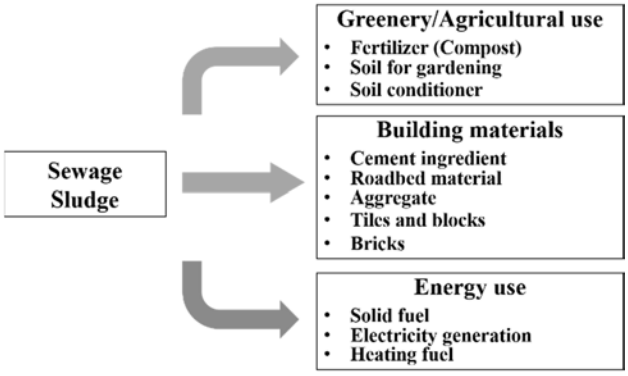


Note: B: Black water, G: Greywater; TSE: Treated Sewage Effluent, TG: Treated Greywater, STP: Sewage Treatment Plant, GTP: Greywater Treatment Plant
Source: JICA Project Team

Figure 7.3.9 Typical Reuse Pattern of Treated Sewage Effluent and Treated Greywater

(5) Sewage sludge disposal/utilization

The amount of sewage sludge will increase along with the continued progression of sewerage development. It is required for the centralized sludge treatment plants to treat and dispose of/utilize sewage sludge properly by means of i) a drying bed or ii) a composting bed. For the disposal or utilization of sewage sludge, a disposal site for sewage sludge is necessary, in addition to an investigation into sewage sludge utilization/recycling for greenery and/or



Source: JICA Project Team

Figure 7.3.10 Sewage Sludge Disposal/ Utilization

agriculture, such as i) soil conditioners or ii) fertilizers used in regulatory compliance (refer to Figure 7.3.10).

7.3.5 Proposed project and cost estimates

(1) Urban sewerage system

The sewerage development covering Dargahan City and Holor Village is the first priority for the urban sewerage systems on Qeshm Island. The Dargahan Sewerage Development Study which has been already concluded by the HUWWC with respect to the areas of Dargahan City, Holor Village and Azad University. The Dargahan Sewerage Development Plan is described in the Development Study, below:

1) Planning frame in the Development Plan

- Target year: 2016 to 2041 (Islamic calendar 1395 to 1420)
- Planning area: 1,073 ha set based on the city plan (refer to Figure 7.3.5 and Table 7.3.5)
- Design population and Design sewage flow: refer to Table 7.3.9
- Design influent and effluent quality: refer to Table 7.3.10

Table 7.3.9 Design Population and Daily Average Flow

	2016	2041
Design population	19,300 people	37,400 people
Sewage generation per capita	123 Lpcd	148 Lpcd
Sewage flow per capita*	135 Lpcd	163 Lpcd
Design sewage flow (Daily average)	2,606 m^3/d	6,097 m^3/d

Note: Sewage flow per capita is estimated from generated sewage, leakage (-10%) and inflow (+20%)
Source: Dargahan Sewerage Development Study

Table 7.3.10 Design Influent and Effluent Quality

	Influent	Effluent*
PH	-	6-9
BOD_5	208 mg/l	≤30 mg/l
TSS	234 mg/l	≤30 mg/l
COD	374 mg/l	-
TN	34 mg/l	-
TP	8 mg/l	-
E.coli	-	≤200 (number in 100 ml)
Chlorine	-	≤1 mg/l

Note: Effluent quality is set in consideration of the standards of EPA, WHO and DOE of Iran.
Source: Dargahan Sewerage Development Study

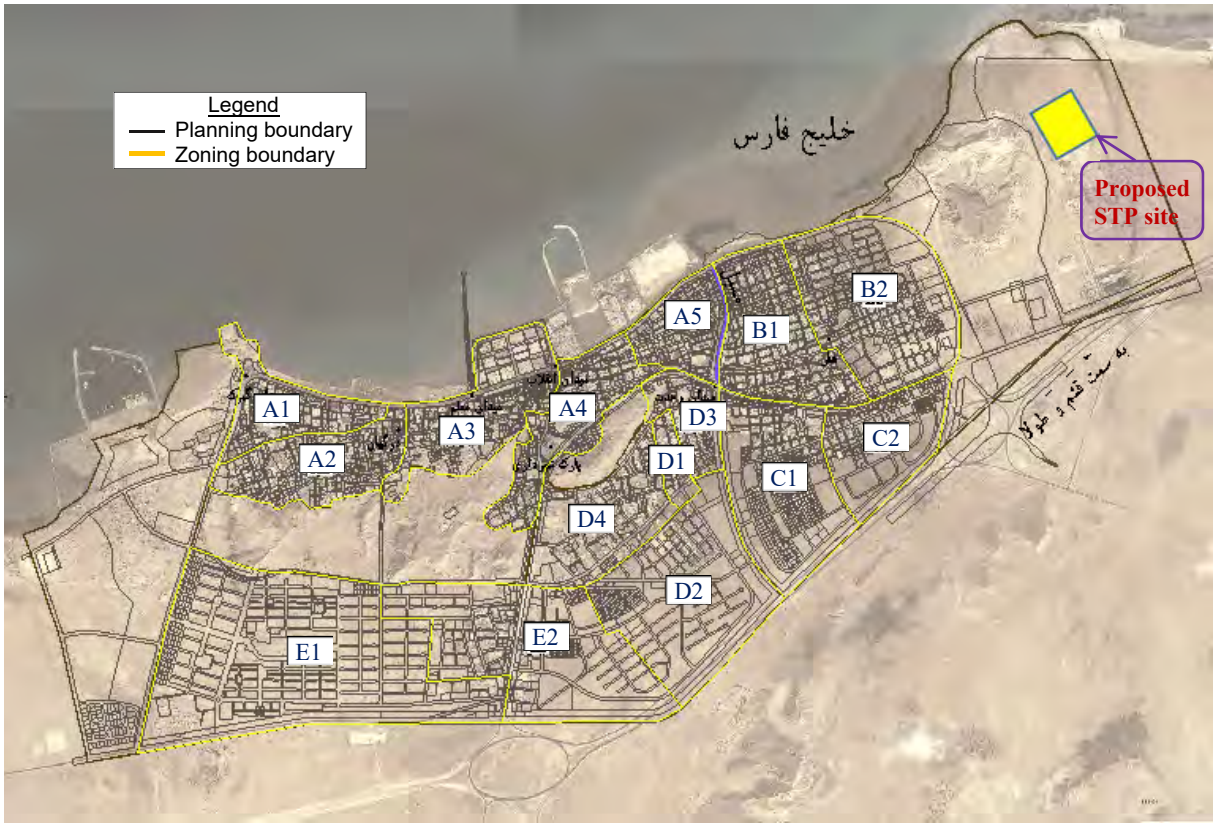
2) Outline of the Dargahan Sewerage Development Plan

The overall sewerage development plan for Dargahan City and Holor Village is shown in the above Figure 7.3.5, with the planning boundary and sewerage zoning areas (Zone A to E). Also, the Table 7.3.5 shows the area and population of total and each zone in the overall plan.

A more detailed Dargahan Sewerage Development Plan is shown in the following figure and table. Figure 7.3.11 shows several subzones which each zone (Zone A to E) is divided into, and Table 7.3.11 shows population and average flow rate for overall sewerage development area (667.3 ha) in 2021 and 2041 by each subzone with the area and the sewer length. The Total length of the sewer network is 115.5 km, while the average daily sewage flow is estimated at 6,097 m^3/d for 37,400 people.

3) STP site proposed in the Development Plan

Three candidate locations were nominated for the site of STP at the eastern end of the urbanized area of Dargahan and Holor, and were compared using several effective parameters such as required length of transferring sewer lines and discharge pipes, access to the existing road and energy supply lines, distance from residential area, observation of the prevailing wind, land prices, possibility of land acquisition, land availability for future expansion, and so on. Finally, a candidate location was proposed as the STP site, which is located just beyond a hilly rock quarry at the eastern end of the urbanized area (refer to Figure 7.3.11).



Source: Dargahan Sewerage Development Study

Figure 7.3.11 Dargahan Sewerage Development Area and the Proposed Location of STP

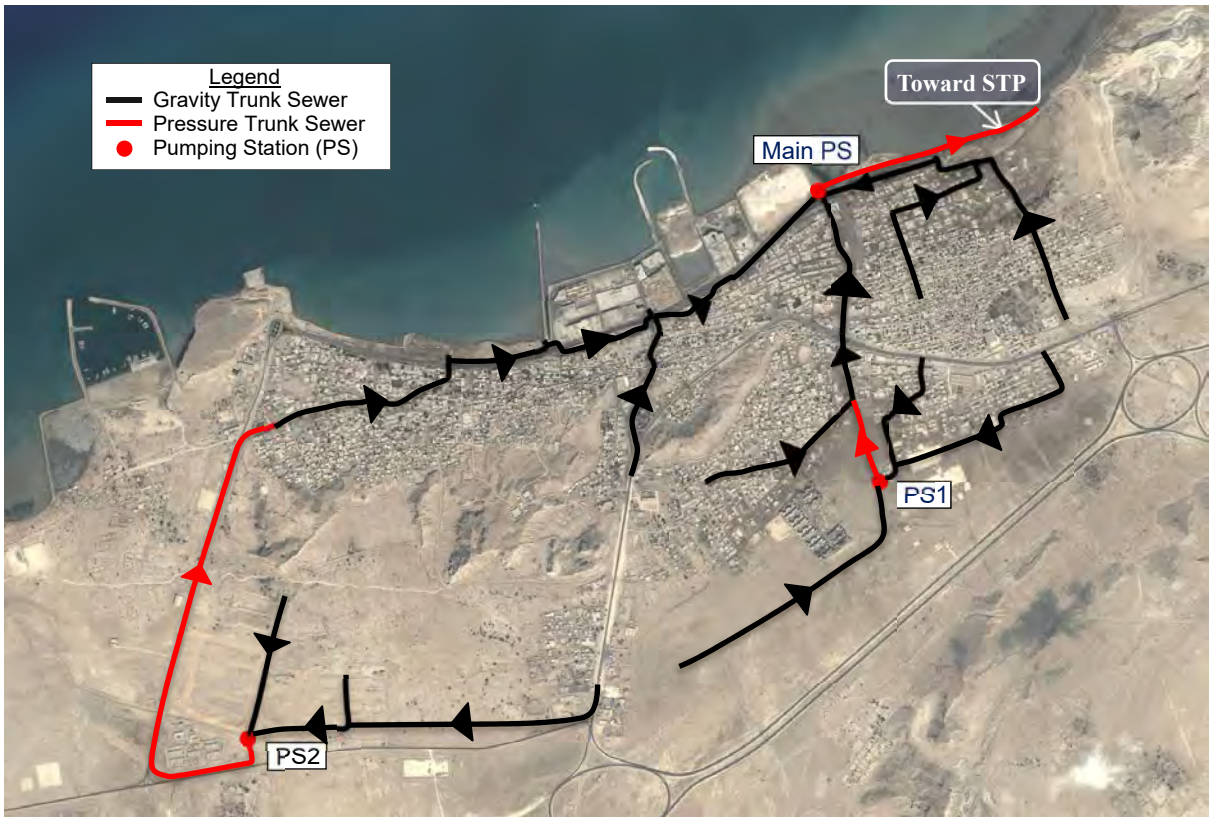
Table 7.3.11 Overall Development Plan of Dargahan Sewerage System

Zone Name		Area (ha)	Population (people)		Average flow rate (m^3/d)		Length of sewer (m)
			2021	2041	2021	2041	
A	A1	25	1,300	2,000	173	330	5,000
	A2	33	1,700	2,700	228	436	8,000
	A3	40	2,000	3,200	276	528	9,500
	A4	31	1,600	2,500	214	409	7,100
	A5	21	1,100	1,700	145	277	5,800
Sub-T (A1-5)		150	7,700	12,100	1,036	1,980	35,400
B	B1	43	1,800	2,800	255	456	13,200
	B2	63	2,700	4,100	374	667	11,400
Sub-T (B1-2)		106	4,500	6,900	629	1,123	24,600
C	C1	52	2,200	3,400	309	551	8,600
	C2	33	1,400	2,100	196	350	5,800
Sub-T (C1-2)		85	3,600	5,500	505	901	14,400
D	D1	6.5	300	500	45	86	1,100
	D2	65.5	700	2,000	90	320	5,700
	D3	15.2	800	1,200	105	201	4,300
	D4	38.1	1,900	3,100	263	503	4,400
Sub-T (D1-4)		125.3	3,700	6,800	503	1,110	15,500
E	E1	126	1,300	3,800	174	616	18,000
	E2	75	800	2,300	104	367	7,600
Sub-T (E1-2)		201	2,100	6,100	278	983	25,600
Total		667.3	21,600	37,400	2,951	6,097	115,500

Note: Sewage flow per capita in 2021: 136.6 Lpcd = 2,951m^3/d÷21,600 people
Sewage flow per capita in 2041: 163.0 Lpcd = 6,097m^3/d÷37,400 people
Source: Dargahan Sewerage Development Study

4) Sewer network proposed in the Development Plan

Four possible options for the sewage collection network in Dargahan Sewerage Development Area were considered from the perspectives of topography, ground elevation and location of the proposed STP site, and compared from both technical and economical points of view. The construction condition is considered from the technical view, evaluating aspects such as high groundwater level, unstable soil condition and sewer depth; economical comparisons were also conducted among the four options. As a result, the following sewer network plan was proposed for sewage collection network in Dargahan Sewerage Development Area as shown in Figure 7.3.12.



Source: Dargahan Sewerage Development Study

Figure 7.3.12 Proposed Trunk Sewer Network with Pumping Station

5) Stage development plan of Dargahan Sewerage System

The planned area of Dargahan Sewerage System was divided into Zones A to E. Zones A and B are inclined toward the sea (north side), whereas Zones C, D and E are inclined to the opposite side from the sea (south side) (refer to Figure 7.3.11 and 12). In addition, Zones A and B have higher population densities than those of Zones C and E. Moreover, the northern part of Zone D (Zone D1, D3 and the north side of D4) has the same high population density as Zones A and B, and the sewage generated in the northern part of Zone D can be collected under gravity flow. Thus, Zones A, B and the northern part of Zone D were selected as initial stage development areas.

Having established this, the three stage development plan including "Urgent Plan" for the initial stage, "Alternative Plan" for the mid stage and "Overall Plan" for the final stage is shown in Table 7.3.12.

In addition, project cost estimation for the stage development plan of Dargahan Sewerage System including side cost is shown in Table 7.3.13,

Table 7.3.12 Stage Development Plan of Dargahan Sewerage System

	Urgent Plan (Initial Stage)	Alternative Plan (Mid Stage)	Overall Plan (Final Stage)
Target year of plan	2021	2031	2041
Population for overall area (667.3 ha)	21,600 people	26,000 people	37,400 people
Target area to develop	Zone A, B, & Zone D1, D3, north side of D4	Zone A, B, C & Zone D1,D3,D4, north side of D2	Zone A, B, C, D & E
Area the above	293.7 ha	433.6 ha	667.3 ha
Population in the above area	14,100 people	21,800 people	37,400 people
Length of pipe line	67.2 km	87.1 km	115.5 km
Main pumping station	1	1	1
Sub pumping station	0	1	2
Sewage flow per capita	136.6 Lpcd	143 Lpcd	163 Lpcd
Flow rate (for capacity)	1,926 m^3/d (47%)	3,117 m^3/d (77%)	6,097 m^3/d (100%)
Flow line of STP (capacity)	2 (4,066 m^3/d)	2 (4,066 m^3/d)	3 (6,099 m^3/d)

Source: JPT prepared based on the data from the Dargahan Sewerage Development Study

Table 7.3.13 Cost Estimation of the Stage Development Plan

(Unit: Billion IRR)

	Urgent Plan (Initial Stage)	Alternative Plan (Mid Stage)	Overall Plan (Final Stage)
Pipe line	268	348	428
Pumping station	12	19	29
STP	120	120	170
Total (Basic cost)	400	487	627
Side cost	60	60	60
Total (Project cost*)	580	693	875

Note: Project cost = basic cost×30% (indirect cost) + side cost
Side cost includes the cost of second phase studies, supervision, land ownership, geotechnical survey, and procurement/transformation of electric power.
Source: JPT prepared based on the data from the Dargahan Sewerage Development Study

6) Sewage treatment process for Dargahan STP proposed in the Development Plan

Different sewage treatment processes were evaluated from a technical perspective which resulted in the following three sewage treatment processes being nominated as candidates for Dargahan STP, which can comply with design effluent quality in Table 7.3.10;

- Extended Aeration Process
- Oxidation Ditch Process (OD Process)
- Anaerobic-Anoxic-Oxic Process (A2O Process)

The three processes were compared by technical and economical investigations. In the end, the A2O Process was proposed as the optimum sewage treatment process for Dargahan STP.

A2O process is described in the Study, as follows;

- *Pretreatment*: Manual and mechanical screen for trash removal→Aerating grit chamber →
- *Sewage treatment*: Anaerobic tank → Anoxic tank→ Aeration tank → Final sedimentation tank →Chlorination → reuse
- *Sewage sludge treatment*: excess sludge → Mechanical Thickener → Mechanical Dewatering → reuse

7) Policy of treated wastewater reuse and sewage sludge reuse in the Development Plan

How to dispose of wastewater and sludge from STP and ensure compliance with the regulations and

criteria will be the most important factors in choosing the treatment process. According to HUWWC, the proposed process for Dargahan STP must be able to produce wastewater suitable for the irrigation of urban green spaces. As a result, the National DOE standards regarding irrigation of urban green spaces were applied.

In addition, EPA standards with regards to reducing the pathogens and vector attraction by class B were selected for using the sludge of Dargahan STP for agricultural purposes.

(2) Rural sewerage system

1) Selection of priority villages to develop

The rural sewerage systems have been formulated for 57 villages on Qeshm and Hangom Islands, indicated in Table 7.3.6. Nevertheless, the priority focus should be on developing a rural sewerage system for the 57 villages within a limited budget.

Several factors were identified as per below, in consideration of the priority regarding rural sewerage development:

(a) Size of sewerage beneficiary (user population)
(b) Cost-effectiveness (unit development cost)
(c) Incentives for development, including:
- ✓ Improvement of living environment (e.g., in areas without sufficient leaching capacity to introduce a general sanitary system)
- ✓ Contribution to water environment conservation (e.g., for the Hara mangrove area)
- ✓ Contribution to the tourism industry (e.g., traditional culture and coastal sightseeing area)
- ✓ Reuse of treated sewage effluent (e.g., in areas where a sufficient supply of agricultural water is necessary)

The above factors were compared for 57 villages in Table 7.3.14 and evaluated as follows:

(d) Size of sewerage beneficiary (user population): The following 14 villages each have a population of more than 3,000 people in 2036 and also more than 2,000 people in 2016, which have been highlighted in the Table: Baseidou, Mesen, Tabl, Selakh, Ramchah, Kouvei, Giadon, Laft, Holor, Towla, Peyposht, Kousha, Tourion and Ramkon.
(e) Tentative cost-effectiveness (unit development cost): Almost 46 of the 57 villages have an initial cost of less than USD 2,000 per capita highlighted in the Table.
(f) Incentives to develop
- ✓ The following 15 villages have requested improvements to their living environment (based on the socio-economic baseline survey): Mesen, Haft Rangou, Dourbani, Gomboron, Gouron, Melki, Tabl, Selakh, Noghasha, Kouvei, Holor, Peyposht, Kardova, Tourion and Ramkon.
- ✓ Tentatively, the following eight villages appear to contribute to water environment conservation: Dehkhoda, Sohli, Haft Rangou, Dourbani, Melki, Tabl, Kovarzin and Laft.
- ✓ Tentatively, the following four villages appear to contribute to the tourism industry: Shibderaz, Selakh, New Hangom and Laft.
- ✓ Tentatively, the following seven villages appear to have the potential to reuse treated sewage effluent: Direston, Haft Rangou, Khaladin, Zeinabi, Kousha, Tourion and Ramkon.

Finally, the following 10 villages are tentatively listed as the priority villages for developing a rural sewerage system, covering all of the above three factors: Mesen, Tabl, Selakh, Kouvei, Laft, Holor, Peyposht, Kousha, Tourion and Ramkon (refer to Table 7.3.14). Of these 10 villages, Holor village is developed with Dargahan City and so excluded from priority development of rural sewerage system.

2) Staged development plan of rural sewerage system

It was noted that the 9 village rural sewerage systems stated above, out of 57 villages are

recommended for the first stage of development. These have been classified as "1st stage" in the column of "Tentative evaluation" in Table 7.3.14.

Next, 13 villages are tentatively listed as second priority villages for the development of a rural sewerage system, these each have a population of more than 2,000 people in 2036, and are indicated as "2nd stage" in the column of "Tentative evaluation" in Table 7.3.14. In the case of Towla village, urban planning is required because significant increases in the population have elevated it to city level.

Following this, 10 villages with a population of more than 1,000 people in 2036 can be tentatively classified as third priority villages in terms of developing a rural sewerage system, which are indicated as the colored cells of the "Tentative evaluation" column in Table 7.3.14.

In addition, four villages in Table 7.3.14 are recommended as being suitable for decentralized treatment systems (leaching pit system). These villages have a population density of less than 10 people/ha in 2036 and face an initial cost of more than USD 3,000 per capita

For the remaining villages, it is unclear whether the rural sewerage system or the leaching pit system would be better suited for development.

Table 7.3.14 Evaluation of 57 villages for Rural Sewerage Development

Nbr	ID	Village name (Eng.)	Village name (Farsi)	Population in 2036 (Beneficiary)	Future Land Use Area (ha)	Pop. Density in 2036 (people/ha)	Sewer Cost (Mil. USD)	STP Cost (Mil. USD)	Total Cost (Mil. USD)	Investment Cost (10^3 USD/capita)	Incentives to develop: WE, LE, SR, TD	Tentative Evaluation
1	DOU-01	Baseidou	باسَیدو	3,405	109.3	31	3.06	1.18	4.24	1.25		2nd stage
2	DOU-02	Derakou	دِرَکو	838	23.7	35	0.66	0.44	1.10	1.31		
3	DOU-03	Doustakou	دوستَکو	995	30.2	33	0.85	0.49	1.34	1.35		
4	DOU-04	Kani	کانی	429	23.8	18	0.48	0.32	0.80	1.86		
5	DOU-05	Konar Sia	کُنارسِیا	497	20.5	24	0.41	0.34	0.75	1.51		
6	DOU-06	Gouri	گوری	1,283	41.5	31	1.16	0.57	1.73	1.35		
7	DOU-07	Moradi	مُرادی	574	21.2	27	0.59	0.36	0.95	1.66		
8	DOU-08	Tomgez	تُم گِز	332	16.6	20	0.33	0.30	0.63	1.90		
9	DOU-09	West Chahou	چَهوکِبلَی	783	30.2	26	0.85	0.42	1.27	1.62		
10	DOU-10	East Chahou	چَهوگوشی	1,376	24.7	56	0.69	0.59	1.28	0.93		
11	DOU-11	Doulab (Doulow)	دولَو	2,243	84.7	26	2.37	0.84	3.21	1.43		2nd stage
12	DOU-12	Sar Rig	سَرریغ	2,236	78.2	29	2.19	0.84	3.03	1.36		2nd stage
13	DOU-13	Aysheh-Abad	عایشه آباد	149	6.3	24	0.13	0.24	0.37	2.48		
	Doulab Rural District			**15,140**	**510.9**							
14	SOU-01	Shibderaz	شیب دراز	802	44.6	18	1.25	0.43	1.68	2.09	TD	
15	SOU-02	Mesen	مِسِن	3,240	103.6	31	2.46	1.13	3.59	1.11	LE	1st stage
16	SOU-03	Borka Khelaf	بُرکَه خِلَف	528	26.2	20	0.73	0.35	1.08	2.05		
17	SOU-04	Rigoo	ریغو	718	39.9	18	1.12	0.41	1.53	2.13		
18	SOU-05	Zirong	زیرُنگ	2,088	78.1	27	2.19	0.80	2.99	1.43		2nd stage
19	SOU-06	Nakhl Gol	نخل گل	454	21.4	21	0.43	0.33	0.76	1.67		
20	SOU-07	Direston	دیرستُن	2,819	120.2	23	3.87	1.01	4.88	1.73	SR	2nd stage
	Souza Rural District			**10,649**	**434.0**							
21	SAL-01	Dehkhoda	دهخدا	945	29.7	32	0.83	0.47	1.30	1.38	WE	
22	SAL-02	Sohli	سُهلی	2,806	80.4	35	2.25	1.01	3.26	1.16	WE	2nd stage
23	SAL-03	Haft Rangou	هفت رنگو	1,078	46.9	23	1.11	0.51	1.62	1.50	WE, LE, SR	
24	SAL-04	Dourbani	دوربَنی	1,035	30.8	34	0.91	0.50	1.41	1.36	WE, LE	
25	SAL-05	Gomboron	گُمبُرُن	866	35.7	24	0.86	0.45	1.31	1.51	LE	
26	SAL-06	Gouron	گورُن	2,210	59.1	37	1.50	0.84	2.34	1.06	LE	2nd stage
27	SAL-07	Melki	مِلکی	408	20.4	20	0.41	0.32	0.73	1.79	WE, LE	
28	SAL-08	Tabl (Towl)	طَول	6,374	182.1	35	5.10	1.98	7.08	1.11	WE, LE	1st stage
29	SAL-09	Selakh	صَلَخ	4,800	113.6	42	3.20	1.58	4.78	1.00	LE, TD	1st stage
30	SAL-10	Noghasha	نُغاشَه	474	31.6	15	0.73	0.34	1.07	2.26	LE	
	Selakh Rural District			**20,996**	**630.3**							

Nbr	ID	Village name (Eng.)	Village name (Farsi)	Population in 2036 (Beneficiary)	Future Land Use Area (ha)	Pop. Density in 2036 (people/ha)	Sewer Cost (Mil. USD)	STP Cost (Mil. USD)	Total Cost (Mil. USD)	Investment Cost (10^3 USD/capita)	Incentives to develop: WE, LE, SR, TD	Tentative Evaluation
31	HEN-01	New Hangom	هَنگُم جدید	1,064	53.2	20	1.49	0.51	2.00	1.88	TD	
32	HEN-02	Old Hangom	هَنگُم قدیم	25	9.8	3	0.20	0.21	0.41	16.40		Decentralized
	Hangom Rural District			**1,089**	**63.0**							
33	HOW-01	Ramchah	رمچاه	4,909	129.1	38	3.61	1.61	5.22	1.06		2nd stage
34	HOW-02	Tourgon	نخلستان تورگُن	124	16.5	8	0.33	0.24	0.57	4.60		Decentralized
35	HOW-03	Kouvei	کووَی	5,547	158.5	35	5.07	1.80	6.87	1.24	LE	1st stage
36	HOW-04	Giadon	گیادُن	4,545	148.2	31	4.15	1.51	5.66	1.25		2nd stage
37	HOW-05	Tonbon	تُمبُن	1,688	86.2	20	2.41	0.69	3.10	1.84		
38	HOW-06	Kovarzin	کُوَرزین	2,552	81.7	31	3.07	0.94	4.01	1.57	WE	2nd stage
39	HOW-07	Laft	لافت	7,210	206.0	35	5.77	2.16	7.93	1.10	WE, TD	1st stage
40	HOW-08	Holor	هُلُر	9,451	216.8	44	6.07	2.56	8.63	0.91	LE	Joint with Dargahan City
41	HOW-09	Hamiri	حَمیري	221	38.6	6	0.77	0.26	1.03	4.66		Decentralized
42	HOW-10	Defari	دفاري	1,117	37.6	30	1.05	0.52	1.57	1.41		
43	HOW-11	Towla	طَولا	11,251	272.2	41	7.62	2.82	10.44	0.93		2nd stage*
44	HOW-12	Kabeli	کابلی	59	25.3	2	0.51	0.22	0.73	12.37		Decentralized
	Howmeh Rural District			**48,674**	**1,416.7**							
45	RAM-01	Bangali	بَنگالي	140	7.0	20	0.14	0.24	0.38	2.71		
46	RAM-02	Jijiyon	جي جيُن	1,044	40.9	26	1.15	0.50	1.65	1.58		
47	RAM-03	Gorvodon	گُروُدُن	1,579	70.9	22	1.99	0.65	2.64	1.67		
48	RAM-04	Peyposht	پي پشت	3,477	102.5	34	2.99	1.20	4.19	1.21	LE	1st stage
49	RAM-05	Khaladin	خالَدین	2,003	57.1	35	1.60	0.78	2.38	1.19	SR	2nd stage
50	RAM-06	Zeinabi	زَینَبي	2,256	78.8	29	2.21	0.85	3.06	1.36	SR	2nd stage
51	RAM-07	Karavon	کارَوُن	1,436	43.0	33	1.20	0.61	1.81	1.26		
52	RAM-08	Kousha	کوشَه	3,178	77.1	41	3.15	1.12	4.27	1.34	SR	1st stage
53	RAM-09	Kardova	گَردُوا	277	18.5	15	0.37	0.28	0.65	2.35	LE	
54	RAM-10	Bagh Bala	باغ بالا	482	21.8	22	0.44	0.34	0.78	1.62		
55	RAM-11	Tomsenati	تُم سِنَتي	489	9.5	51	0.19	0.34	0.53	1.08		
56	RAM-12	Tourion	توریُن	3,983	143.7	28	5.03	1.35	6.38	1.60	LE, SR	1st stage
57	RAM-13	Ramkon	رمکُن	9,686	282.0	34	7.90	2.60	10.50	1.08	LE, SR	1st stage
	Ramkon Rural District			**30,030**	**952.8**							
Village Total				**126,578**	**4,007.7**							

Note: WE: Water Environment Improvement, LE: Living Environment Improvement, SR: TSE Reuse, TD: Tourism Development
* In the case of Towla village, urban planning is required.

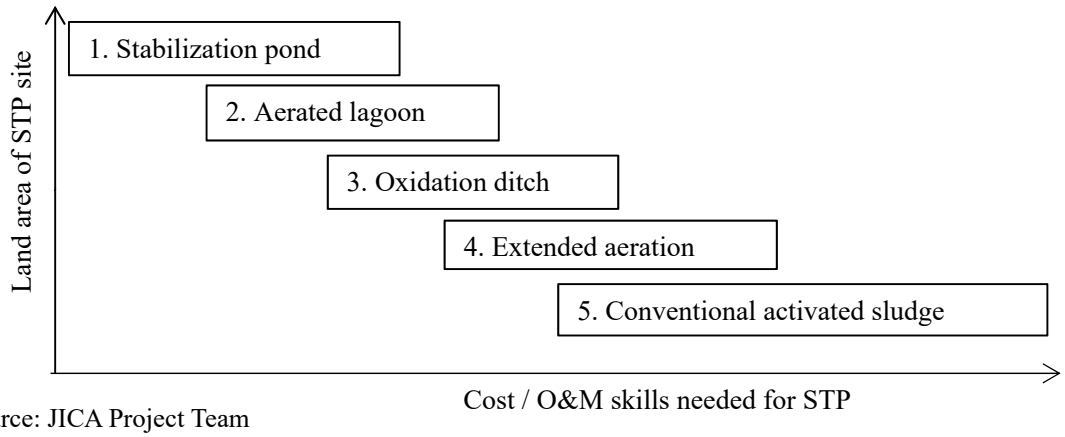
Source: JICA Project Team

3) Sewage treatment process

The sewage treatment process shall be selected in consideration of the following factors:

(a) Quantity and quality of raw sewage, including any fluctuations
(b) Effluent discharge standards to be applied to the receiving water body or TSE reuse
(c) The present and future water use in the receiving water body
(d) Reuse plan for the treated wastewater
(e) Construction cost and operation/maintenance (O&M) cost
(f) Ease of operation and maintenance
(g) Land area available for the STP
(h) Location and neighborhood of the STP site
(i) Legal conditions to be applied at the STP site

A low-cost treatment process, which is easy to operate and maintain, such as a stabilization pond and an aerated lagoon, requires a large space in general. At the extreme end of the X-axis, a conventional activated sludge process and other similar processes require high-cost and skilled operation and maintenance, but require less space, as shown in the following figure.



Source: JICA Project Team

Figure 7.3.13 Relationship Between Required Land Area and Cost / O&M Skills Needed for STP by Treatment Process

The following table shows the outline of each treatment process.

Table 7.3.15 Outline of Each Treatment Process

Treatment process	Process	Retention time (day)*	Features
Stabilization pond	A→F→M	12-24	Low-cost and easy maintenance are expected. However, a large water surface is required because oxygen is provided by natural air and photonic synthesis of algae.
Aerated lagoon	AL→SL	4-9	Retention time is shortened because oxidation is forced by aerator.
Oxidation ditch	OD→FST	0.8-1.2	Stable sewage treatment, acceleration of nitrification and less sludge generation are expected due to the long sludge retention time, compared to the conventional activated sludge process. PST can be omitted, but a sewage sludge treatment facility is required.
Extended aeration	RT→FST	0.8-1.2	
Conventional activated sludge	PST→RT→FST	0.4-0.6	High-cost and skilled operation/maintenance are needed, but less land area is required. A PST and a sewage sludge treatment facility are required.

Note: A: anaerobic pond, F: facultative pond, M: maturation pond, AL: aerated lagoon, SL: settling lagoon, OD: oxidation ditch, FST: final settling tank, RT: reaction tank, PST: primary settling tank
Source: JICA Project Team (for retention time, refer to Von Sperling, 1996)

The most economical and pragmatic treatment process needs to be selected from the perspective of overall optimization of cost, ease in terms of operation/maintenance, reliability regarding the treatment process, and space availability. Therefore, the stabilization pond process is recommended for the sewage treatment process within the rural sewerage system on Qeshm Island because there are large open spaces around the villages in general.

The following pictures show examples of stabilization ponds in Bhutan and Thailand.

Note: Top left: Thimphu STP in Bhutan, middle/right: Phuentsholing STP in Bhutan, bottom: Kamphangphet STP in Thailand
Source: JICA Project Team

Figure 7.3.14 Examples of Stabilization Ponds

(3) Reuse of treated sewage effluent

1) Reuse plan of treated sewage effluent (TSE)

The entirety of TSE generation from the two STPs in Qeshm City, after additional treatment of filtration and chlorination, is used for watering the street trees and green spaces in the city under QUC. In addition, one small-scale STP for the Dargahan Maskan Mehr (housing complex) in Dargahan City is in operation and the treated sewage effluent is reused under PFI project and under management by the HUWWC,

The reuse of TSE is more practical and economical than treated greywater (TG) reuse in the areas where STP is already developed; this is because TSE can be easily achieved with some additional treatment of filtration and disinfection within the STP. It is both natural and reasonable for the reuse of TSE to be implemented in conjunction with the sewerage system development project.

Therefore, the TSE reuse project will be carried out along with sewerage development in Dargahan City and Holor Village and in the 9 villages excluded Holor Village prioritized for rural sewerage.

2) Reuse plan of treated greywater (TG)

In the case of TG reuse, for which there is limited experience, there are a number of issues to consider, such as:

System configuration for house connection, collection pipe and treatment plant

- Switching house connection in individual house: Separation of toilet wastewater from other wastewaters in individual house
- Residents may be requested to remove kitchen waste and cooking oil by screen and oil traps in individual houses.
- Installation of collection pipe from individual house to Treatment Plant (TP): Gravity flow and pumping up if necessary

- Installation of TP to treat collected greywater: Necessary to comply with the "Sewage discharge standards for irrigation and agricultural use" established by DOE, if there is no exception rule concerning small scale facilities

Management of the project and consensus forming

- Who will bear the construction cost?
- Who will bear the O&M cost?
- Who is the user of treated greywater?
- User charge system for treated greywater users (e.g., irrigation)
- Potentially, a fee system of greywater treatment paid by dischargers (by each household)
- Who is the project operating body?
- Who is the operator of TP? Outsourcing or involved villagers, training O&M
- Consensus forming among concerned players: QFZO, QUC, HUWWC, HRWWC, Bonyad Maskan and target village

To address these questions, a model project of the TG reuse should be considered at the beginning in several motivated villages of Qeshm Island. The following are items of consideration for the rough design of the model project to implement:

- Selection of planning area/zone (entire or partial): Supposed number of households and length of collection pipe
- Estimation of construction cost and operation & maintenance (O&M) cost
- Cost comparison between project cost and water supply cost

An example of project cost is roughly estimated in the case of 6 m^3/d (10 households = 40 people) and 12 m^3/d (20 households = 80 people)

- Treatment process: Aerobic (SBR: Sequencing Batch Reactor) system
- Required TP area: around 80m^2
- Construction cost of pipe: around 60,000 USD (Dia.=200mm, L=300m)
- Construction cost of TP: around 20,000 USD (in the case of 6 m^3/d)
- Construction cost of TP: around 30,000 USD (in the case of 12 m^3/d)
- Operation and maintenance cost: around 2,500 USD/year (in the case of 6 m^3/d)
- Operation and maintenance cost: around 3,000 USD/year (in the case of 12 m^3/d)
- User charge of treated greywater: To be decided

(4) Capacity development to promote sewerage system

As shown in Table 7.3.1, number of staff is 12 people in Qeshm Branch of HUWWC for water works on Qeshm and other Islands, and only 4 people in Qeshm Branch of HRWWC for water works in rural area on Qeshm Island.

To promote the development of the above urban sewerage system, rural sewerage system and reuse of treated sewage effluent, it is imperative to strengthen the institutional resources in Qeshm Branch of HUWWC and HRWWC in the field of sewerage system development. Furthermore, it is necessary to secure the financial resources of HUWWC, HRWWC and QUC to develop a sewerage system on Qeshm Island.

Targets of capacity development are considered by the following capacity areas to strengthen the institutional and financial resources of HUWWC and HRWWC in the field of sewerage system development. In this case, in accordance with the strengthening of the branch offices, effective and efficient support from the experienced headquarters to the branch offices should be considered.

(a) Institutional development:

- ✓ Establishment of responsible section for sewerage system development
- ✓ Formulation of customer service and public relation section
- ✓ Securing human resources for new sections

(b) Development of management bases:

- ✓ Formulation of sewerage development plans in short, middle and long term
- ✓ Setting key performance indicators (PIs) and targets in short, middle and long term
- ✓ Regular monitoring of the above PIs and reporting

(c) Enhancement of financial management:

- ✓ Securing financial sources for construction
- ✓ Establishment of sewage service charge system
- ✓ Formulation of customer information database

(d) Enhancement of operation and maintenance capability:

- ✓ Formulation of asset database (treatment plant, pumping station, pipeline etc.)
- ✓ Formulation of O&M manual
- ✓ Preparation and management of O&M record
- ✓ Training on improvement of O&M works

(e) Enhancement of public awareness:

- ✓ Execution of customer service and public relation
- ✓ Preparation of materials on sewerage system development and sewage service charge system

(5) Phasing and cost estimates of proposed project

The phasing of proposed projects in this section and the cost estimates are described in Table 7.3.16.

Development of urban sewerage system

Phasing of Dargahan sewerage development is sited from the Table 7.3.12. In the short-term, the sewerage system of Dargahan City and Holor Village will be developed for 294 ha of sewer network covering Zone A, B and northern part of Zone D, and the STP facility of two flow lines out of three as the Urgent Plan. In the mid-term, 140 ha of sewer network covering Zone C and a part of Zone D will be developed. Finally, the sewer network will be expanded toward low density area of 233 ha in the rest of Zones D and E, and one flow line of STP facility will be constructed in the long-term. The cost estimates were cited from the Table 7.3.13.

Development of rural sewerage system

In the mid-term, the rural sewerage systems of 9 villages (Holor village was excluded due to development with Dargahan City) will be developed, which were recommended in Table 7.3.14 as the first stage developments from the 57 villages. In the long-term, the next 13 villages will be developed, which were also recommended in Table 7.3.14 as the second stage developments. The cost estimates are also cited form Table 7.3.14.

Reuse of treated sewage effluent

The TSE reuse project will be carried out in conjunction with urban sewerage development in Dargahan City and Holor Village and rural sewerage development in the prioritized villages. The cost is estimated as a certain cost of main facility.

In the case of treated greywater reuse, model areas were tentatively nominated in the short-term (10), mid-term (20) and long-term (20). The cost is also tentatively presumed based on the above rough estimation.

Capacity development

Increasing number of staff is nominated as the output index of capacity development in the field of

sewerage to strengthen the institutional and financial resources of HUWWC and HRWWC. The target number of staff increase is assumed to be each 20 people for both Qeshm Branch of HUWWC and HRWWC in sewerage works on Qeshm Island.

Table 7.3.16 Proposed Project and Cost Estimate for Each Term in Sewerage Development

Project Title		Implementing Organization	Phasing			Cost (million USD)			
			Short term	Mid term	Long term	Short	Mid	Long	Total
Development of urban sewerage system for Dargahan City*		HUWWC	294 ha, 14,100 people	140 ha, 7,700 people	233 ha, 15,600 people	19.3	3,8	6.1	29.2
Development of rural sewerage system		HRWWC		9* villages	13 villages		55.6	54.7	110.3
Reuse of	Treated sewage effluent	HUWWC/ HRWWC	Dargahan City	Dargahan City, 9 villages	13 villages	0.5	1.5	1.7	3.7
	Treated greywater		10 models	20 models	20 models	1.0	2.0	2.0	5.0
Capacity development		HUWWC/ HRWWC	12 and 8 people	8 and 12 people		0.2	0.2		0.4
Total						21.0	63.1	64.5	148.6

Note: Short term in 2018~2021, Middle term in 2022~2031, and Long term in 2032~2041
Note: * Holor village is developed with Dargahan City and excluded from development of rural sewerage system
Source: JICA Project Team

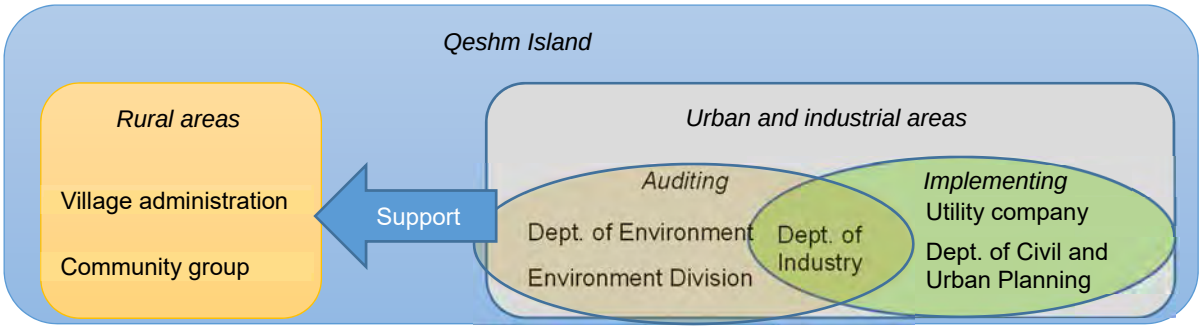
7.4 Solid Waste Management

7.4.1 Existing conditions

(1) Responsible institutions

Several institutions are working in this field based on their respective responsibilities. These are divided into two main groups: implementing institutions and auditing institutions. The Department of Civil and Urban Planning of the QFZO and the QUC are in the former group, while the DoE of the QFZO and the Environment Division of Qeshm County are in the latter. The Department of Industry of the QFZO has a function to control industrial (non-hazardous and hazardous) waste. It works mainly as an auditing institution, but also has responsibility to secure the proper treatment and disposal of industrial waste.

In rural areas, village administrations are generally responsible for solid waste services, especially its collection and disposal. Due to a lack of financial resources and technical knowledge, the QFZO often supports the villages in procuring equipment and locating disposal sites. In addition, community groups work on recycling, sweeping etc.



Source: JICA Project Team

Figure 7.4.1 Institutional System of Solid Waste Management on Qeshm Island

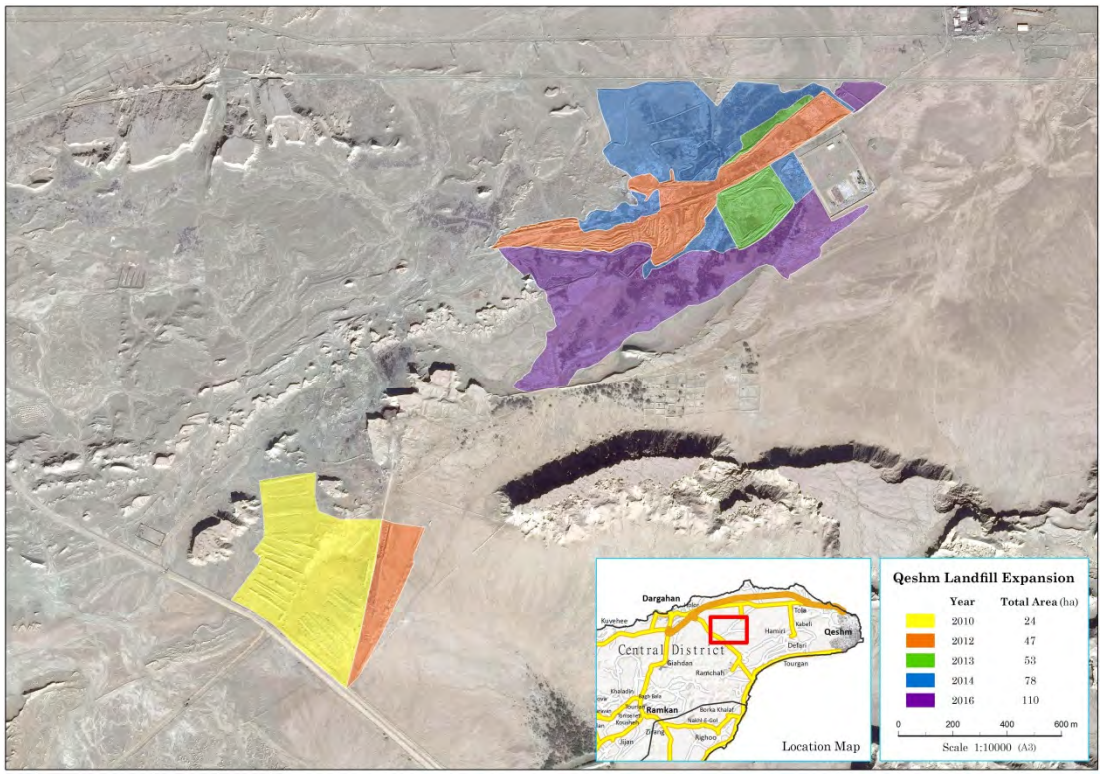
(2) Ordinary waste (urban)

In Qeshm City, a waste collection service is well provided: many waste containers are distributed, compactor trucks of a suitable size for narrow streets of the town are working, with mechanical sweepers attached, and workers are manually cleaning the pavement. The town is kept clean.

Waste collected in Qeshm City, Dargahan and Towla is directly transported to the Towla Disposal Site, which is located approximately 15 km from Qeshm City, next to the Towla Industrial Area. According to the operator, the site received approximately 80 tons/day of waste as of February 2016. The current operation method, which excavates trenches into which waste is buried, is not suitable for dealing with such large amounts. Waste is disposed of in a disorderly fashion and scattered all over the site. An area of approximately 300 ha seems to have become contaminated with waste in recent years as shown in Figure xxx. In addition, intentional or accidental burning of waste often happens, which causes serious smoke emissions. The site has to be improved.

The separation system has not yet been introduced. Although the company that operates the Towla Disposal Site has installed a material recovery facility, it is currently not operational. Material recovery is carried out by the informal sector on the street and the Towla Disposal Site.

It should be underlined that the ordinary waste generation amount per person seems to be very large. The current ordinary waste generation amount is roughly estimated at 1.6 kg/person/day (this is calculated as follows: daily disposal amount (80 tons) divided by estimated total population (50,000), who are covered by a collection service, mainly in Qeshm City, Dargahan and Towla).



Note: This figure shows the status of use for the Towla Disposal Site in recent years, with the total area having reached approximately 300 ha
Source: JICA Project Team

Figure 7.4.2 Status of Use for the Towla Disposal Site

(3) Ordinary waste (rural)

Villages straggle all over the island, especially along the coastline. Their population sizes range from a few hundred to several thousand. Basically, village administrations manage waste services. Waste collection is usually carried out effectively by small trucks. Meanwhile, villages seem to have difficulties with waste disposal. Some villages make trenches in which waste is buried. Others just

dump waste at designated sites due to the lack of heavy equipment. Hengan Island is also not exceptional. Waste generated by the small number of insulars and tourists is collected and disposed of at a disposal site on the island. However, it seems that this situation has not led to a serious environmental problem due to the small amount of waste and abundant lands in the rural areas.

In Ramkon Village, an NGO is working on recycling. Shops are asked to put bins out for recyclable materials. Money is then earned by selling the materials, which is donated to poor people. Usually, villages are faced with scarce financial resources for the operation of waste services. The QFZO supports some villages in this regard.

Typical waste collection truck in villages

Typical excavated trench for waste disposal in villages

Source: JICA Project Team

Figure 7.4.3 Solid Waste Management in Rural Area

(4) Industrial waste (non-hazardous and hazardous)

The Department of Industry of the QFZO, due to its responsibility for controlling industrial waste, ensures that factories treat and dispose of their waste appropriately. Meanwhile, the DoE of the QFZO and the Environment Division of Qeshm County work as auditing agencies in this sector. Currently, there is concern that one cement factory and one zinc factory may be causing contamination. No industrial waste landfill has been constructed yet.

Currently, the most serious problem involves the clandestine dumping of construction waste due to the construction boom in recent years. Such sites are found everywhere, especially on the eastern part of the island.

(5) Hospital waste (non-hazardous and hazardous)

The most important aspect of hospital waste management is handling waste in hospitals: to properly separate the infectious from the non-infectious waste. If adequate separation is not carried out, the infectious contaminates the non-infectious waste. This then leads to an increase in the amount of infectious health hazards, which raises the cost of treatment. In this respect, however, Payambar Azam Hospital is very well organized.

In the hospital, the infectious waste is treated with an autoclave (steam sterilization). After the treatment, the waste is discharged, collected and disposed of by being mixed with the non-hazardous waste. Although the autoclave sterilizes the infectious waste, it cannot guarantee 100% sterilization. Moreover, sharps, needles etc. keep their shapes, which can injure collection workers and others. Therefore, even after treatment, the infectious waste should be separately discharged, collected and disposed of, away from the non-infectious waste.

In small clinics, the infectious and the non-infectious are not well separated. Disseminating information on the appropriate handling of waste in Payambar Azam Hospital is recommended. In addition, a system of collection, treatment and disposal of the infectious waste in such clinics needs to be established.

The bin colored with yellow is for the infections waste, while the blue bin is for the non-infectious waste

Syringes are discharged in special bins

Source: JICA Project Team

Figure 7.4.4 Appropriate Handling of Hospital Waste

(6) Agriculture and fishery waste

Abandoned boats are often found along the coastal area. Furthermore, scattered waste jeopardizes the pleasing scenery of beaches. Although this waste is not necessarily related to the agriculture and fishery sectors, controlling it is recommended in order to maintain the value of beaches as tourist sites.

7.4.2 Issues to be tackled

The table below highlights the issues to be tackled, as derived from an evaluation of the existing conditions. Among the urgent issues, improving the Towla Disposal Site and eliminating the clandestine dumping of construction waste were seriously considered by the responsible institutions.

Table 7.4.1 Issues to be Tackled in Solid Waste Management

Type of waste		Urgent 2017	Short term 2021	Mid term 2026
i a	Ordinary Urban	• Improve Towla Disposal Site	• Keep a collection service alongside urban development • Construct a sanitary landfill at Towla Disposal Site • Introduce waste separation and recycling	• Introduce treatment to reduce the amount of disposal waste • Consider the construction of transfer station(s) and/or another sanitary landfill
b	Rural	• N/A	• Introduce waste separation and recycling • Construct transfer station(s)	• Construct a sanitary landfill
ii	Industrial	• Eliminate the clandestine dumping of construction waste	• Establish a recycling system for construction waste and tires	• Establish a treatment and final disposal system for hazardous industrial waste
iii	Hospital	• Discharge, collect and dispose of the treated infectious waste generated in Payambar Azam Hospital separately from the non-infectious waste	• Establish a separation system in the small clinics • Adequately treat the infectious waste from small clinics	• N/A
vi	Agriculture and fishery sectors	• Eliminate the scatter of waste in coastal areas	• Establish a disposal system of abandoned boats • Establish waste management in coastal areas	• N/A

Source: JICA Project Team

7.4.3 Objectives and development targets

The table below shows the objectives and development targets for the solid waste management sector.

Table 7.4.2 Objectives and Targets for the Solid Waste Management Sector

Type of waste		Present 2016	Short term 2021	Mid term 2026	Long term 2036
i a	Ordinary Urban	Current situation: • Towns and villages are kept very clean • 88% of insulars have access to waste collection services* • 12% of insulars dispose of their waste nearby*	Objectives: • Minimize environmental impacts caused by waste • Encourage recycling Targets: • Sanitary landfilling rate - 94% • Recycling rate - 5%	Objectives: • Same as short term Targets: • Sanitary landfilling rate - 99% • Recycling rate - 10%	Objectives: • Same as short term Targets: • Sanitary landfilling rate - 100% • Recycling rate - 20%
b	Rural		Objectives: • Keep villages clean • Minimize environmental impacts caused by waste • Encourage recycling Targets: • Collection rate - 97% • Sanitary landfilling rate - 81% • Recycling rate - 5%	Objectives: • Same as short term Targets: • Collection rate - 100% • Sanitary landfilling rate - 89% • Recycling rate - 10%	Objectives: • Same as short term Targets: • Sanitary landfilling rate - 100% • Recycling rate - 20%
ii a	Industrial Non-hazardous	Current situation: • Manufacturers manage their waste by themselves • Construction waste is disposed of in the area of Towla Disposal Site separately from ordinary waste	Objective: • Encourage recycling Target: • Recycling rate - 35%	Objectives: • Encourage recycling • Minimize disposal amount Targets: • Recycling rate - 40% • Minimization rate - 49%	Objectives: • Same as medium term Targets: • Recycling rate - 40% • Minimization rate - 68%
b	Hazardous		Objective: • Encourage recycling Target: • Recycling rate - 35%	Objectives: • Encourage recycling • Minimize disposal amount • Secure safe disposal Targets: • Recycling rate - 40% • Minimization rate - 49% • Disposal at special landfill	Objectives: • Same as medium term Targets: • Recycling rate - 40% • Minimization rate - 68% • Disposal at special landfill
c	Construction		Objective: • Encourage proper use for reclamation Target: • Utilization for reclamation - 35%	Objectives: • Encourage proper use for reclamation • Encourage recycling for construction Targets: • Utilization for reclamation - 50% • Utilization for construction - 16%	Objectives: • Same as medium term Targets: • Utilization for reclamation - 50% • Utilization for construction - 32%
iii	Hospital	Current situation: • Waste separation is	Objective: • Separate and treat	Objective: • Same as short term	Objective: • Same as short

Type of waste		Present 2016	Short term 2021	Mid term 2026	Long term 2036
		carried out in the hospitals and clinics to varying degrees. • However, the infectious and the non-infectious are collected together	the infectious waste appropriately Target: • Separation and treatment rate - 88%	Target: • Separation and treatment rate - 98%	term Target: • Separation and treatment rate, 100%
vi	Agriculture, Fishery and Tourism	Current situation: • No serious problem is found in agriculture • There are abandoned boats on the coast • Waste is sometimes scattered on the coast, especially during the tourism season	Objective: • Keep beaches and tourist sites clean Target: • Percentage of sites where waste is to be appropriately discharged and collected - 10% of identified sites	Objective: • Same as short term Target: • Percentage of sites where waste is to be appropriately discharged and collected - 50% of identified sites	Objective: • Same as short term Target: • Percentage of sites where waste is to be appropriately discharged and collected - 100% of identified sites

* Questionnaire survey carried out in 2016 by the JICA Project Team
Source: JICA Project Team

7.4.4 Considerations of key issues for ordinary waste

(1) Collection

1) Collection area division

Qeshm Island stretches approximately 130 km from east to west. The travel distance is more than 150 km. It is usually said that a distance of less than 30 km between a waste collection area and a final disposal site is appropriate in terms of efficiency. If the distance is more than 30 km, waste engineers usually consider the introduction of transfer transport. In this regard, the island is divided into three waste collection areas: namely, East Area, Central Area and West Area (as shown in the section on the forecasted waste amount).

2) Means of collection

Currently, the collection service is well operated. Approximately 90% of insulars have access to the service. In Qeshm, Dargahan and Holor, this service is efficiently carried out by compactor trucks. Meanwhile, villages use small dump trucks and farm tractors. Although these vehicles are not efficient, they somehow handle the small amount of waste generated in those villages effectively. Therefore, this current collection system should be maintained and encouraged to further cover the remaining insulars in the development plan.

(2) Transport

1) Location of transfer station and landfill

The ideal location of a transfer station or a landfill is the gravity center of waste generation points, given that this will keep transport costs to a minimum. The site selection of a transfer station or landfill is carried out based on the gravity center. Other factors are then considered, such as topography, geology, neighboring land use and environmental impacts.

On the other hand, in relation to landfilling, there is a theory that economies of scale function well in landfilling. In other words, landfill on a small scale is economically inefficient. The Central Area and the West Area generate a small amount of waste, which makes it unreasonable for each area to have its own landfill. It is recommended that the areas jointly construct and operate a sanitary landfill in order

to make it more efficient.

Table 7.4.3 Waste Generation Amount by Collection Area

Planning phase	Year	Generation (tons/day)			
		East (urban)	Central (rural)	West (rural)	Total
Current	2016	73	15	7	95
Short term	2021	92	18	8	118
Mid term	2026	116	23	9	148
Long term	2036	184	34	15	233

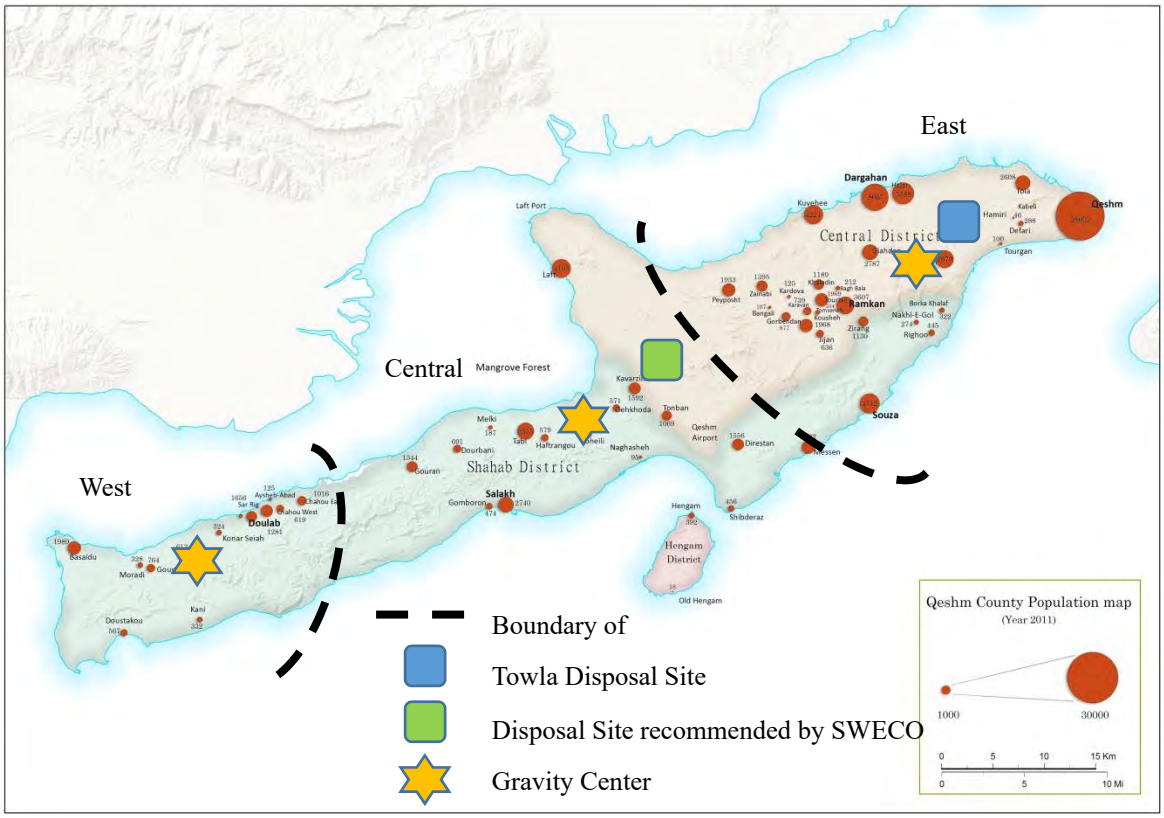
Source: JICA Project Team

As the figure below shows, the Towla Disposal Site is very close to the gravity center of the East Area. This means that its location is theoretically ideal. The gravity center of Central Area is located between Sohli and the mangrove forest. However, this area is valuable in terms of tourism. Therefore, it can be said that the site recommended by SWECO will be much more appropriate for landfill. All waste in the West Area will be transported to the landfill in the Central Area. Therefore, a transfer station in the West Area should be located at the gravity center or on its eastern side.

Table 7.4.4 Gravity Centers for Each Collection Area

Area	North latitude			East longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
East	26	55	37	56	8	15
Central	26	46	5	55	47	16
West	26	39	39	55	24	0

Source: JICA Project Team



Source: JICA Project Team

Figure 7.4.5 Gravity Centers of Waste Generation

2) Means of transport

East Area

It is recommended that cities such as Qeshm and Dargahan continue with the current system, that is, to transport waste by compactor trucks to the Towla Disposal Site directly. This way is efficient.

For small villages, small trucks and/or farm tractors will collect waste and store it at a certain place along the main road for collection by a compactor truck. The compactor truck should stop at several small villages.

Central Area

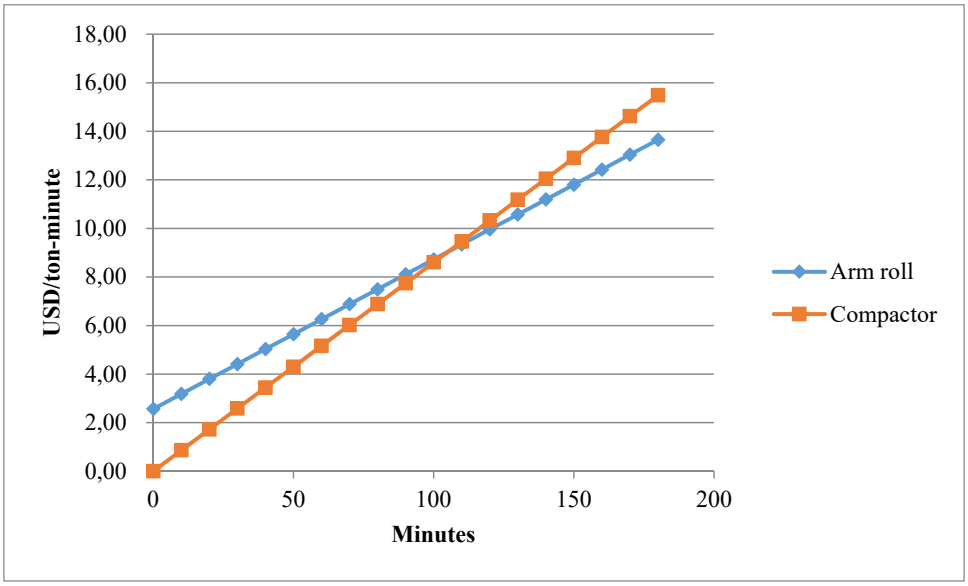
For villages in the Central Area, the same model for small villages in the East Area is to be applied, that is, waste inside the villages will be collected by small trucks or farm tractors and transferred to compactor trucks at certain points in the villages.

West Area

Waste generated in the West Area has to be transported to the landfill in the Central Area. The longest distance is between Baseidou and the landfill, which is approximately 60 km. However, the waste amount will be small. Even in 2036, the estimated waste generation amount is 15 tons/day. The transfer transport system also follows the theory of economies of scale. The system that deals with small amounts of waste does not bring economic benefits.

A comparison between two transfer transport systems was made. One system employed compactor trucks, as in the East Area and the Central Area, to pick up waste from each village. The other system had a transfer point for all the villages, put a large waste container there and carried the container to the landfill using an arm roll truck. If the trucks run at 40 km/hour, it takes 90 minutes from Baseidou to the landfill. In this case, the unit cost per ton-minute is almost the same, as the figure below shows.

In terms of cost, either system is recommended. However, it is possible that the compactor truck could be flexibly used. On the other hand, the arm roll truck can only be used for transferring waste. It will be difficult to manage the transfer point properly, as various villages collectively use it.



Source: JICA Project Team

Figure 7.4.6 Comparison of Transfer Transport Systems

(3) Treatment

1) Solid waste treatment alternatives

There are several methods of waste treatment as the table below shows. Incineration is not suitable for waste on Qeshm, as its calorific value is low due to the large portion of organic waste with high water content. Methane fermentation produces energy. However, it may not be competitive in terms of costs, as energy is available at a low price on Qeshm. Composting from ordinary waste is almost always not feasible due to the difficulty of maintaining quality. Material recovery is currently conducted by the informal sector on the streets and the disposal sites. In order to formally carry out material recovery on a large scale, waste separation at source will be necessary. Landfilling can flexibly and easily deal with waste with a large portion of organic composition at a low cost.

Consequently, material recovery and landfilling are thought to be applicable to Qeshm. However, waste separation at source has to be practiced before material recovery is introduced.

Table 7.4.5 Solid Waste Treatment Alternatives

Treatment method	Advantages	Disadvantages
Incineration	• Waste volume is largely minimized • Incineration plant does not require a large area • It can treat several types of burnable waste	• Both initial and operation costs are very high • It requires a high level of technical skills • It is not suitable for waste with a low calorific value
Composting	• Both initial and operation costs are relatively low • It does not require a high level of technical skills • Compost produced may be salable	• A very high level of waste separation at source is required for maintaining the quality of compost. • Compost produced from ordinary waste is usually not welcomed by the market • A large volume of residue is generated when waste is not effectively separated at source
Methane fermentation	• Methane produced is used as energy • It emits less GHGs than others • Residue may be used as fertilizer	• Both initial and operation costs are very high • It requires a high level of technical skills • It is not suitable for treating a large amount of waste • A high level of waste separation at source is required
Material recovery	• It does not require a high level of technical skills • Recovered materials are salable	• Efficiency will be very low when waste separation at source is not effectively carried out
Landfilling	• Both initial and operation costs are low • It does not require a high level of technical skills • It does not require waste separation at source	• It requires a large land area • It gives off bad odors • It may impair the scenery

Source: JICA Project Team

2) Recycling

Material recycling is recommended for Qeshm. However, it is not recommended to introduce a large scale material recovery facility immediately. The existing facility at the Towla Disposal Site highlights the inappropriateness of such an approach. The facility confirms that material recovery and composting from mixed waste are of no business interest.

Waste separation at source is crucial, not only for material recovery, but also for various treatment methods. Therefore, disseminating information on the importance of waste separation at source should

first be carried out among insulars by means of education concerning small recycling activities, as follows.

(a) Education in schools
(b) Waste separation at schools, government offices, public facilities, parks etc.
(c) Installation of recyclable material exchange points
(d) Recycling at shops, restaurants, hotels etc.
(e) Recycling in communities
(f) Use of food waste for animal feeding
(g) Food waste for composting etc.

The following shows some examples of recycling.

Education materials prepared in Bandar Abbas

Recycling in a grocery shop in Ramkon

Recyclable material exchange point in Bandar Abbas

Community recycling in Japan

Source: JICA Project Team

Figure 7.4.7 Example of Recycling Activities

(4) Final disposal

Sanitary landfilling is recommended for Qeshm as mentioned in the section on solid waste treatment alternatives. However, it should be emphasized that the most important priority is to minimize the amount of waste to be disposed of in landfills. A sanitary landfill is an engineered disposal site, which controls environmental impacts, such as waste scattering, odor, fires, proliferation of vermin, and contamination of soil and groundwater. The following photos show some examples of sanitary landfills.

Bottom structure of a sanitary landfill in Vietnam

Bird's-eye view of a sanitary landfill in Japan

Operation (compaction) in a sanitary landfill in UAE

Operation (soil cover) in a sanitary landfill in UAE

Source: JICA Project Team

Figure 7.4.8 Examples of Sanitary Landfills

7.4.5 Consideration of key issues for industrial waste

(1) Waste from the manufacturing industry

1) Information control

Record keeping of industrial waste

The principal law on waste in Iran is the Waste Management Law, which stipulates that generators of non-hazardous and hazardous industrial waste are responsible for minimizing waste generation through the optimization of production processes and recycling. Therefore, it can be said that the generators of industrial waste should bear the primary responsibility for the minimization, treatment and disposal of their waste. However, it does not mean that public authorities can absent themselves from this issue. The authorities concerned have to guide and control industry in order for them to properly fulfill their responsibility. In this regard, establishing an information system is indispensable because it provides information about the types and amounts of waste generated, recycled, treated and disposed of. Such information gives industry and the government a crucial basis for preparing future plans and monitoring the progresses of these plans.

Types of industrial waste

Industrial waste is any type of waste resulting from industrial operations, such as manufacturing, mining, petrochemical refineries and power generation. Some types of waste are hazardous due to toxicity, infectiousness, explosiveness, corrosiveness etc. Other types are non-hazardous. Defining the types of industrial wastes is very important with regard to record-keeping. In Japan, industrial waste is categorized into the following 20 types:

(a) Ash
(b) Sludge: inorganic, organic

(c) Oil: liquid, solid, sludge
(d) Acid
(e) Alkali
(f) Plastic: plastic, tire
(g) Rubber
(h) Metal
(i) Glass, concrete and ceramic
(j) Slag
(k) Construction and demolition waste
(l) Dust
(m) Paper
(n) Wood
(o) Textile
(p) Animal and vegetable
(q) Residue from slaughterhouses
(r) Night soil from the animal industry
(s) Dead bodies from the animal industry
(t) Material resulting from treating the above

Industrial waste on Qeshm

The industrial waste amount is estimated at 24,893 tons/year in 2016 and 100,676 tons/year by 2036. Qeshm currently has various types of manufacturing. Furthermore, more industrial parks are supposed to be developed in the future. Manufacturers can potentially generate almost all types of industrial waste, both non-hazardous and hazardous. The tables below show the manufacturing groups that are currently operating and the planned industrial parks.

Table 7.4.6 Manufacturing Currently in Operation on Qeshm

No.	Manufacturing group	Number of units	Major products
1	Food, tobacco and fishery	30	Ice, industrial bread, canned fish, packaged fish, packaged water
2	Textile and clothing	1	Dresses, jeans
3	Cellulose	3	Tissues, perfumes, disposable medical equipment, hygienic cellulose products
4	Metal	3	Zinc ingots, lead ingots
5	Chemical	3	Polymer tubes, batteries, nylon, PVC tanks, car engine oils, chemical solvents, fatty acids
6	Boats and ships	18	Wooden boats, fiberglass boats, aluminum vessels
7	Electrical and electronics	4	LCD and LED TVs, instrument control systems, air conditioning systems, mobile billboard assembly
8	Construction	19	Concrete, block, bricks, asphalt, cement, metal doors and windows
9	Automobile	4	Radio, bent glass, shocks absorber, motorcycle assembly
10	Wood	3	Wood products (doors, windows, cabinets etc.), home and office furniture
11	Recycling	3	Package waste, PET
12	Oil, gas and petrochemicals	7	Refined oil, condensed gas
13	Others	5	Vessel repairing, turbine repairing, construction of offshore structures etc.

Source: Qeshm Free Zone Organization website

2) Minimization and treatment

Minimizing the amount of disposed waste is one of the principal objectives. In this regard, priority should be given in the order as described below.

(a) Avoiding the generation of waste through appropriate design and material procurement,
(b) Reusing material within the factory and exchanging material with other factories,
(c) Converting waste into raw materials for recycling, and
(d) Reducing the waste amount by use of treatment technologies, such as incineration and melting.

In addition to the above, the following are also important for dealing with hazardous waste:

(a) Using non-toxic raw materials for production,
(b) Neutralizing acid and alkali,
(c) Detoxifying hazardousness by incineration, melting etc., and
(d) Solidifying hazardous waste with concrete.

The table below shows the typical recycling method(s) according to the type of waste.

Table 7.4.7 Recycling of Industrial Waste

No.	Type of waste	Recycling
1	Ash	Cement
2	Sludge: inorganic, organic	Cement, energy
3	Oil: liquid, solid, sludge	Oil, energy
4	Acid	Acid
5	Alkali	Alkali
6	Plastic: plastic, tire	Plastic material, energy etc.
7	Rubber	Rubber powder, energy
8	Metal	Metal
9	Glass, ceramic	Glass, ceramic
10	Slag	Aggregate etc.
11	Construction and demolition waste	Aggregate, energy etc.
12	Dust	Cement, fertilizer etc.
13	Paper	Pulp, energy
14	Wood	Pulp, energy
15	Textile	Pulp, energy
16	Animal and vegetable	Compost, gas

Source: JICA Project Team

3) Final disposal

Non-hazardous industrial waste can be disposed of, together with ordinary waste, in a sanitary landfill, although it is preferable to have an exclusive site for industrial waste.

Hazardous waste must be treated in order to become non-hazardous before being disposed of in the sanitary landfill. If the waste or residue after treatment is hazardous, it should be disposed of in a special landfill.

(2) Construction and demolition waste

The amount of construction and demolition waste is estimated to increase from 32,005 tons/year in 2016 to 129,441 tons/year in 2036. A manufacturing factory usually generates only a few types of waste, whereas a construction/demolition site generates various types of waste. Therefore, it is very important to conduct on-site separation of waste to ensure successful recycling. Qeshm Island is undergoing rapid economic development, which requires a lot of materials for constructing roads, buildings etc., as well as for the reclamation of low ground, such as valleys and swamps.

The following shows examples of on-site separation, on-site recycling etc. of construction and demolition waste. It is recommended that information on the importance of on-site separation is disseminated on Qeshm.

Separation on the worksite

Grind on the worksite

Source: JICA Project Team

Figure 7.4.9 Separation of Construction and Demolition Waste

7.4.6 Consideration of key Issues for hospital waste

The hospital waste amount is estimated to be 134 tons/year in 2016 and 265 tons/year by 2036. This amount includes infectious and non-infectious waste. The estimates for the hospital waste amount are presented in detail in the Appendix.

Separation at generation sources is the most important activity in hospital waste management. Hospitals generate infectious and non-infectious waste. Usually, the amount of infectious waste is much smaller than non-infectious waste. However, if these two kinds of waste are mixed in the hospital, all waste becomes infectious, which directly impacts on the costs of treatment and disposal.

Currently, infectious waste is treated by an autoclave in Payambar Azam Hospital. Introducing incineration, which is more secure than other treatment method, is recommended. Nowadays, good quality small incinerators are available.

Table 7.4.8 Hospital Waste Treatment Alternatives

Treatment method	Advantages	Disadvantage
Incineration	• A high temperature of more than 800˚C can appropriately treat almost all types of hospital waste • The waste converts to ash, meaning that it can be easily confirmed whether the waste has been treated • Waste volume is highly minimized • The residue (ash) can be disposed of in a landfill	• Incinerators are usually more expensive than other treatment methods • It may require skilled staff • A low performance incinerator may emit toxic gas
Autoclave	• This method does not usually emit toxic gases • This is usually less expensive than incineration • Hospitals are usually familiar with this method for sterilizing medical tools	• It cannot be assured whether the waste has been disinfected, as it maintains its original shape after treatment • It is usually necessary to crash the waste before landfilling • It does not minimize the volume of the waste
Chemical disinfection	• This method does not require special equipment • It is usually the least expensive of the three methods	• It cannot be assured whether the waste has been disinfected • Chemicals themselves are hazardous to health

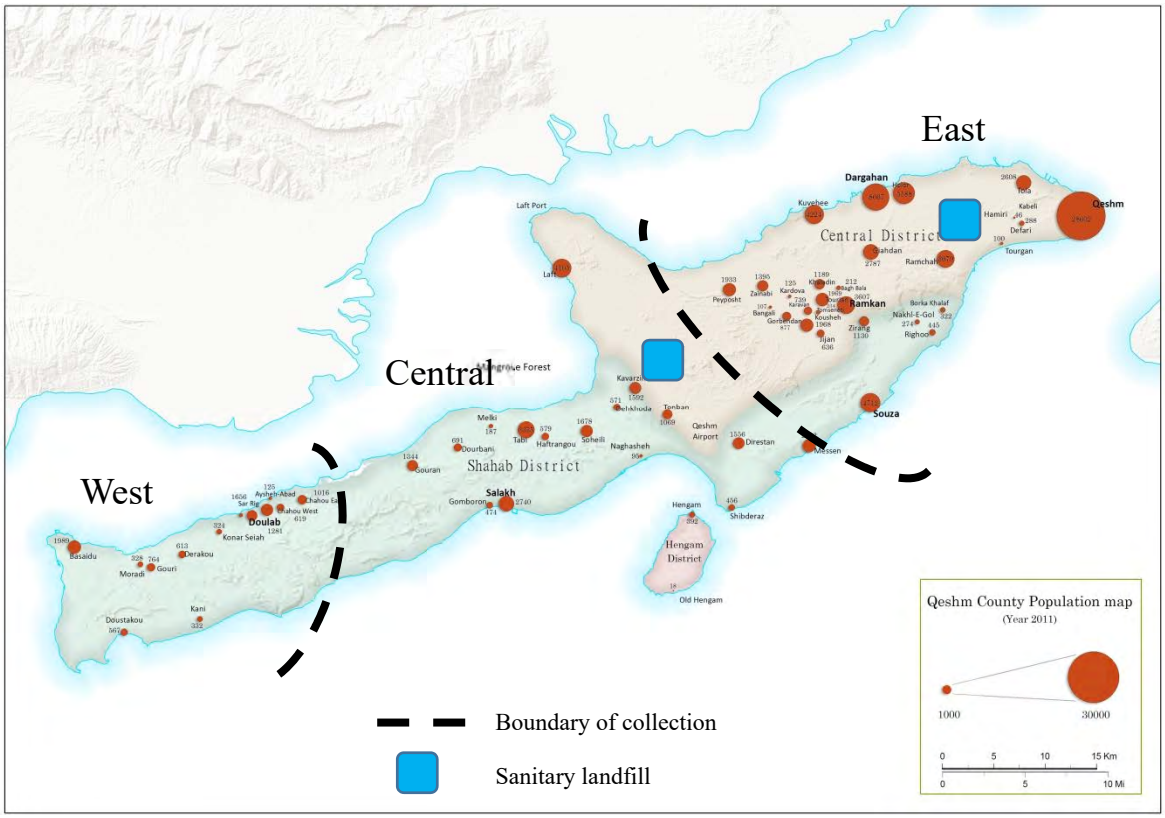
Source: JICA Project Team

7.4.7 Development plan

This section presents the development plan for the solid waste management sector based on the previous discussions.

(1) Ordinary waste

The figure below schematizes the overall picture regarding the management of ordinary waste. The island is to be divided into three areas (East, Central and West Areas) for the purposes of collection. The Towla Disposal Site is to be converted from the current dumping site to a sanitary landfill in the short-term phase and will serve the East Area until 2036. The island is to have another landfill in the Central Area. The recommended location is between Laft and Kovarzin. This landfill is to be used by the Central Area and the East Area.



Source: JICA Project Team

Figure 7.4.10 Ordinary Waste Management Plan

1) Development objectives and measures

The following shows the objectives, as well as the measures to attain them, regarding ordinary waste management.

Table 7.4.9 Development Objectives and Measures of the Ordinary Waste Management Plan

Area	Development objectives	Measures
East	• To establish sanitary landfilling • To encourage recycling to minimize the waste amount to be disposed of at the landfill • To eliminate waste disposal in villages	• Construction and operation of a sanitary landfill at the Towla Disposal Site • Dissemination of the importance of waste separation at sources and the implementation of various recycling activities • Introduction of transportation from villages to the sanitary landfill at the Towla Disposal Site by compactor trucks
Central	• To establish sanitary landfilling • To encourage recycling to minimize the waste amount to be disposed of at the landfill • To eliminate waste disposal in villages	• Construction and operation of a sanitary landfill in the Central Area • Dissemination of the importance of waste separation at sources and the implementation of various recycling activities • Introduction of transportation from villages to the sanitary landfill by compactor trucks
West	• To establish sanitary landfilling • To encourage recycling to minimize the waste amount to be disposed of at the landfill • To eliminate waste disposal in villages	• Construction and operation of a sanitary landfill in the Central Area • Dissemination of the importance of waste separation at sources and the implementation of various recycling activities • Introduction of transportation from villages to the sanitary landfill by compactor trucks

Source: JICA Project Team

2) Target rates and waste amount

The following shows the target rates and waste amount for each planning phase. The agencies concerned can monitor the progress of development by comparing the figures presented in Table 7.4.10 below.

Table 7.4.10 Target Rates and Amount of Ordinary Waste

No.	Item	Unit	2016	2021	2026	2036
	East Area (urban)					
1	Target rate					
	Recycling	%	1	5	10	20
	Village disposal	%	10	6	1	0
	Inappropriate dumping	%	89	0	0	0
	Sanitary landfilling	%	0	89	89	80
2	Annual waste amount					
	Generation	Tons/year	26,807	33,522	42,237	67,266
	Recycled	Tons/year	268	1,672	4,224	13,453
	Village disposal	Tons/year	2,681	2,011	422	0
	Inappropriate dumping	Tons/year	23,858	0	0	0
	Sanitary landfilling	Tons/year	0	29,835	37,591	53,813
3	Daily waste amount					
	Generation	Tons/day	73	92	116	184
	Recycled	Tons/day	1	5	12	37
	Village disposal	Tons/day	7	6	1	0
	Inappropriate dumping	Tons/day	65	0	0	0
	Sanitary landfilling	Tons/day	0	81	103	147
	Central Area (rural)					
1	Target rate					
	Recycling	%	1	5	10	20
	Village disposal	%	84	15	10	0
	Disposal around houses	%	15	3	0	0
	Sanitary landfilling	%	0	77	80	80
2	Annual waste amount					
	Generation	Tons/year	5,631	6,708	8,357	12,333
	Recycled	Tons/year	56	335	836	2,467
	Village disposal	Tons/year	4,730	1,006	836	0
	Disposal around houses	Tons/year	845	201	0	0
	Sanitary landfilling	Tons/year	0	5,166	6,685	9,866
3	Daily waste amount					
	Generation	Tons/day	15	18	23	34
	Recycled	Tons/day	0	1	2	7
	Village disposal	Tons/day	13	3	2	0
	Disposal around houses	Tons/day	2	1	0	0
	Sanitary landfilling	Tons/day	0	13	19	27
	West Area (rural)					
1	Target rate					
	Recycling	%	1%	5%	10%	20%
	Village disposal	%	84%	15%	10%	0%
	Disposal around houses	%	15%	3%	0%	0%
	Sanitary landfilling	%	0%	77%	80%	80%
2	Annual waste amount					
	Generation	Tons/year	2,427	2,863	3,369	5,605
	Recycled	Tons/year	24	143	337	1,121
	Village disposal	Tons/year	2,039	429	337	0
	Disposal around houses	Tons/year	364	86	0	0
	Sanitary landfilling	Tons/year	0	2,205	2,695	4,484
3	Daily waste amount					
	Generation	Tons/day	7	8	9	15
	Recycled	Tons/day	0	0	1	3
	Village disposal	Tons/day	6	1	1	0
	Disposal around houses	Tons/day	1	0	0	0
	Sanitary landfilling	Tons/day	0	7	7	12

Source: JICA Project Team

3) Technical system

The following shows the technical system for ordinary solid waste management.

Table 7.4.11 Technical System for Ordinary Solid Waste Management

Technical system	Short term	Medium term	Long term
East Area			
Collection	• Towns: by compactor trucks • Villages: by small trucks and/or farm tractors (use compactor trucks, if available)	• Same as short term	• Same as short term
Transport	• Towns: by compactor trucks used for collection • Villages: by compactor trucks dedicated to transportation	• Same as short term	• Same as short term
Recycling	Education, with small-scale recycling activities, as follows: • Education in schools • Waste separation at schools, government offices, public facilities, parks etc. • Installation of recyclable material exchange points • Recycling at shops, restaurants, hotels etc. • Recycling in communities • Use of food waste for animal feeding • Food waste for composting etc.	• Same as short term	• Same as short term
Final Disposal	• Initiation of sanitary landfilling at the Towla Disposal Site	• Expansion of the sanitary landfill at the Towla Disposal Site	• Same as medium term
Central Area			
Collection	• By small trucks and/or farm tractors (use compactor trucks, if available)	• Same as short term	• Same as short term
Transport	• By compactor trucks dedicated to transportation	• Same as short term	• Same as short term
Recycling	Education, with small-scale recycling activities, as follows: • Education in schools • Waste separation at schools, government offices, public facilities, parks etc. • Installation of recyclable material exchange points • Recycling at shops, restaurants, hotels etc.	• Same as short term	• Same as short term
Final Disposal	• Initiation of sanitary landfilling	• Expansion of the sanitary landfill in the Central Area	• Same as medium term
West Area			
Collection	• By small trucks and/or farm tractors (use compactor trucks, if available)	• Same as short term	• Same as short term
Transport	• By compactor trucks dedicated for transport	• Same as short term	• Same as short term
Recycling	Education, with small-scale recycling activities, as follows: • Education in schools • Waste separation at schools, government offices, public facilities, parks etc. • Installation of recyclable material exchange points • Recycling at shops, restaurants, hotels etc.	• Same as short term	• Same as short term
Final Disposal	• Initiation of sanitary landfilling	• Expansion of the sanitary landfill in the Central Area	• Same as medium term

Source: JICA Project Team

(2) Industrial waste

1) Development objectives and measures

The following shows the objectives and measures for the management of non-hazardous and hazardous waste from the manufacturing industry, as well as construction and demolition waste.

Table 7.4.12 Development Objectives and Measures for the Industrial Management Plan

Waste	Development Objectives	Measures
Non-hazardous	• To minimize the waste amount to be disposed of	• To establish an information system • To encourage recycling
Hazardous	• To secure proper management by generators • To secure safe disposal	• To establish an information system • To introduce treatment technology • To construct a special landfill
Construction and demolition waste	• To minimize the waste amount to be disposed of	• To introduce separation at sources • To introduce treatment technologies • To link waste management with construction works

Source: JICA Project Team

2) Targets and waste amount

The following shows the target rates and waste amount for each planning phase. The agencies concerned can monitor the progress of development by comparing the figures presented here.

Table 7.4.13 Target Rates and Waste Amount of Industrial Waste

Item	Unit	2016	2021	2026	2036
Non-hazardous					
1. Target rates					
Recycling	%	30	35	40	50
Treatment	%	0	0	10	20
Minimization	%	30	35	49	68
2. Annual waste amount					
Generation	Tons/year	20,448	29,115	42,189	82,698
Recycling	Tons/year	6,134	10,190	16,876	41,349
Treatment	Tons/year	0	0	4,219	16,540
Final disposal	Tons/year	14,314	18,925	21,516	26,463
3. Daily waste amount					
Generation	Tons/day	56	80	116	227
Recycling	Tons/day	17	28	46	114
Treatment	Tons/day	0	0	12	45
Final disposal	Tons/day	39	52	59	73
Hazardous					
1. Target rates					
Recycling	%	40	45	50	60
Treatment	%	0	0	10	30
Minimization	%	40	45	59	87
2. Annual waste amount					
Generation	Tons/year	4,445	6,329	9,171	17,978
Recycling	Tons/year	1,778	2,848	4,586	10,787
Treatment	Tons/year	0	0	917	5,393
Final disposal	Tons/year	2,667	3,481	3,760	2,337
3. Daily waste amount					
Generation	Tons/day	12	17	25	49
Recycling	Tons/day	5	8	13	29
Treatment	Tons/day	0	0	3	15
Final disposal	Tons/day	7	9	9	7
Construction					
1. Target rates					
Reclamation	%	20	35	50	50
Recycling	%	0	0	20	40
Minimization	%	20	35	66	82
2. Annual waste amount					
Generation	Tons/year	32,005	45,572	66,304	129,441
Reclamation	Tons/year	6,401	15,950	33,017	64,721
Recycling	Tons/year	0	0	13,207	51,776
Final disposal	Tons/year	25,604	29,622	22,451	23,299
3. Daily waste amount					
Generation	Tons/day	88	125	181	355
Reclamation	Tons/day	18	44	91	178
Recycling	Tons/day	0	0	36	142
Final disposal	Tons/day	70	81	61	63

Source: JICA Project Team

3) Technical system

The following shows the technical system for industrial solid waste management.

Table 7.4.14 Technical System for Industrial Waste Management

Technical system	Short term	Medium term	Long term
Non-hazardous waste			
Collection/transport	• By generators • By authorized collector/ transporter	• Same as short term	• Same as short term
Recycling	• Establishment of information system about types and amounts of non-hazardous waste generated at each factory • Encouragement of waste reuse within each factory or waste exchange among factories	• Operation of the information system about types and amounts of non-hazardous waste generated at each factory • Encouragement of waste reuse within each factory or waste exchange among factories	• Same as medium term
Treatment	• Establishment of information system about types and amounts of non-hazardous waste generated at each factory	• Introduction of treatment with hazardous waste	• Operation of treatment with hazardous waste
Final disposal	• Disposal with ordinary waste	• Same as short term	• Same as short term
Hazardous waste			
Collection/ transport	• By generators • By authorized collector/ transporter	• Same as short term	• Same as short term
Recycling	• Establishment of information system about types and amounts of hazardous waste generated at each factory • Encouragement of waste reuse within each factory or waste exchange between factories	• Same as short term	• Same as short term
Treatment	• Establishment of information system about types and amounts of hazardous waste generated at each factory	• Operation of the information system about types and amounts of hazardous waste generated at each factory • Introduction of treatment system • Introduction of hazardous waste landfill	• Same as short term
Final disposal	• Treatment by factories and/or storage in factories	• Treatment residue to be disposed of at ordinary landfill • Hazardous waste to be disposed of at special landfill	• Same as short term
Construction and demolition waste			
Collection/transport	• By generators • By authorized collector/ transporter	• Same as short term	• Same as short term
Reclamation	• Establishment of information system about types and amounts of construction and demolition waste at each construction site • Encouragement of separation at source	• Operation of the information system about types and amounts of construction and demolition waste at each construction site • Linkage of construction and demolition waste information to construction works	• Same as medium term
Recycling	• Establishment of information system about types and amounts of construction and demolition waste	• Operation of the information system about types and amounts of construction and	• Operation of the information system about types and amounts of

	at each construction site • Encouragement of separation at source	demolition waste at each construction site • Introduction of recycling system which produces road construction materials	construction and demolition waste at each construction site • Operation of recycling system to produce road construction materials
Final disposal	• Inert waste to be disposed of at construction and demolition waste disposal site • Other non-hazardous waste to be disposed of at ordinary landfill • Hazardous waste to be stored by generators	• Same as short term	• Same as short term

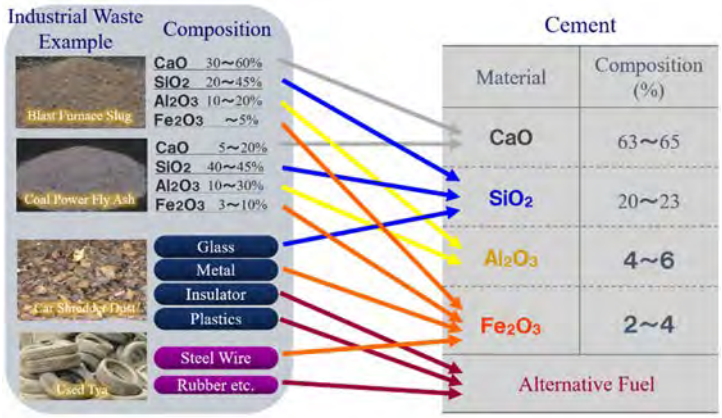
Source: JICA Project Team

The amount of ordinal waste and industrial waste will increase as the population increases and economic activity is encouraged. In Japan, both types of waste are treated in cement plants. By using the waste for cement materials, the chemical composition of the waste becomes stable. A final disposal site is not required because the waste is used for the cement material. There is a cement plant on Qeshm Island. It is worthwhile considering the utilization of this cement plant for the treatment of solid waste. A concept using cement plants for waste treatment is shown below.

Towards a zero-emissions city using cement manufacturing for treatment of solid waste

(1) Cement manufacturing and solid waste treatment in Japan

The daily production volume of cement plants was 59,114 tons in Japan in 2016. The amount of 27,994 tons from solid wastes was used to produce the cement. In turn, 0.474 tons of solid waste was used for the materials to produce 1 ton of cement. The used solid waste includes a variety of ordinal waste and industrial waste, such as iron slag, construction waste, used tires, plastic, chemical products, waste oil and incinerated ash.
According to the Japanese Industrial Standards (JIS), the required chemical and mineral compositions are specified for Portland cement and Eco-Cement, which is made from waste. The differences in the required compositions are small for these two types of cements. There is no problem using Eco-Cement for concrete materials.



Source: JICA Project Team
Industrial Waste and Ingredients of Cement

Standard of Portland Cement and Eco-Cement

Cement Type	Chemical Composition (%)								Mineral Composition (%)				
	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	R_2O	Cl^-	C_3S	C_2S	C_3A	C_4AF	Others
Portland Cement	25.0 max.	5.0 max.	4.0 max.	65.0 max.	5.0 max.	3.0 max.	0.75 max.	0.035 max.	57	19	8	8	8
Eco-Cement					5.0 max.	4.5 max.	0.75 max.	0.1 max.	49	12	14	13	12

Source: JIS

(2) Cement plants in Iran

There are 65 cement plants with a daily cement production capacity of more than 350 tons in Iran. The total production capacity is estimated at 234,660 tons/day. If these plants are used to treat solid waste, the issues related to solid waste treatment in cities may be considerably solved. Cement plants can be utilized for the treatment of ordinal waste and industrial waste. They can be utilized for the treatment of incinerated ash from waste incineration plants. Cement plants can be incorporated with different types of solid waste treatment. Characteristics of waste treatment using a cement plant are shown on the right.

Features of a Cement Plant

	Cement Kiln
Processing temperature	1,450°
Waste to be used	
Municipal Waste	Yes
Industrial Waste	Yes (including hazardous industrial waste)
Waste residue	
Amount	0
Disposal	0
Construction/Facility Cost	Minimum additional cost
Operation Cost	Low (as part of cement manufacturing)

Source: JICA Project Team

(3) Way forward in using cement plants for solid waste treatment in Iran

The type of treatment process using cement plants differs depending on the composition of solid wastes. The most suitable treatment process, such as incineration and fermentation, must be examined after the composition of solid waste is studied in each city. Experts, universities, research institutes and cement companies, by having knowledge related to chemical reaction, incineration technology, cement engineering, etc., should be engaged to find the best treatment process.

4) Hospital waste

Development objectives and measures

The following shows the objectives and measures for the management of hospital waste, both infectious and non-infectious.

Table 7.4.15 Development Objectives and Measures of Hospital Management Plan

Waste	Development objectives	Measures
Infectious	• To treat and dispose of in order to avoid infection by the waste	• To establish a collection system for small clinics • To dispose of waste in a special landfill • To introduce incineration
Non-infectious	• To prevent non-infectious waste from becoming infectious	• To separate out infectious waste properly in order not to contaminate non-infectious waste

Source: JICA Project Team

Targets and waste amount

The following shows the target rates and waste amount for each planning phase. The agencies concerned can monitor the progress of development by comparing the figures presented here.

Table 7.4.16 Target Rates and Amount of Hospital Waste

Item	Unit	2016	2021	2026	2036
Infectious					
1. Target rates					
Separation	%	80	88	98%	100
Treatment	%	80	88	98%	100
2. Annual waste amount					
Generation	tons/year	47	55	65	93
Treatment	tons/year	38	48	64	93
Disposal at special cell	tons/year	-	7	1	0
3. Daily waste amount					
Generation	tons/day	0.13	0.15	0.18	0.25
Treatment	tons/day	0.10	0.13	0.18	0.25
Disposal at special cell	tons/day	-	0.02	0.00	0.00
Non-infectious					
1. Target rates					
Separation	%	80	88	98	100
2. Annual waste amount					
Generation	tons/year	87	101	120	172
Disposal at special cell	tons/year	-	12	2	0
3. Daily waste amount					
Generation	tons/day	0.24	0.28	0.33	0.47
Disposal at special cell	tons/day	-	0.03	0.01	0.00

Source: JICA Project Team

Technical system

The following shows the technical system for hospital solid waste management.

Table 7.4.17 Technical System for Hospital Waste Management

Technical System	Short term	Medium term	Long term
Infectious waste			
In hospitals/clinics	• Dissemination of separation at source in clinics • Installment of storage facilities at clinics	• Ditto	• Ditto
Collection/transport	• Establishment of collection system of infectious waste generated at small clinics	• Expansion of collection system of infectious waste generated at small clinics	• Ditto
Treatment	• Introduction of an incinerator	• Operation of the incinerator	• Ditto
Final disposal	• Incineration residue to be disposed of at ordinary landfill	• Ditto	• Ditto
Non- infectious waste			
In hospitals/clinics	• Dissemination of separation at source in clinics	• Ditto	• Ditto
Collection/transport	• By ordinary waste collection service	• Ditto	• Ditto
Final disposal	• At ordinary landfill	• Ditto	• Ditto

Source: JICA Project Team

7.4.8 Proposed projects and cost estimates

The following tables show the projects relating solid waste management in phases.

Table 7.4.18 Solid Waste Management Projects

Project title	Organization	Phasing			Cost (USD millions)			
		Short term	Mid term	Long term	Short term	Mid term	Long term	Total
Ordinary waste								
1. Transport of village waste	QFZO	X			0.35			0.35
2. Encouragement of recycling *	QFZO	X						0
3. Sanitary landfilling at Towla	QFZO	X			2.40			2.40
4. Sanitary landfilling in Central Area	QFZO	X			1.20			1.20
Industrial waste								
1. Information system of waste type and amount *	QFZO	X						0
2. Hazardous waste treatment	QFZO		X	X		12.00	12.00	24.00
3. Hazardous waste landfilling	QFZO		X			5.00		5.00
4.Construction and demolition waste recycling	QFZO		X	X		2.00	2.00	4.00
Hospital waste								
1. Infectious waste management at small clinics	Clinics	X		X	0.05		0.05	0.10
2. Incineration of infectious waste	QFZO	X		X	0.08		0.08	0.16

Source: JICA Project Team

7.5 Power Supply and Renewable Energy

7.5.1 Existing conditions

(1) Outline of the electric power industry in the Islamic Republic of Iran

The Tavanir Company, under the Ministry of Energy, is a holding company for the generation, transmission and distribution of electricity in Iran, which is currently responsible for the management of the following entities in the context of the electric power industry in Iran:

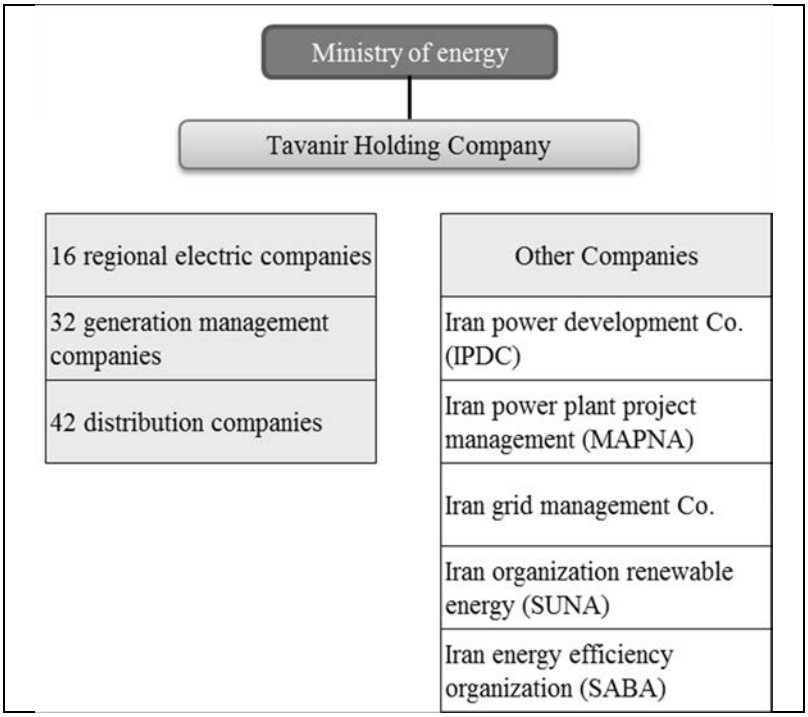
(a) Sixteen regional electric companies – The facilities for generation, transmission, and distribution in each region are owned by the respective regional electric companies, except for the generation facilities owned by the private sector.
(b) Thirty-two generation management companies – Each of these companies acts as a contractor for the operation of a power plant(s), under an agreement with the respective regional electric company, and is responsible for the operation of one or more of the power plants in the region.
(c) Forty-two distribution companies – At present, the activities of the distribution companies are carried out under five agreements with the regional electric companies:
- ✓ Agreement for customer service
- ✓ Agreement for planning design and supervision
- ✓ Agreement for improvement and optimization
- ✓ Agreement for the development of services

Of these 42 companies, some cover distribution in the provinces, while others cover distribution in the cities.
(d) Iran Power Development Company (IPDC) – National projects for the construction of power plants and transmission lines are assigned to the IPDC by the Tavanir Company.
(e) Iran Power Plant Project Management (MAPNA) – MAPNA started its activities in 1993, working with 170 Iranian and foreign contractors. It is the largest company implementing power plant projects in Iran.
(f) Iran Grid Management Company (IGMC) – This network management company has been established to pursue the following objectives:
- ✓ To conduct and monitor the transmission network for the country, as well as maintain network stability and reliability,
- ✓ To provide the necessary measures for indiscriminate access by the public to the electric network of the country, and
- ✓ To implement missions as defined for this company by the Tavanir Company or the Minister of Energy in order to ensure a reliable supply of electricity, as well as develop a competitive environment for companies involved in the generation and distribution of electricity.

(g) Iran Power Plant Repairs Company – This company consists of sections dealing with mechanical repairs, power plant repairs, electrical repairs and the manufacturing of equipment.
(h) Renewable Energy Organization of Iran (SUNA) – Responsible for developing the utilization of energy from renewable and new sources of energy, SUNA was established with the following mission:
- ✓ To carry out research and development projects, deliver training, publish information booklets, generate designs and perform consultancy services regarding the construction of pilot plants, as well as provide techno-economical support for capacity development (particularly in the non-governmental sector), in order to realize the efficient use of energy and new resources within the framework of energy policies set forth by the Ministry of Energy,
- ✓ To manage the plans and projects related to the mission of the organization, and
- ✓ To cooperate with other companies and institutes to fulfill the mission of the organization

(i) Iran Energy Efficiency Organization (SABA) – SABA was established with the following mission:
- ✓ To implement energy and load management in various factories in the country,
- ✓ To offer consultancy services for the provision of measuring instruments,
- ✓ To prepare and set standards of energy consumption by home appliances and industries,
- ✓ To subsidize facilities and provide low-interest loans for the implementation of energy conservation projects, and
- ✓ To create publications and hold cultural activities to promote the development of public cooperation in the optimization of energy consumption.

The following figure shows the organizational chart of electric power affairs in the Ministry of Energy of Iran (related companies only).



Source: JICA Project Team based on the Tavanir Company website

Figure 7.5.1 Organization Chart of Electric Power Affairs in the Ministry of Energy of Iran

(2) Outline of the electric power industry on Qeshm Island

1) Structure of the electric power industry

The following table shows the structure of the electric power industry on Qeshm Island, as classified by sectors (transmission, distribution and generation), excluding the Towla Industrial Zone. The Qeshm Electric Power Distribution Company (TOZI) covers the distribution power line with 20 kV or less. Higher voltage is covered by the Hormozgan Regional Electric Power Company. Currently, there is only one power plant on Qeshm Island, which is owned and operated by MAPNA (see the table below).

Table 7.5.1 Outline of Infrastructural Ownership and Operation in the Electric Power Industry on Qeshm Island, Excluding the Towla Industrial Zone

	Ownership	Operation
Transmission	Hormozgan Regional Electric Power Company	Hormozgan Regional Electric Power Company
Distribution	Hormozgan Regional Electric Power Company	TOZI
Generation	MAPNA	MAPNA

Source: JICA Project Team, based on information from the QUC

Hengan Island receives electricity via three undersea cables of 20kV from Qeshm Island. The peak demand is estimated at approximately 1.2 MW.

2) Reliability of the power supply

There are 10 substations (step-down: 63kV to 20kV) and 62 feeders (step-down: 20kV to 380V or 200V) on Qeshm Island. The following data in 2015 regarding the reliability of the power supply have been provided by TOZI.

(a) Number of interruptions per feeder: 2.56 times per month
(b) Average duration of interruptions: 55 minutes
(c) Average duration of interruptions per all customers: 5.4 minutes per month

The third index above is the same as the System Average Interruption Frequency Index (SAIFI)8, which is an index commonly used worldwide that indicates the reliability of the power supply; if converted to an annual basis, it is 64.8 minutes/year (5.4 minutes x 12 = 64.8). This value is the highest among developing countries, as shown in the table below.

Table 7.5.2 SAIFI in Other Developing Countries

Country or region	SAIFI	
	2008	2009
Mongolia (Western Region)	17	23
Indonesia (PLN)	13.33	10.78
Thailand (MEA)	2.3	1.85
Philippines (Meralco)	1.38	1.48
Malaysia (TNB)	0.87	0.76

Source: JICA Project Team, based on the following information:
Mongolia – Annual Report 2009, Energy Regulatory Authority; Indonesia – PLN Statistics, 2000–2010; Thailand – Annual Report 2003–2010, MEA; Philippines – Financial and Operating Results, 1Q, Meralco; Malaysia – Electricity Supply Industry in Malaysia, Performance and Statistical Information 2010, EC (formerly DEGSM)

(3) Power demand forecast

On Qeshm Island, the current peak demand is thought to be approximately 200 MW, with 70% of the electric power demand derived from residential customers. Considering the strong growth in power demand resulting from this, it is recognized that non-industrial (e.g., residential) customers are the major drivers of power demand, according to TOZI. The numbers of customers by type in 2014 within the service area of TOZI are shown in the following table.

8 The SAIFI is the average time of interruptions per consumer/year (duration of interruptions (min.)/number of all customers/year).

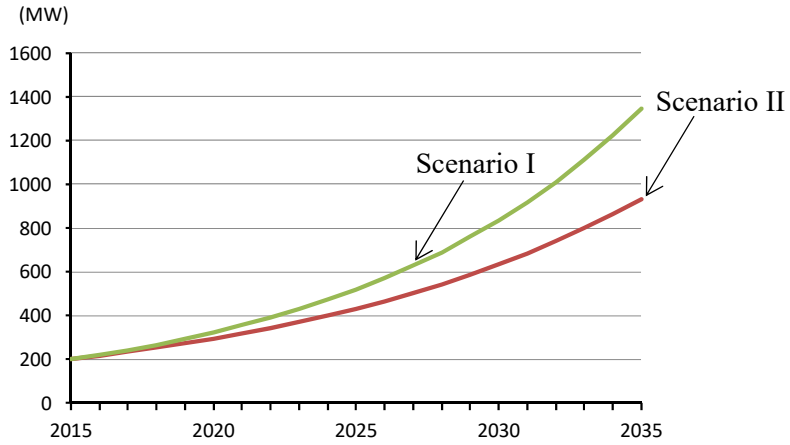
Table 7.5.3 Number of Customers in 2014 in the TOZI Service Area

Residential	Public	Agriculture	Industrial	Other	Street lighting	Total
46,368	2,461	53	139	12,683	117	61,821

Source: JICA Project Team, based on TOZI, 2014-2015, Performance of Electric Power Management on Qeshm

An average annual growth rate of 8-10% is forecasted by TOZI for the foreseeable future. Based on the current peak demand and this forecast, two scenarios are estimated with different growth rates, as below.

(a) *Scenario I: AAGR=10%* – The peak demand is forecasted at 1,345 MW by 2035
(b) *Scenario II: AAGR=8%* – The peak demand is forecasted at 932 MW by 2035



Source: JICA Project Team based on information from TOZI

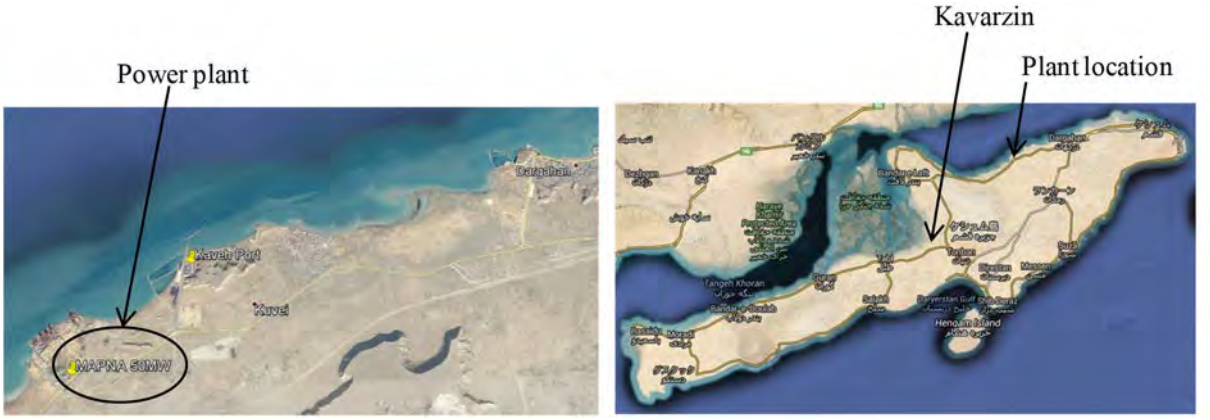
Figure 7.5.2 Peak Demand Forecast on Qeshm Island, 2015-2035

(4) Existing power plant and construction plan for power generation plants

A power (and water desalination) plant exists on Qeshm Island, with a production capacity of 50 MW (25 MW x 2) as its rated output. It is the only power plant connected to the electric power system on Qeshm Island. As for the fuel supply to the plant, the source of natural gas is the Hangom Reserve, which is located south of Hangom Island. The natural gas is delivered from the reserve to Kovarzin, where the refinery facilities are located, through a sea-bottom pipeline and an underground pipeline. Then, the natural gas is distributed to Qeshm City and the mainland through an underground pipeline and a sea-bottom pipeline. The power plant is located between Kovarzin and Qeshm City, and receives natural gas from the underground pipeline heading towards Qeshm City.

The plant is owned by MAPNA and the power generated at the plant is connected to TOZI9. The location of the power plant is shown in the following figure. The separation of infrastructural ownership and operation of the existing power plant is shown in the table below.

9 In Iran, there are many private power generation companies selling electric power to both private and public sector customers.



Source: JICA Project Team

Figure 7.5.3 Location of the Power Plant Near Kavah Port

In this power and desalination plant, 90% of the power generated is utilized at the desalination plant, while the remaining 5 MW is supplied to the distribution system based on its specifications. The table below describes the major specifications of the plant.

Table 7.5.4 Major Specifications of a Power and Desalination Plant

Item	Specifications
Power output	50 MW (2 x 25 MW)
Power generator	Gas turbines with natural gas combustion Gross electric efficiency = 34.2%
Flue gas temperature	488℃
Heat recovery steam generators (HRSG)	HRSG efficiency = 78.4%
Water desalination units	4 x 4,500 m^3/day
Power demand for water desalination units	45 MW (approx.22 MW for each)
Heat to power ratio	1.59

Source: JICA Project Team, based on UNFCCC, 2013, CDM-Project Development Design for the Power and Dissimilated Water Plant

According to the QUC, there are currently construction plans for two new power plants, summarized as below. Natural gas will be supplied to both plants in the same way as the existing plant.

(a) *No. 2 power plant* – Total capacity of 500MW. This plant will start with 70 MW (likely to be a combined cycle) in the very near future, although water desalination is not planned to be a part of this unit.
(b) *No. 3 power plant* – Total capacity of 500MW.

The locations of the planned power plants are shown in the following figure, alongside a comparison with those suggested in the SWECO Master Plan.

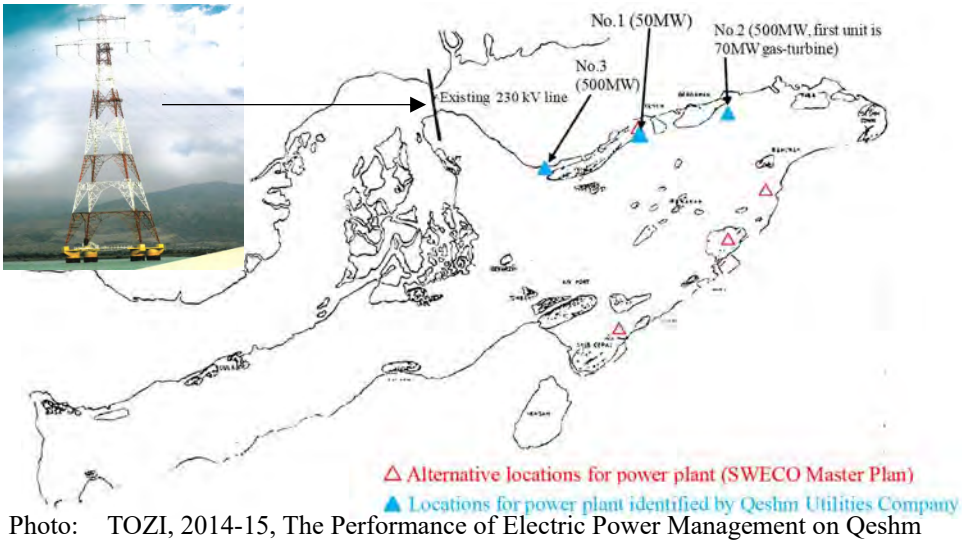


Photo: TOZI, 2014-15, The Performance of Electric Power Management on Qeshm
Source: JICA Project Team

Figure 7.5.4 Locations of Planned Power Plants

In addition to these construction plans for power generation plants, the electricity supplied from the mainland by the transmission line will also continue to be one of the major power supply sources for Qeshm Island. The two-line transmission line was constructed in the early 2000s, connecting Laft to Bandar Pol (approximately 2 km) with a voltage of 230kV (400MW).

In order to maintain the current stable situation regarding the supply of electric power, it is concluded that the current construction plans should be implemented, as indicated by the QUC, on a timely basis, in consideration of the aforementioned peak demand forecast for 2035 (1,345 MW under Scenario I).

7.5.2 Issues to be tackled

(1) Dissemination of renewable energy sources

The National Energy Plan of Iran is focused on the optimized utilization of fossil fuel resources, with improvements in the exploitation of diversified resources (i.e., renewable energy sources) in order to supply a portion of the power demand. SUNA, under the Ministry of Energy, officially set a target for renewable sources to provide 5% of the national generation of electricity; this target is mostly achieved by hydropower.

Meanwhile, Iran is also one of the 147 members of the International Renewable Energy Agency (IRENA). IRENA is an intergovernmental organization that supports countries in their transition to a sustainable energy future. In its recent report, IRENA's deployment target for renewable energy in the electric power sector is quantitatively described in relation to two scenarios, as described below:

- Reference Case 2030 based on existing plans and policies
  - ✓ Renewable energy target for installed capacity: 29GW (30% of total)
  - ✓ Renewable energy target for electricity generation: 63TWh (15% of total)
- REmap Options 2030 including the deployment of additional renewable energy
  - ✓ Renewable energy target for installed capacity: 42GW (39% of total)
  - ✓ Renewable energy target in electricity generation: 93TWh (22% of total)

As such, the active stance towards the diffusion of renewable energies in the electric power sector is apparent and the major renewable sources expected to be increased by the Iranian government in the period to 2030 are hydro, wind and solar (PV) energies. The following table shows the targets for electricity generation by renewable energy sources by 2030.

Table 7.5.5 Deployment Targets for Renewable Energies in the Electric Power Sector in Iran by 2030

	Unit	2010	Reference Case 2030	REmap 2030
Total installed power generation capacity	GW	67	98	108
Renewable capacity	GW	10	29	42
Hydropower (excl. pumped hydropower)	GW	10	21	21
Wind	GW	0	6	12
Biofuels (solid, liquid, gaseous)	GW	0	1	2
Solar PV	GW	0	1	8
Non-renewable capacity	GW	57	69	66
Renewable energy share of total installed capacity	%	15	30	39
Total electricity generation	TWh	245	425	425
Renewable generation	TWh	13	63	93
Hydropower	TWh	12	37	37
Wind	TWh	0	16	30
Biofuels (solid, liquid, gaseous)	TWh	0	7	12
Solar PV	TWh	0	2	14
Non-renewable generation	TWh	233	362	331
Renewable energy share of electricity generation	%	5	15	22

Source: Roadmap for a Renewable Energy Future, 2016 Edition, IRENA

Currently, no power plants or specific plan using renewable energies on a utility scale exist on Qeshm Island. In light of the stance by the national government, the introduction of power plants utilizing REs should be highly considered in the future.

In addition, through the meetings with the QFZO, it was suggested that the diffusion of renewable energies as electric power sources is one of its challenges. Among various renewable sources, it was confirmed that the diffusion of PV systems in the residential sector is the most important. Hence, the JPT has conducted case studies for introducing residential PV systems on Qeshm Island.

(2) Case studies of residential PV systems

In Iran, a feed-in tariff (FIT) was established in July 2015, with a new purchase price issued in April 2016, which was set at IRR 8,000/kWh (which equates to USD 0.246/kWh) for the PV systems with a capacity of 20 kW or less (for consumers). This price is considered to be very high in comparison with the unit price for residential customers, which is IRR 1,300/kWh, as well as the unit price in other countries.

Initial case study

The JPT received a quote of USD 1,740/kW for the PV systems this past spring. Within this price, PV panels and inverter and installation expenses are included, while the foundations, cables, connections and transport expenses from Tehran to Qeshm are not included. As it is considered appropriate to assume that the total cost of the installation of the PV system will range from USD 2,000 USD/kW to USD 3,000/kW, the initial case study has been conducted based on this price range. The following shows the assumptions of the initial case study.

- Assumptions:
  i) All power generated by PV systems to be sold to the grid
  ii) Peak power demand: 10 kW
  iii) Annual power generation: 12,797 kWh/y
  iv) Total solar panel area: 60 m²
  v) Annual average irradiation on tilted panels (shadings not included)*: 1,897 kWh/m².y
  vi) Total power of the system: 9.0 kW
  vii) Rate of purchase power under FIT: USD 0. 246/kWh (IRR 8,000/kWh)

viii) Rate for residential customers: USD 0.04/kWh (IRR 1,300/kWh)

Due to the very high purchase rate currently set under the FIT, the payback period is estimated to be between 5.7 and 8.6 years. Annual sales with regard to selling power to the grid are calculated as follows: 12,797 (kWh/y) x 0.246 (USD/kWh) = 3,148 (USD/y). The payback period equates to the results of the trial calculation of the payback period, as shown in the following table.

Table 7.5.6 Payback Period Where All Generated Power is Sold to the Grid (Initial Case Study)

Unit price of initial cost (USD/kWh)	2,000	2,500	3,000
Payback period (y)	5.7	7.1	8.6

Source: JICA Project Team

Case 1

The trial calculation for case 1 has been conducted with other assumptions added in order to ascertain the feasibility of PV systems in the residential sector.

- Additional assumptions to the initial case study:
  - i) Power consumption in the households
  - ii) Load factors by season, day and night, and residents' presence at home are shown in the following table
    (Note: the JPT has made this assumption based on the data shown in appendix 2.5 of Volume 5.)
  - iii) Ratio of residents staying at home during daytime: 20%
  - iv) Ratio of residents staying at home during nighttime: 90%

Table 7.5.7 Assumed Load Factors by Season, Day and Night, and Residents' Presence at Home

		Residents at home		No residents at home	
		Day (7-18)	Night (18-7)	Day (7-18)	Night (18-7)
High AC usage season (May-October)	Load factor (%)	87	67	25	17
Low AC usage season (November-April)	Load factor (%)	63	52	25	17

Source: JICA Project Team

The payback period ranges from 9.9 to 14.8 years as shown in the table below.

Table 7.5.8 Payback Period by Unit Price of the PV system (Case 1)

Unit price of initial cost (USD/kWh)	2,000	2,500	3,000
Payback period (y)	9.9	12.4	14.8

Source: JICA Project Team

It is concluded that the estimated annual financial benefit will be approximately USD 1,800/year due to the decrease in power supply from the grid, while selling power to the grid cannot be realized due to the shortage in the capacity of PV panels. The results of the trial calculation are shown in the following table.

Table 7.5.9 Results of the Trial Calculation (Case 1)

	Total days (7-18)	Total nights (18-7)	Total	Current	PV systems
Power consumption in high AC season (kWh)	7,570	14,830	22,400	22,400	22,400
Power consumption in low AC season (kWh)	6,491	11,412	17,903	17,903	17,903
Power consumption in a year (kWh)	14,060	26,242	40,303	40,303	40,303
Power generation in high AC season (kWh)	6,451		6,451		6,451
Power generation in low AC season (kWh)	6,346		6,346		6,346
Power generation in a year (kWh)	12,797		12,797		12,797
Power from grid with PV in high AC season (kWh)	1,119	14,830	15,949		15,949
Power from grid with PV in low AC season (kWh)	145	11,412	11,557		11,557
Power from grid with PV in a year (kWh)	1,263	26,242	27,506		27,506
Cost for buying power in high AC season (USD)				896	638
Cost for buying power in low AC season (USD)				4,407	2,845
Cost for buying power in a year (USD)				5,303	3,483
Power sold to grid in high AC season (kWh)					0
Power sold to grid in low AC season (kWh)					0
Power sold to grid in a year (kWh)					0
Income from selling power in high AC season (USD)					0
Income from selling power in low AC season (USD)					0
Income from selling power in a year (USD)					0
Cost benefit in high AC season (USD)					258
Cost benefit in low AC season (USD)					1,562
Cost benefit in a year (USD)					1,820

Source: JICA Project Team

Case 2

The trial calculation of case 2 has been conducted with the same assumptions as the aforementioned assumptions, excluding the capacity of PV systems. The additional assumptions are shown below with a view to ascertaining the feasibility of residential large-scale PV systems.

- Additional assumptions:
  - i) Annual power generation: 27,727 kWh/y
  - ii) Total solar panel area: 130 m²
  - iii) Total power of the system: 19.5 kW

The payback period ranges from 9.9 to 14.9 years as shown in the table below.

Table 7.5.10 Payback Period by Unit Price of PV System (Case 2)

Unit price of initial cost (USD/kWh)	2,000	2,500	3,000
Payback period (y)	9.9	12.4	14.9

Source: JICA Project Team

It is concluded that the estimated annual financial benefit will be approximately USD 3,900/year due to the sales of selling power to the grid, in addition to the decrease in power supply from the grid. The results of the trial calculation are shown in the following table.

Table 7.5.11 Results of the Trial Calculation (Case 2)

	Total days (7-18)	Total nights (18-7)	Total	Current	PV systems
Power consumption in high AC season (kWh)	7,570	14,830	22,400	22,400	22,400
Power consumption in low AC season (kWh)	6,491	11,412	17,903	17,903	17,903
Power consumption in a year (kWh)	14,060	26,242	40,303	40,303	40,303
Power generation in high AC season (kWh)	13,977		13,977		13,977
Power generation in low AC season (kWh)	13,749		13,749		13,749
Power generation in a year (kWh)	27,727		27,727		27,727
Power from grid with PV in high AC season (kWh)	0	14,830	14,830		14,830
Power from grid with PV in low AC season (kWh)	0	11,412	11,412		11,412
Power from grid with PV in a year (kWh)	0	26,242	26,242		26,242
Cost for buying power in high AC season (USD)				896	593
Cost for buying power in low AC season (USD)				716	456
Cost for buying power in a year (USD)				1,612	1,050
Power sold to grid in high AC season (kWh)					6,408
Power sold to grid in low AC season (kWh)					7,259
Power sold to grid in a year (kWh)					13,666
Income from selling power in high AC season (USD)					1,577
Income from selling power on low AC season (USD)					1,787
Income from selling power in a year (USD)					3,364
Cost benefit in high AC season (USD)					1,880
Cost benefit in low AC season (USD)					2,046
Cost benefit in a year (USD)					3,926

Source: JICA Project Team

Conclusion and approaches towards the dissemination of residential PV systems

The current electricity purchase price from residential PV generation under the FIT (IRR 8,000/kWh = USD 0.246/kWh) is set at an extremely high price compared to the unit price of electric power for residential users (IRR 1,300 /kWh = USD 0.04/kWh).

However, in the event that the actual introduction of residential PV generation is considered, the payback period will be 9.9 years, even if the unit price for installation of the PV system is assumed to be USD 2,000 /kW, which is reasonable on a global basis, as shown in the results for case 1 and case 2. However, when the unit price of PV systems exceeds 2,000 USD/kW, it should be concluded that the dissemination of PV systems will be difficult due to the economical reason. On the other hand, as the payback period ranges from eight to 10 years in Japan (including subsidies), and the PV systems for residential customers have been spreading widely in the past years.

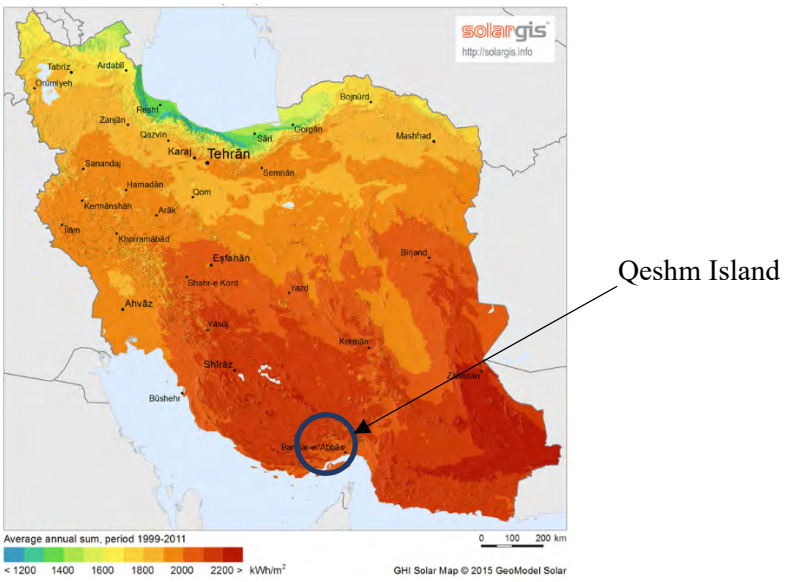
From the above, the following approaches are deemed to be effective in order to accelerate the dissemination of residential PV systems on Qeshm Island:

(a) The establishment of subsidy programs for the installation of residential PV systems during the initial phase (e.g., first several years).
(b) The promotion of the advantages in introducing large-scale residential PV systems, with participation by residential users living in single-occupancy homes.
(c) The promotion of public understanding regarding PV systems by installing PV systems, initially in government-related facilities, to demonstrate their operation and effectiveness, reflecting the fact that there are only a few cases where actual PV systems are installed on Qeshm Island. This can also be a good opportunity for collecting data on actual PV system operation.
(d) The formulation of goals with regard to the dissemination of PV systems on Qeshm Island.

7.5.3 Objectives and targets

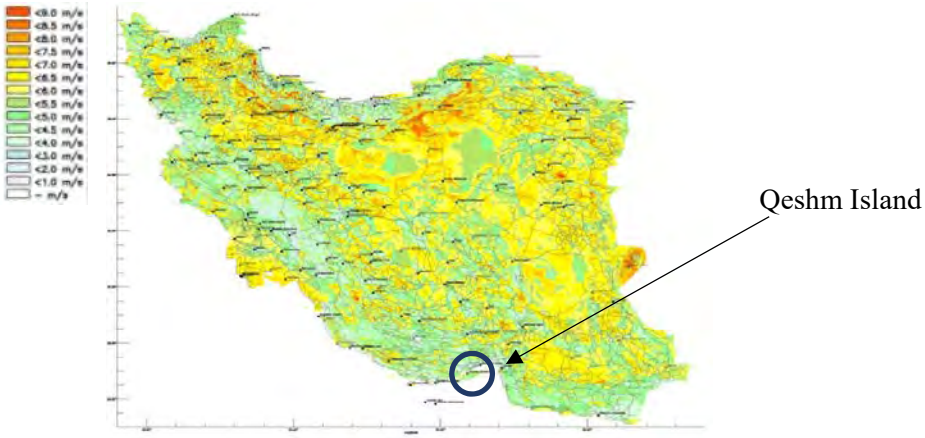
The following items should be taken into account when formulating targets for electricity generation by renewable energy on Qeshm Island:

(a) The national renewable energy policy and targets in Iran to increase the installed capacity to 30% of the total in the Reference Case 2030 option and 39% in the REmap option.
(b) The current situation on renewable energy generation on Qeshm Island: that is, there is no renewable energy generation facility.
(c) The expectation of stakeholders regarding the deployment of renewable energy generation on Qeshm Island: villages as well as the QFZO have high expectations for the installation of renewable energy.
(d) The natural condition of the utilization of renewable energies: Qeshm Island is blessed with high solar radiation levels, which exceed 2,000 kWh/m^2/year, as shown in the figure below. The wind speed on Qeshm Island is within an average range, compared to Iran as a whole.



Source: Solargis

Figure 7.5.5 Solar Radiation Map of Iran



Source: SUNA homepage

Figure 7.5.6 Wind Map of Iran (80 m Above Ground) (March 2009)

In consideration of the above circumstances, it is appropriate to conclude that the renewable generation share on Qeshm Island is in line with the roadmap set forth by IRENA. The following table shows the targets of the utilization of the renewable resources in electric power generation.

Table 7.5.12 Targets for Renewable Energy Generation on Qeshm Island, 2035

	Unit	Scenario I	Scenario II
Peak demand forecast	MW	1,345	932
Installed capacity of power generation (required)	MW	1,478	1,024
Installed capacity of renewable energy generation	MW	443-576	307-399

Source: JICA Project Team

The area needed for the installation of PV panels with a capacity 300 MW to 600 MW will range from approximately 2m m^2 to approximately 4m m^2. These values correspond to approximately 0.13% to 0.27% out of the total area for Qeshm Island.

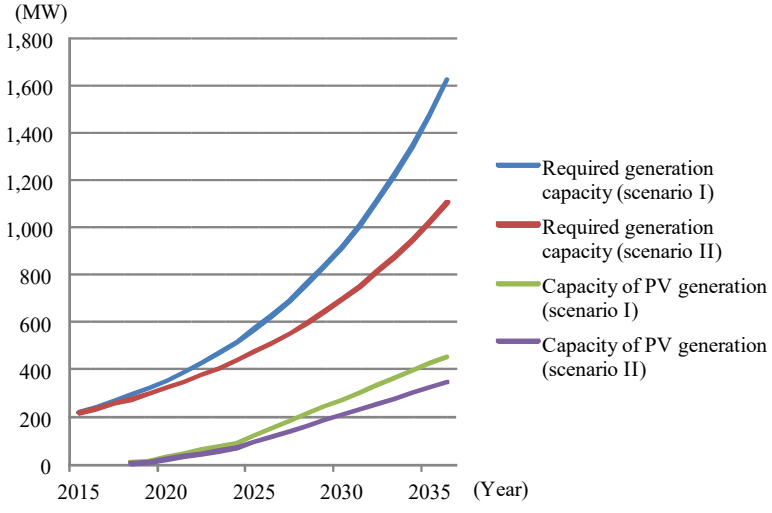
7.5.4 Development plan

It is deemed that the electric power demand and supply balance can be maintained through to 2036 by constructing the planned gas-fired power generation facilities and upgrading transmission and distribution networks appropriately. Meanwhile, considering the fact that the utilization of renewable energies is being promoted as a national policy, introducing renewable energy generation should be taken into account as an option for Qeshm Island.

According to the renewable energy target, PV generation and wind power generation will play key roles among renewable energies. Together with this and the natural condition of Qeshm Island, where solar radiation is abundant, as well as the QFZO's strong interest in PV generation, an introduction plan for PV generation facilities should be examined.

7.5.5 Proposed project and cost estimates

As for the scale of PV generation to be introduced, the following figure shows the perspectives of the required generation capacities of a PV system in order to meet future power demand and the RE target as set out in Reference Case 2030. The perspective is made on the assumption that the introduction of a PV system will be commenced in 2018. The rate of dissemination refers to the technical document from the International Energy Agency.



Source: JICA Project Team

Figure 7.5.7 Perspectives on the Required Generation Capacities of a PV System on Qeshm Island

Since several villages, as well as the QFZO, have shown strong interest in introducing PV generation, PV systems are to be installed in their facilities (e.g., the information center in the Geopark and the village offices) in the short phase (2019-2021). While PV systems, on small- to large-scales, are operational in desert climate areas around the world, the degraded efficiency caused by dust and high ambient temperature is a concern for Qeshm Island. Hence, the introduction of PV generation systems

at the initial stage should be demonstrational and small in scale with a view to confirming whether the systems will work as expected. In addition, the operational data should be analyzed and evaluated quantitatively, while information, such as the effects of PV generation, should be shared with citizens through promotional activities, including seminars and leaflet distribution, to support the diffusion of PV systems.

After completion of the demonstrational phase of small-scale PV generation systems, a study will be commenced leading to the construction of a mega solar generation plant, which will commence operation during the mid-term phase (2022-2026). The study will cover the following subjects:

(a) Determination of specifications regarding the generation facilities based on the demand-supply forecast,
(b) Determination of specifications regarding the generation facilities based on outcomes of the demonstration of small-scale PV systems,
(c) Determination of the location of the plant,
(d) Coordination with the existing construction plan of the gas-fired generation plant, and
(e) Coordination with TOZI on subjects such as various schedules and countermeasures for reverse flow at substations.

After the mid-term phase, when manufacturing costs of PV panels for both residential use and utilities have decreased, appropriate timing shall be considered in terms of whether PV generation will go into a voluntary diffusion phase.

Table 7.5.13 Proposed Project and Cost Estimates for PV Generation Development

Project title	Implementation organization	Phasing			Construction cost (USD million)
		Short term (2019-2021)	Mid term (2022-2026)	Long term (2027-2036)	
Promotion project for PV generation	QFZO	X (demonstration and promotion activities)	-	-	2 (five systems x 100 kW x USD 4,000/kW)
Mega solar construction project	QFZO	X (initial study)	X (study and construction of a mega solar plant, 50-100 MW)	Voluntary diffusion due to the lower construction cost	150-300 (50-100 MW x USD 3,000/kW)
Total	-	-	-	-	152-302

Source: JICA Project Team

Case study for a mega solar plant on Qeshm Island

The trial calculation of a mega solar plant has been conducted with the following assumptions:

(a) Annual power generation: 71,094,213 kWh/y
(b) Total solar panel area: 333,333 m²
(c) Total power of the system: 50 MW
(d) Construction cost: USD 3,000 /kW
(e) Purchase price with capacity of more than 30MW (under the current FIT): IRR 3,200/kWh (= USD 0.098/kWh)
(f) The payback period has been estimated to be approximately 21.5 years: USD 3,000/kW x 50 MW/(71,094,213 kWh/y x USD 0.098/kWh)

CHAPTER 8 ENVIRONMENTAL MANAGEMENT PLAN

8.1 Marine Ecosystem Management

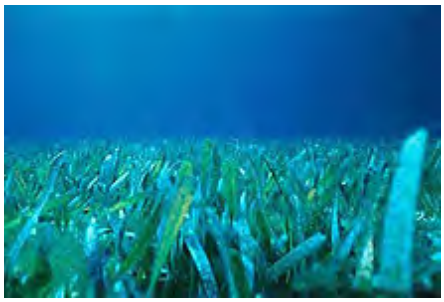
8.1.1 Existing conditions

(1) Definition of marine ecosystem

Under the Convention on Biological Diversity, the Global Biodiversity Outlook (GBO) is periodically published by UNEP to inform the summary of the status of biological diversity and analyze the steps taken by the global community to ensure that biodiversity is conserved and sustained, and that benefits arising from the use of genetic resources are shared equitably. In the third edition of the GBO (GBO-3), the ecosystem is classified into three categories: terrestrial ecosystem, inland water ecosystem, and marine and coastal ecosystem. Meanwhile, six habitats are stated in terms of the marine and coastal ecosystem: mangroves, seagrass beds, salt marshes, shellfish reefs, coral reefs and deep water habitats.

Mangrove (Avicennia marina)
Source:http://thingsonly.blogspot.jp/2011/08/avicennia-marina-qeshm-island.html

Tidal flat (Doulab)
Source: JICA Project Team



Seagrass bed
Source: http://en.wikipedia.org/wiki/Seagrass

Coral reef
Source: http://mudfooted.com

Figure 8.1.1 Marine Ecosystem as Defined by the UNEP

In the Project, out of the six habitats mentioned above in relation to the marine ecosystem, four exist around Qeshm Island: namely, mangroves, seagrass beds, salt marshes and coral reefs (see Figure 6.1). The salt marshes are normally associated with mud flats or sand flats (so-called tidal flats) in intertidal zones, which are considered synonymous with the salt marshes in the Project. Seaweed beds are also regarded as important habitats in the same way as seagrass beds in the Project.

Mangroves are a highly productive ecosystem in the intertidal zones. They not only provide wood and medicines for local communities, but also act as a nursery area for a wide range of creatures, such as insects, birds, fishes and crustaceans, while serving as a vital energy barrier, protecting low-lying coastal communities from offshore storms.

Seagrass beds and **seaweed beds** perform a number of vital, but underrecognized, ecosystem

functions, which include providing a nursery ground for fishes, being a food source for species, such as dugongs and sea turtles, and acting as a physical stabilizer for sediments.

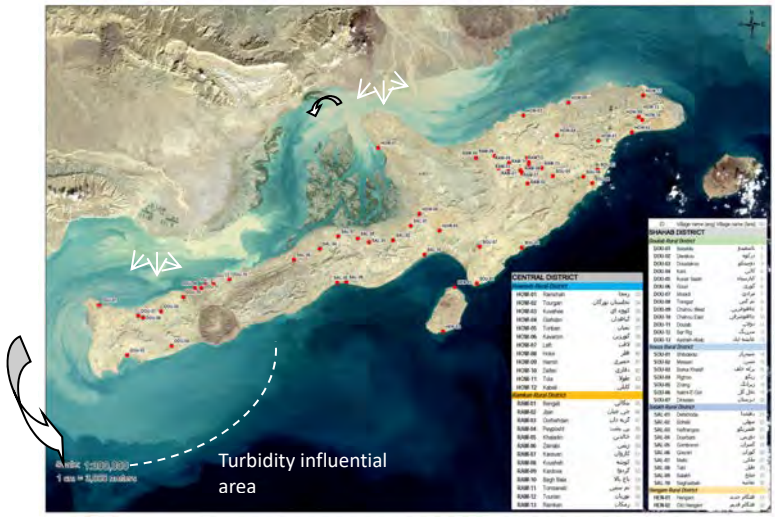
Intertidal zones are an important ecosystem, especially for removing carbon dioxide from the atmosphere, through the photosynthesis of algae on the surface of its habitat. Three types of habitat are identified on Qeshm Island: mud flats, sandy beaches and rocky shores. These habitats also provide a living environment for various organisms, such as shellfish and benthic fish, and serve as a feeding ground for seabirds. In the Blue Carbon concept[1], sabkha[2] is also included as an important marine habitat, which provides carbon absorption functions.

Coral reefs contribute significantly to the livelihood and security of coastal regions in the areas where they exist, through tourism based on their aesthetic beauty, as well as providing income and nutrition through the fish species they support, and protecting coastlines from storms and waves (GBO-3).

(2) Water quality around Qeshm Island

On the mainland located at the opposite side of the island, there are two watersheds: Kol-Mehran watershed and Baloochestan Jonoobi watershed. The average runoff volume of these river systems reaches 2,250 million m^3 annually (JICA, 2016[3]).

Figure 8.1.2 is a satellite image that shows the influential area of river water. Although the date is not specified, it shows that the river water (turbidity) flows into the strait between the mainland and Qeshm Island. Some of the freshwater is flowing into the Hara mangrove area, while other freshwater influences the western area of the island, reaching the western area of Gomboron Village.



Source: JICA Project Team

Figure 8.1.2 Influential Area of River Water

The JICA Project Team (JPT) measured the basic water quality, using a handheld water quality meter and a water quality test kit, in April (Hara mangrove Area) and May (southern area of the island) of 2016 (see Figure 8.1.3).

[1] The recent concept against Green Carbon. A coastal ecosystem is considered as a carbon stock resource.
[2] Sabkha is an Arabic term for a salt flat, which is a flat and very saline area of sand or silt, lying just above the water table.
[3] JICA Project Team, 2016 Environmental Baseline Survey of Qeshm Island.

Name	Date	Time	Water Temperature	Salinity	pH	NH4-N	NO2-N
Unit	-	-	oC	-	-	mg/L	mg/L
WQ-N1	26/4/2016	11:15	26.5	35.6	8.34	1.0	0.005
WQ-N2	26/4/2016	11:35	27.6	35.7	8.34	0.5	0.005
WQ-N3	26/4/2016	11:58	27.3	35.8	8.35	0.3	0.005
WQ-N4	26/4/2016	12:12	27.0	35.8	8.35	0.5	0.005
WQ-N5	26/4/2016	12:36	27.6	35.8	8.35	0.8	0.010
WQ-N6	26/4/2016	10:55	26.6	35.5	8.19	0.3	0.005
WQ-S1	10/5/2016	10:40	31.8	40.2	8.82	<0.2	<0.005
WQ-S6	10/5/2016	10:20	29.7	39.7	8.18	<0.2	<0.005

Source: JICA Project Team

Figure 8.1.3 Results of the Water Quality Survey

Water temperature and salinity in the Hara mangrove area are lower than that in the southern area of the island. Nutrient levels (NH_4-N and NO_2-N) show the counter-results. The nutrient levels appear higher in the northern part of the island than that the southern part. The concentrations of nitrogen (NH4-N + No2-N) are within the range of the water quality standard for Japan (0.2-1.0 mg/L as total nutrients). However, the level is considered rather high for a normal sea area. The reason for this phenomenon could be due to the fact that the northern area of the island is influenced by land-based water, while the southern area of the island is influenced by offshore water.

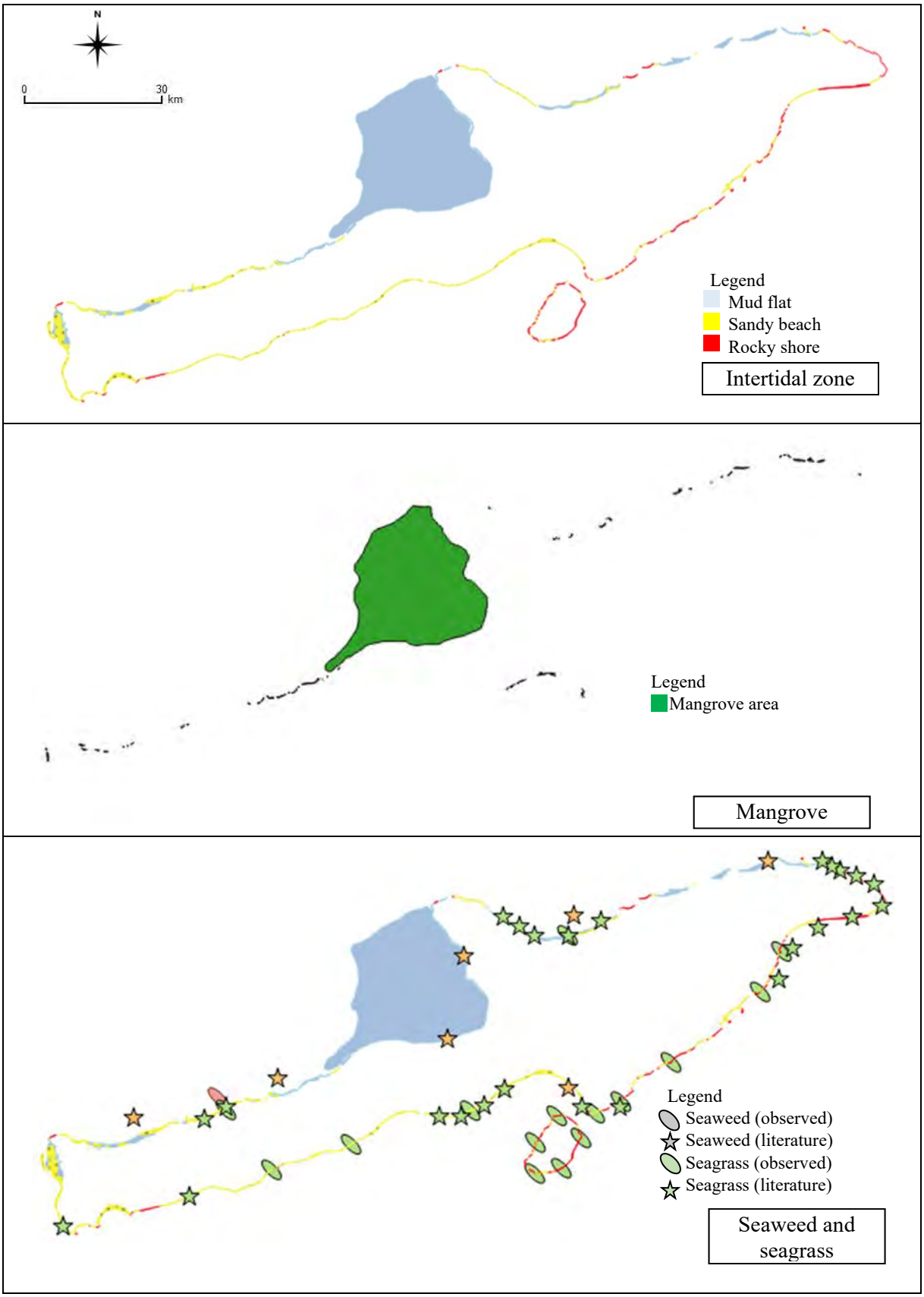
The pH values are also within the level of the water quality standard for Japan (7.8-8.3), except WQ S-1. Since this point is in a lagoon, which is an enclosed area, water temperature and salinity are also high.

Considering the influence of the river water discussed in Figure 8.1.2 and the results shown in Figure 8.1.3, periodical supply of lower salinity water might keep the Hara mangrove area healthy. In addition, comprehensive management of the river basin, such as the regulation of dam construction in the upstream of the river systems in mainland or the control of excess water intake for agricultural purposes, might be necessary from the viewpoint of maintaining a sustainable supply of river water.

Marine ecosystem status on Qeshm Island

Based on the field inspection by the JPT and a desktop study subcontracted to the local consultant, the present status of the marine ecosystem on Qeshm Island was assessed. The habitat in the intertidal zone was classified into three types: mud flats, sandy beaches and rocky shores.

Figure 8.1.4 shows the distribution of the ecosystem on Qeshm Island: namely, intertidal zone, mangrove, seagrass and seaweed bed, and coral. These maps were generated by analyzing satellite images (Google Earth), which were compared with the results of the visual observation during the field inspection (specified as "observed") and the results of the desktop study (specified as "literature").



Source: JICA Project Team

Figure 8.1.4 Distribution of the Ecosystem on Qeshm Island

Source: JICA Project Team

Figure 8.1.4 Distribution of the Ecosystem on Qeshm Island (Continued)

Mud flats are developed in the northern area of the island. Benthic organisms, such as goby and shellfish, live in the area. Mud flats are favorable as feeding and resting grounds for seabirds, including both resident birds and migrant birds.

Sandy beaches are mainly located around the western area to the southern area of the island. Sea turtles visit the sandy beaches to lay eggs.

Rocky shores are mainly distributed from the eastern area to the southern area of the island. Shellfish lives on the rocky shore.

Sabkha occurs at the upper range of the intertidal area around the entire island. While it has less ecological value, it occasionally forms a salt marsh, which supports the habitat of salt-tolerant plants, fish and birds.

Mangroves are developed mainly in the northern area of the island. The likely reason is that lower salinity, less influence of waves and distributed mud flats create a suitable environment for growing mangroves. The wide area of mangroves, which is located at the middle of the island's north shore, is called the Hara mangrove area and naturally occurring. Other areas where mangroves are found have been transplanted. The natural species of the mangrove on Qeshm Island is *Avicennia marina* (see Figure 8.1.1). However, a small patch of other species, *Rhizophora spp* (see Figure 8.1.5), was found in the Hara mangrove area. This species was transplanted from the opposite shore by the QFZO about five years ago.

Mangroves on the southern coast of the island are mainly developed at the mouth of wadis (dry rivers). These locations are suitable for the protection of juvenile trees from wave influence, as well as obtaining occasional supplies of freshwater from the mountain side or underground during rainfalls.

The condition of mangrove trees on the island is considered healthy, based on visual observation.

According to the interview with the QFZO and the FRWMO[4], there are two million transplanted mangroves on the island. After the transplantation, the local residents maintain the juvenile trees until the trees are rooted in the location, in order to protect them from drifting seaweeds. The entire mangrove area is reviewed using satellite images every 10 years.

[4] Forests, Range and Watershed Management Organization (FRWMO), Natural Resources Assistance, Ministry of Jahad and Agriculture.

Source: JICA Project Team

Figure 8.1.5 *Rhizophora* Found in the Hara Mangrove Area

Although mangroves can live in a high-salinity environment, it is reported that better growth can be observed in a lower-salinity environment or an environment in which groundwater or freshwater is occasionally supplied. That is, mangroves on Qeshm Island are survivors of the harsh environment, with only an occasional supply of freshwater from rainfalls. In the Hara mangrove area, it is likely that the freshwater supply from the mainland highly contributes to keeping the mangrove condition healthy.

Seaweed beds and seagrass beds are distributed around the island, mainly in the eastern area. Seaweed beds are dominant at the southern area and northeastern area of the island, while seagrass beds are found in the northwestern area of the island. Forty-nine seaweed species are found on the northern coast and 152 species on the southern coast of Qeshm Island.

Two seagrass species (*Halophia ovalis* (LC5) and *Haledule uninervis* (LC)) are identified (JICA, 2016) on the island. The northern area of the island is considered to be a suitable environment for the seagrass species because of the calm sea conditions and dominant muddy bottom sediment.

Corals are found mainly in the southern area, especially the southeastern area of the island. This is likely due to turbid water dominated in the northern and southwestern areas of the island, as shown in Figure 8.1.2. Corals live symbiotically with zooxanthella, which provides nutrients and oxygen to the corals through photosynthesis. Moreover, zooxanthella cannot live in a turbid environment, which interferes with the intensity of sunlight. Forty-seven species of coral are identified in the Persian Gulf (JICA, 2016).

(3) Marine organisms

The following outline the marine organisms identified around Qeshm Island (JICA, 2016):

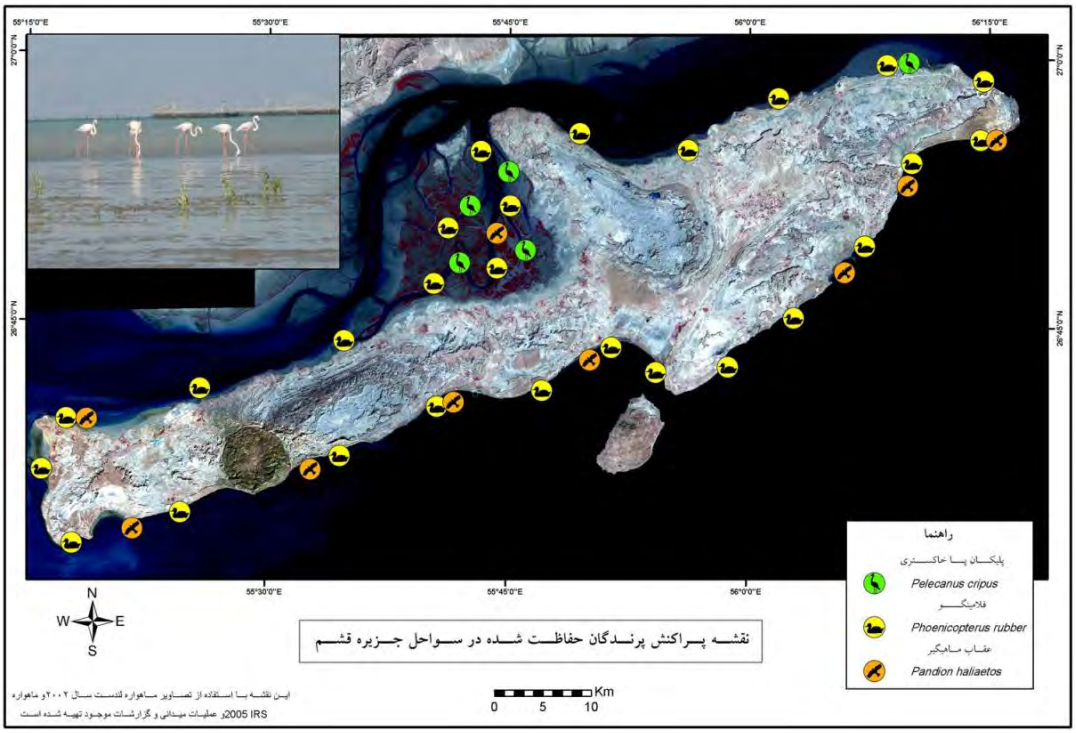
(a) Fish: Approximately 400 to 450 fish species live in the Persian Gulf, while 300 to 450 other species also live in the sea area. About 60 of the fish species have been identified on Qeshm Island.

(b) Crustaceans: Three species of lobster and four species of shrimp are identified on Qeshm Island.

(c) Shellfish: As benthic animals, gastropods and bivalves are commonly observed on Qeshm Island, while 69 species are identified in the rocky coasts. One species of oyster (*Sacostrea cocculata*) is identified on the island.

(d) Water Seabirds: 48 species of water birds are listed (JICA, 2016). Out of 48 species, 33 species are migrating birds to utilize the coastline of the Qeshm Island. The distribution map of the 3 species is shown in Figure 8.1.6. Those species are also migrating birds and they utilize the coastline of Qeshm Island uniformly. One species, *Numenius tenuirostris*, is categorized as CR (Critically Endangered) by IUCN.
According to the BirdLife International, *Ardea goliath* (Goliath heron) has its only confirmed breeding site in Iran at Hara mangrove area and there is a small colony of *Casmerodius albus modestus* (South Asian race), which probably reaches its western limit in this region.

[5] The following abbreviations refer to the status categories on the International Union for Conservation of Nature and Natural Resources (IUCN) Red List: LC: least concern; NT: near threatened; VU: vulnerable; EN: endangered; CR: critically endangered; EW: extinct in the wild; EX: extinct and DD: Data Deficient.



Source: JICA,2016

Figure 8.1.6 Distribution of Sea Birds in Qeshm Island

(e) Marine mammals: Table 8.1.1 shows a list of marine mammals observed around Qeshm Island. All the listed species are classified as endangered (vulnerable and nearly threatened) and data deficient. Besides the list, a small juvenile whale, which was live-stranded on Qeshm Island in 2007, was identified as *Balaenoptera omurai* (Omura's whale) in 2016[6]. There have been many sightings of possible *Stenella longirostris* (spinner dolphins), which were classified as data deficient by the IUCN Red List.

Table 8.1.1 List of Marine Mammals Recorded Near Qeshm Island

No.	Scientific name	Common Name	Category on IUCN Red List	Year of Classification
1	*Tursiops aduncus*	Indo-Pacific bottlenose dolphin	DD	2016
2	*Sousa chinensis*	Indo-Pacific humpbacked dolphin	NT	2016
3	*Neophocaena phocaenoides*	Indo-Pacific finless porpoise	VU(A2cde)	2016
4	*Delphinus capensis*	Long-beaked common dolphin	DD	2016
5	*Pseudorca crassidens*	False killer whale	DD	2016
6	*Balaenoptera edeni*	Bryde's whale	DD	2016
7	*Dugong dugon*	Dugong	VU(A2bcd+4bcd)	2016

Source: Gillian T. Braulik et al., 2010, Marine mammal records from Iran. In: *Journal of Cetacean Research and Management*, 11(1): pp. 49-63

(f) Sea turtles: Table 8.1.2 shows a list of sea turtles found around Qeshm Island. Green turtles *(Chelonia mydas)* have some important habitats in the waters along the southern coast of Qeshm in the Hara Protected Area, as well as around Hangom and Larak Islands. Breeding sites of hawksbill turtles *(Eretmochelys imbricate)* can also be observed on some sandy beaches on the south of Qeshm, including Shib Derazt, the beach near to Old Hangom on Hangom Island.

[6] Sharif Ranjbar et al., 2016, Omura's Whale (*Balaenoptera Omurai)* Stranded on Qeshm Island, Iran: Further Evidence of a Wide (Sub)tropical Distribution, Including the Persian Gulf. Unpublished.

Table 8.1.2 List of Sea Turtles on Qeshm

Scientific name	Common name	Category on IUCN Red List	Year of publication
Eretmochelys imbricata	Hawksbill turtle	CR(A2bd)	2016
Chelonia mydas	Green turtle	EN (A2bd)	2016
Caretta caretta	Loggerhead turtle	VU (A2b)	2016
Lepidochelys olivacea	Olive Ridley Turtle	VU (A2bd)	2017
Dermochelys coriacea	Leatherback Turtle	VU (A2bd)	2016

Source: JICA Project Team

(g) Coral: Forty-two species are identified at Lalak Island and Hangom Island (Dab, Koosha, 2015).

Table 8.1.3 shows marine species listed in the IUCN Red List as vulnerable or more critical. Since the living environment around Qeshm Island is harsh, due to high water temperatures and salinity, the coral species is surviving, as well as seaweeds and seagrasses as food for sea turtles. Although dolphin watching is managed at Hangom Island, dolphins are violated and hurt by unregulated boat operations.

Table 8.1.3 Species listed in IUCN Red List as VU or more critical

Marine Organism	Scientific name	English name	IUCN Red List
Bird	*Numenius tenuirostris*	Slender billed Curlew	**CR**
Coral	*Acropora horrida*	-	VU
	Pavona decussata	Cactus Coral	VU
	Pavona diffluens	-	VU
	Psammocora stellata	Stellar coral	VU
Marine mammal	*Neophocaena phocaenoides*	Finless Porpoise	VU
Sea turtle	*Chelonia mydas*	Green Sea Turtle	EN
	Eretmochelys imbricata	Hawksbill Sea Turtle	CR
	Caretta caretta	Loggerhead Sea Turtle	VU
	Lepidochelys olivacea	Olive Ridley Sea Turtle	VU
	Dermochelys coriacea	Leather-back Sea Turtle	VU

Source: JICA Project Team

Figure 8.1.7 Sea Turtle Nesting Beaches on Qeshm Island

8.1.2 Issues to be tackled

Figure 8.1.8 shows the protected area around Qeshm Island. The Hara Protected Area is a multi-designated international protected area, which includes the Hara Biosphere Reserve (UNESCO), the Khouran Straits (Ramsar) and the Geopark (UNESCO).

In early recognition of its importance, the main area of mangroves and mudflats in Hara (an area of 82,360 ha) was designated as a "Protected Region" in 1972. This reserve was later enlarged to an area of 85,686 ha in 1975 and upgraded to "National Park" status. However, after the Iranian Revolution, the park was downgraded to a "Protected Area" in 1982. The reasons for this change have not been clarified during the study.

Under the Ramsar Convention, the vaster area (100,000 ha) overlapping with the Hara Protected Area and the Hara-e Khouran Protected Area was designated as a Ramsar site (known as the "Khouran Straits") on June 23, 1975. The Hara Protected Area was designated as a UNESCO Man and the Biosphere Programme (MAB) Biosphere Reserve, under the name of the "Hara Biosphere Reserve", in June 1976.

The Khouran Straits are identified as an "Important Bird Area" by BirdLife International based on its assessment in 1994[7], which identified this area as that regularly holds significant numbers of a globally threatened species, or other species of global conservation concern. Also, the assessment warns that this area is one of the five most important sites in the country/territory for a species with an unfavorable conservation status in the Middle East.

The part of the Hara Protected Area on the coast of Qeshm Island was also included as a part of Qeshm Geopark in the application made by the QFZO for a UNESCO Global Geopark in January 2016[8].

JPT identified the multiple responsible bodies for management of the area and observed no overall management system (see Section 8.2.2 for more details). Therefore, a mechanism/coordination for comprehensive management or demarcation of responsibilities is considered necessary.

"National Natural Heritages" are areas identified by the Iran Cultural Heritage, Handicrafts and Tourism Organization. Nine such areas have been identified on Qeshm, of which four are marine sites: (1) Dolphin Bay, (2) Turtle Beach, (3) Naz Islands and (4) the Birds Wetland; meanwhile, the remaining five are terrestrial sites: (5) Habitat of Shrews, (6) Star Valley, (7) Chahkooh Gorge, (8) the Old Territory of the Geopark, and (9) the Salt Cave and the Salt Dome. Based on the Foundation Law of the Cultural Heritage Organization issued in 1988, and the Islamic Prosecution Law, regarding historical features, it is the responsibility of the ICHHTO to identify and conserve valuable features of the country. However, since full power of ICHHTO is transferred to QFZO, the Department of Tourism, Handicrafts and Cultural Heritage of QFZO is organization in charge to protect those nine heritages currently. The full list of the registered sites including natural, historical, intangible and tangible is mentioned in Table 6.5.5 and Table 6.5.6 in Tourism section.

According to the interview with the QFZO, although those sites are designated as protected areas, a practical management plan or guideline has not been prepared. For example, the QFZO sent a request letter to the Fishery Department prohibiting the use of surrounding net fishing in Dolphin Bay and asking that only handline fishing is used. Although this request was accepted and agreed, the former type of fishing (e.g. surrounding net) is still in operation.

The JPT also conducted an interview with the Qeshm County Office of the Iranian Fisheries Organization, Ministry of Agriculture and Jihad. They consider the complication of multi-sector management sometimes cause confusion on the responsibility which leads to no-management in the consequences.

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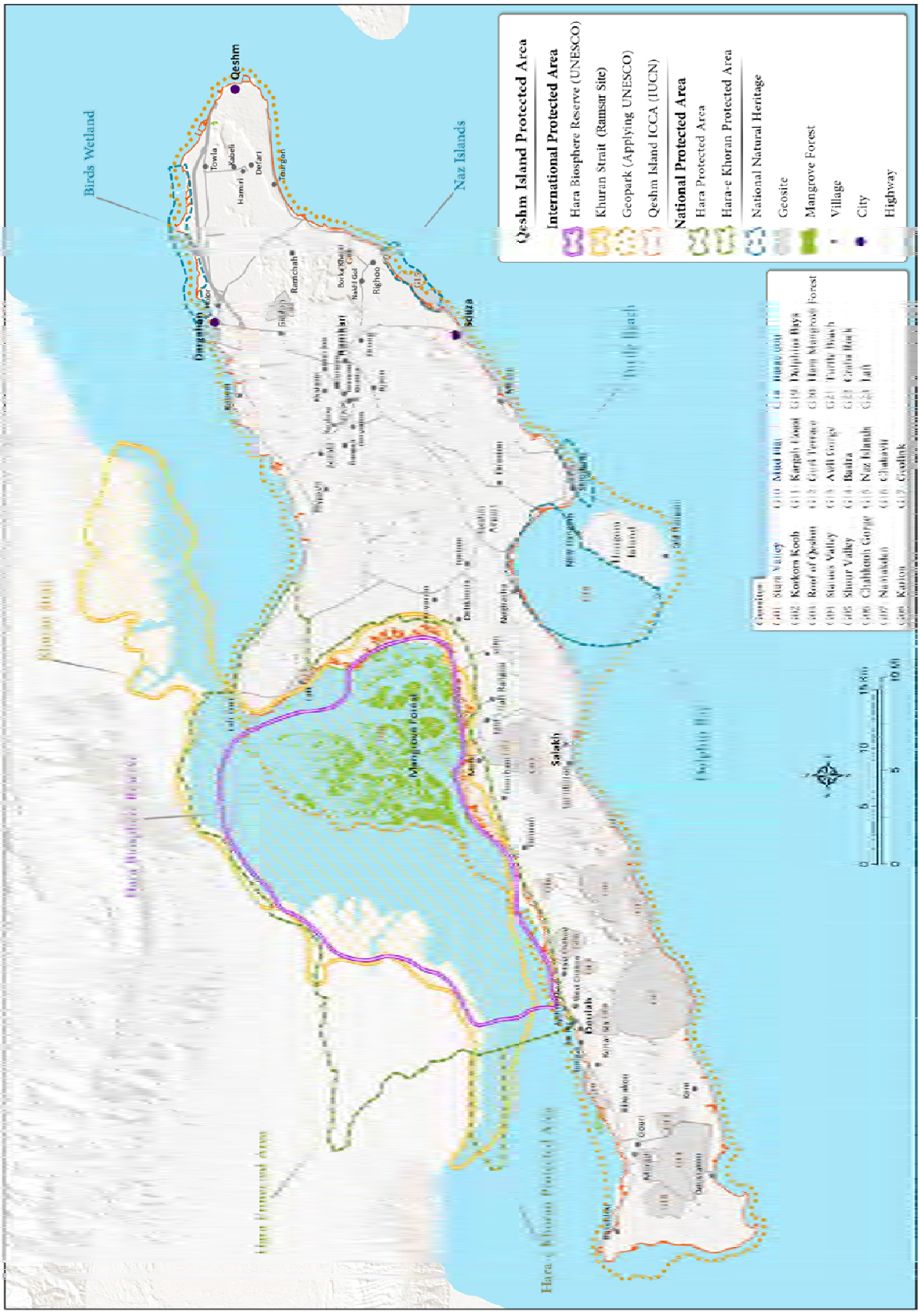
[7] http://www.birdlife.org/datazone/sitefactsheet.php?id=8158, accessed on July 25, 2016.

[8] The Deputy of Natural Environment, in the DoE, approved the inclusion of the Hara Protected Area in the proposed Qeshm Global Geopark in advance in his letter to the QFZO, dated November 28, 2015.

Therefore, the establishment of a management mechanism and guidelines for the protected areas and biologically important areas is necessary. A multi-sectoral management mechanism based on the legislation support should also be considered.

At moment, JPT considers QFZO, DoE, IFO are the major stakeholders for marine environment conservation.



Source: JICA Project Team

Figure 8.1.8 Protected Area Around Qeshm Island

8.1.3 Objectives and target of the environmental management

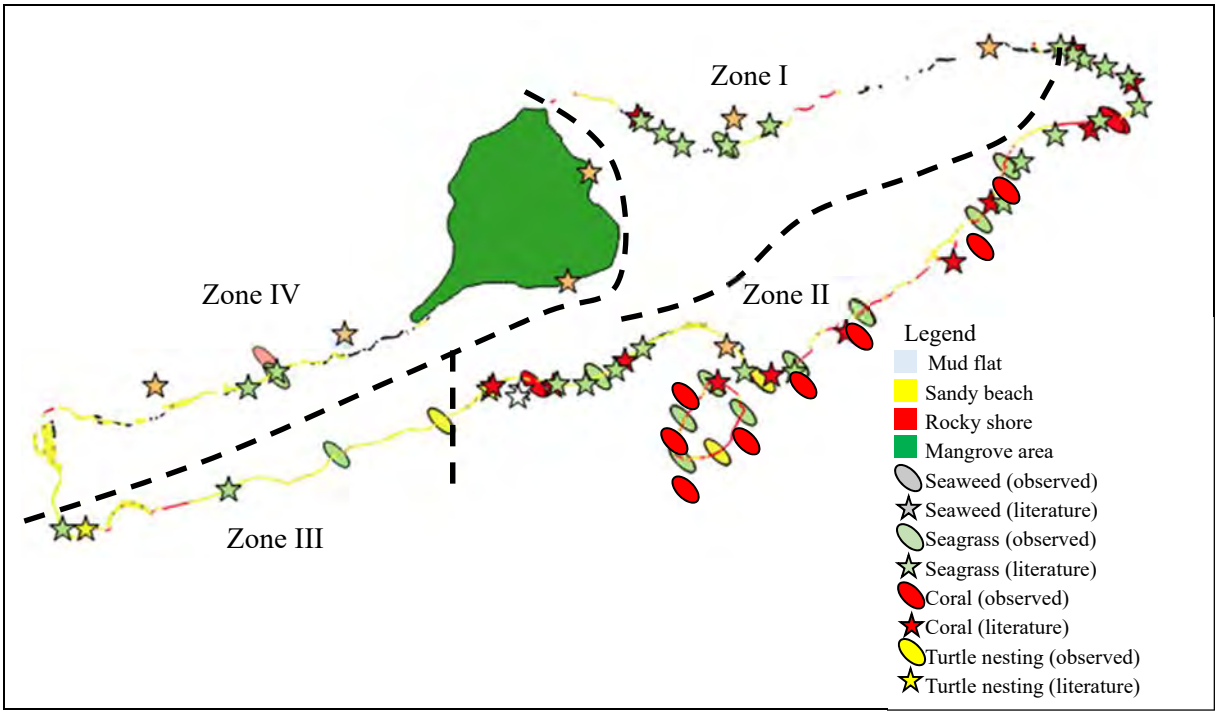
(1) Objectives

For the conservation of the marine ecosystem, an environmental management plan will be established, aimed at sustainable management. The plan consists of two major parts: a management plan and a monitoring plan.

The management plan describes the critical area to be conserved or developed, while the monitoring plan describes the items to be monitored and at what frequency in terms of the sustainable management of the marine ecosystem. The demarcation of related authorities, such as Department of Environment of Iran and Iranian Fisheries Organization, shall also be proposed in the plan. Establishing legislation for the demarcation might be necessary.

(2) Target

Qeshm Island is divided into four zones based on the major ecosystem and marine environment, as shown in Figure 8.1.9.



Source: JICA Project Team

Figure 8.1.9 Expediential Zoning of the Ecosystem

Zone I is characterized by the dominant mud flat, where the bird sanctuary is designated. A similar environment for feeding birds must be conserved. Although an urban area is included in **Zone II**, the coral habitat is dominant in this area because of the clear water quality. Therefore, wastewater management and runoff management will be carefully considered for this area so as not to violate the coral habitat, especially in urban areas.

Zone III is characterized by the dominance of the sandy beach. Part of the area might be considered as a nesting beach for sea turtles. A beautiful sandy beach will be conserved for scenery.

The natural mangrove area that is designated as a protected area is in **Zone IV**. Seagrass beds are identified in this area. Therefore, an environment for such species shall be conserved, while moderate development is in effect.

Characteristics of each zone, as well as the viewpoint regarding conservation and development potentials, are summarized in Table 8.1.4.

Table 8.1.4 Characteristics of Each Environmental Zoning Area

		Zone I	Zone II	Zone III	Zone IV
Major ecosystem	Mangrove	x	(x)	(x)	x
	Seagrass	x	x		x
	Seaweed	x	x	x	x
	Coral	x	x		
	Turtle nesting beach		x	x	
Characteristics of the nature		• Transplanted mangrove area • Mud flat	• Urban area • Coral • Turtle Beach • Dolphin	• Sandy beach • Turtle Beach	• Natural mangrove area • Transplanted mangrove area • Seagrass bed • Dolphin
Designated protected area		• Bird sanctuary	• Naz Islands • Turtle Beach • Dolphin Bay		• Hara mangrove
Viewpoint for conservation		• Bird sanctuary • Mud flat	• Coral, turtle and dolphin	• Scenery of sandy beach • Turtle Beach	• Mangrove and seagrass bed
Viewpoint of development potentials		• Moderate development • Nature conservation	• Tourism • Coral snorkeling	• Traditional life • Contact with nature	• Moderate development

Source: JICA Project Team

Therefore, the conservation viewpoint for each zone is as follows:

Zone I

A bird sanctuary is designated in the mud flat and the transplanted mangrove area. According to the interview with the QFZO, birdwatchers from abroad are also visiting this area. Since seabird is coming here for feeding, the existence of mud flat is important. Transplanted mangroves have already started natural reproduction. Therefore, mangrove transplanting may not be carried out actively, because growth of mangrove forest might violate the area of mud flat. Some areas in this zone are already being developed and further moderate development might be possible, unless it violates the ecosystem of the designated area or transplanted mangrove area.

Zone II

Corals can be seen everywhere in this zone, even in the areas near the shoreline, although coverage of the coral varies between locations. According to the interview with a scuba diving club member, there is a spawning area of corals in the offshore area.

Naz Islands are designated as a protected area. The sandy beach in front of the islands is utilized as an access area and cars are parked. Parking cars on the sand makes the ground soil harder, which leads to an unfavorable environment for sea turtle spawning. Therefore, car parking in the sandy beach area will be limited in this area.

Hangom Island is an important area with corals, which could help it to become a resource for tourism. Dolphin watching is also operated in this area (designated as Dolphin Bay), while fishing for sardines is also operated. As dolphins come to this area for feeding, due to the availability of sardines, for example, fishing controls are necessary, which should be introduced in cooperation with fishery authority.

Sea turtles are seen along the coast in this area because of the existence of their food source, namely, seaweeds. Shibderaz is designated as protected area for sea turtle spawning. Although the control of tourists with regard to sea turtle watching is managed, further consideration of sea turtles' needs, such as light limitation and light direction control, might be necessary.

Since an important ecosystem is distributed in this zone, careful study in advance is necessary regarding the development plans. The control of sewage discharge and runoff caused by heavy rain

must be carefully considered, especially in urban areas to protect the natural environment, such as corals and seaweeds.

Zone III

Although a major ecosystem does not exist in this zone, except for turtle beach, the scenery of an untouched beach, as well as the contrast with a steep landscape and the coast, is worth mentioning. Swimming sea turtles are also often seen.

According to the interview with Hormozgan University, sargassum weed occurs around Doustakou, the western side of Qeshm Island. This habitat plays an important role as a nursery for fish.

This zone could be considered as an area for direct contact with nature.

Zone IV

The natural mangrove area, as well as the transplanted mangrove area, exists in this zone. Seagrass beds are also identified. While preparation of a management plan for the natural mangrove area is being discussed, a transplanted area with a seagrass bed will be considered for conservation. The continuity of the river water basin from the mainland (see Section 8.1.3 (3)) will also be considered for conservation.

(3) Importance of connectivity of the marine ecosystem

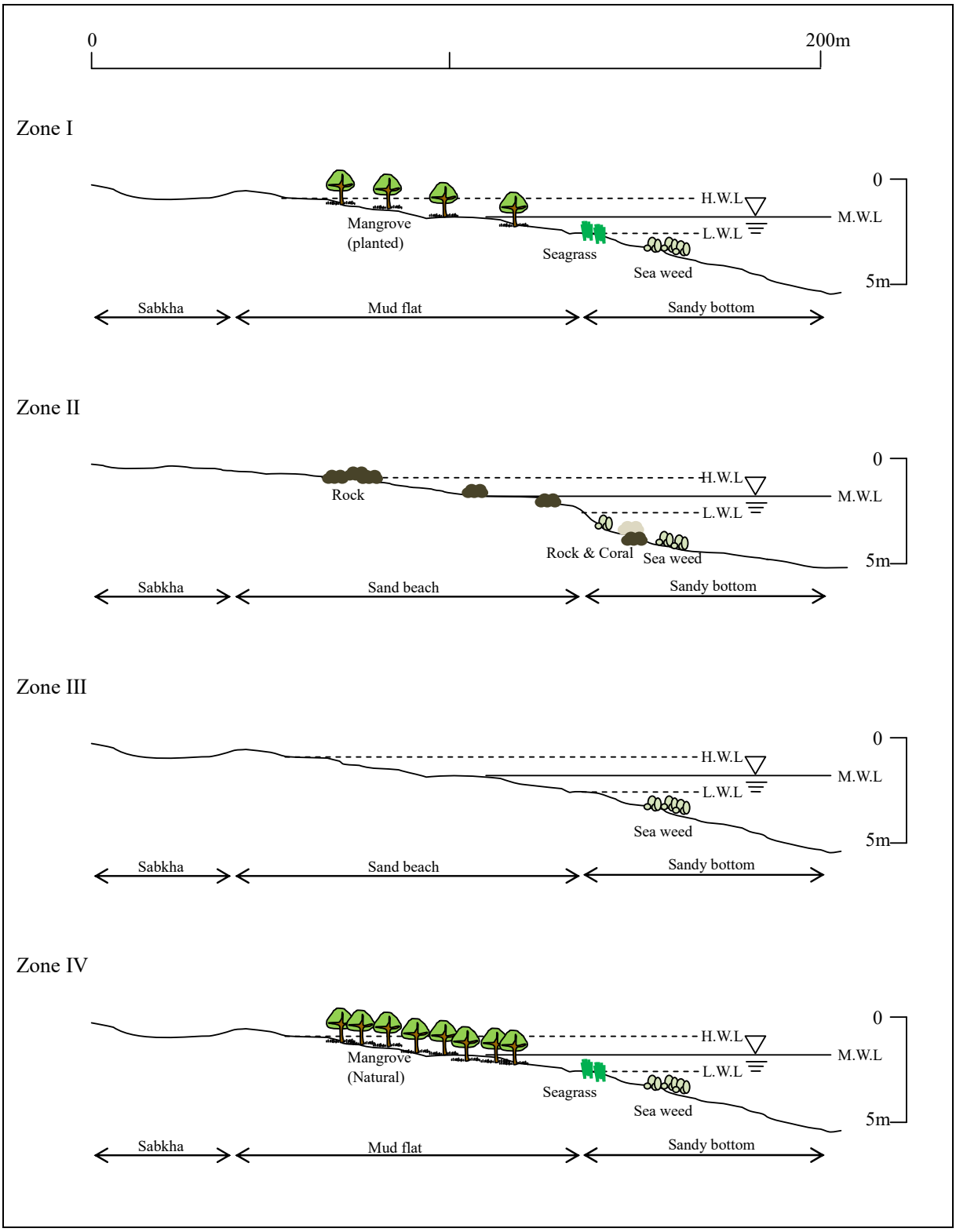
According to an interview with Dr. Mohammad Sharif Ranjibal of Hormozgan University, Larak Island is considered as a spawning ground for fish and coral, while eggs and juveniles are continuously transported to Qeshm Island by seawater currents. In addition, the freshwater supply mechanism should not be forgotten (see Section 8.1.1 (1) 2)). Therefore, topographically horizontal connectivity will be considered during the development of a management plan (see Figure 8.1.10).

Figure 8.1.11 shows the image of the vertical profiles of the ecosystem distribution in each zone, based on the field inspection by the JPT.

Each ecosystem is seamlessly connected to the next ecosystem and contributes to each other. This connectivity must be considered for conservation or development. The lack of this connectivity might lead to the degradation of the ecosystem service. For example, the loss of sabkha might weaken the binding function of the sediment, which may lead to the degradation of water clarity that affects the growth of seagrasses, seaweeds and corals. From this point of view, vertical connectivity will also be considered.

Source: JICA Project Team

Figure 8.1.10 Horizontal Connectivity of Ecosystem Distribution



Note: HWL-High Water Level, MWL-Mean Water Level, and LWL-Low Water Level
Source: JICA Project Team

Figure 8.1.11 Vertical Profile of the Ecosystem Distribution

(4) *Satoyama-satoumi* concept

As an idea for the sustainable conservation of the natural environment, a harmonious balance between the natural environment and human activity is proposed in the form of the *satotama-satoumi* concept. This concept allows conserving natural resources through seamless and endless material circulation,

from the land area to the coastal area, by conscious maintenance/conservation activities of natural resources by human beings.

The conservation plan in the Project will be based on securing sustainability.

8.1.4 Development of environmental management plan

Frameworks and time frame of environmental management are described in the section.

(1) Technical framework

The items for the environmental management plan and monitoring plan are proposed in Table 8.1.5 and Table 8.1.6, respectively.

Table 8.1.5 Environmental Management Plan

Category	Environmental Item	Zone I	Zone II	Zone III	Zone IV
Viewpoint of development potentials		Moderate industrial development Nature conservation	Tourism development	Traditional life Contact with nature	Moderate development
1 Permits and Explanation	(1) EIA and Environmental Permits	EIA and permits shall be considered depending on the scale.			
	(2) Explanation to the Local Stakeholders	Involvement of local stakeholders from the early stage of the plan is fundamental. If possible, they also should be involved in the planning, because they know the environment well.			
	(3) Examination of Alternatives	Alternative plans, including changing locations, shall be considered, comparing advantage, disadvantage, cost, environmental impact, etc.			
2 Pollution Control	(1) Air Quality	N/A (depending on the project)	N/A (depending on the project)	N/A (depending on the project)	N/A (depending on the project)
	(2) Water Quality	ditto	Runoff control is necessary.	ditto	ditto
	(3) Wastes	ditto	ditto	ditto	ditto
	(4) Soil Contamination	ditto	N/A (depending on the project)	ditto	ditto
	(5) Noise and Vibration	ditto	ditto	ditto	ditto
	(6) Subsidence	ditto	Limitation of access to the beach area shall be controlled.	Limitation of access to the beach area shall be controlled.	ditto
	(7) Odor	ditto	N/A (depending on the project)	N/A (depending on the project)	ditto
3 Natural Environment	(1) Protected Areas	Protection of bird sanctuary is the priority.	Fishing activity in the dolphin area shall be controlled.	N/A (depending on the project)	Access to the mangrove area must be controlled.
	(2) Ecosystem	Seagrass bed must be conserved.	Coral community must be conserved and rehabilitated. Protection of dolphin and sea turtle shall be planned. Conservation of nesting beach of sea turtle, as well as feeding locations, shall be planned.	Conservation of nesting beach of sea turtle, as well as feeding locations, shall be planned.	Breading and feeding are of birds (mangrove, tidal flat) shall be conserved. Seagrass bed must be conserved.
	(3) Hydrology	N/A (depending on the project)	Area wide hydrology shall be considered.	N/A (depending on the project)	N/A (depending on the project)
	(4) Topography and Geology	ditto	N/A (depending on the project)	Scenery must be conserved.	ditto
4 Social Environment	(1) Resettlement	It must be considered, depending on the project.			
	(2) Living and Livelihood	Local people must be consulted, whether they agree with the project.			
	(3) Heritage	It must be considered, depending on the project.			
	(4) Landscape	ditto			
	(5) Ethnic Minorities and Indigenous Peoples	Local people must be consulted, whether they agree with the project.			
	(6) Working Conditions	It must be considered, depending on the project.			
5 Others	(1) Impacts during	Bird behavior	Illegal activities,	Limitation of	Bird behavior

	Construction	must be monitored. Transition of seagrass bed must be monitored.	such as reclamation without assessment and permit shall be controlled.	access to the beach area shall be controlled.	must be monitored. Transition of seagrass bed must be monitored.
	(2) Monitoring	ditto	Corals along side of the coastal line shall be monitored.	Coastal water quality must be kept in good condition.	ditto

Source: JICA Project Team

Table 8.1.6 Environmental Monitoring Plan

Category	Environmental Item	Zone I	Zone II	Zone III	Zone IV
Viewpoint of development potentials		Moderate industrial development Nature conservation	Tourism development	Traditional life Contact with nature	Moderate development
1 Permits and Explanation	(1) EIA and Environmental Permits	N/A (depending on the project)			
	(2) Explanation to the Local Stakeholders	Opinion and complaint must be monitored.			
	(3) Examination of Alternatives	N/A (depending on the project)			
2 Pollution Control	(1) Air Quality	N/A (depending on the project)	N/A (depending on the project)	N/A (depending on the project)	N/A (depending on the project)
	(2) Water Quality	Coastal water (2 times/year)	Coastal water (2 times/year)	Coastal water (2 times/year)	Coastal water (2 times/year)
	(3) Wastes	N/A (depending on the project)	N/A (depending on the project)	N/A (depending on the project)	N/A (depending on the project)
	(4) Soil Contamination	ditto	ditto	ditto	ditto
	(5) Noise and Vibration	ditto	ditto	ditto	ditto
	(6) Subsidence	ditto	ditto	ditto	ditto
	(7) Odor	ditto	ditto	ditto	ditto
3 Natural Environment	(1) Protected Areas	Transition of mud flat area for bird feeding (every other year)	Number of dolphin heart by boat Transition of fish catches (1 time/year)	N/A (depending on the project)	Condition of mangrove Transition of mud flat area for bird feeding (every other year)
	(2) Ecosystem	Distribution of seagrass bed Detailed study of flyway Species and number of bird (1time/ year)	Coral composition and area Turtle species and number (trapped, egg laying and observation) Distribution of seaweed (1 time/year)	Turtle species and number (trapped, egg laying and observation)	Distribution of seagrass bed Detailed study of flyway Species and number of bird Turtle species and number (trapped, egg laying and observation) (1time/ year)
	(3) Hydrology	N/A (depending on the project)	N/A (depending on the project)	N/A (depending on the project)	N/A (depending on the project)
	(4) Topography and Geology	ditto	ditto	ditto	ditto
4 Social Environment	(1) Resettlement	Shall be monitored, if resettlement happened.			
	(2) Living and Livelihood	ditto			
	(3) Heritage	N/A			
	(4) Landscape	Shall be monitored regularly			
	(5) Ethnic Minorities and Indigenous Peoples	Shall be monitored, if resettlement happened.			
	(6) Working Conditions	ditto			

Source: JICA Project Team

(2) Institutional framework

Institutional framework of the environmental management plan is proposed in Table 8.1.7.

Table 8.1.7 Institutional Framework

QFZO	DOE	IFO
・ Study on ecosystem distribution ・ Environmental management plan in Qeshm Island ・ Supervision of fishing boat in the protected area ・ Supervision of tourism sector from the viewpoint of environmental conservation ・ Conservation activity of coral, seagrass bed	・ Study on ecosystem distribution ・ Hara mangrove area management plan ・ Water quality monitoring ・ Permission of activity in Hara mangrove area ・ Consultation of development in environmentally sensitive area	・ Fishery resources monitoring ・ Control of fishing including Mushta ・ Permission of fishing activity in Hara mangrove area ・ Conservation activity of coral, segarass bed

Source: JICA Project Team

(3) Phasing and priority project

The phasing of environmental management is summarized in Table 8.1.8. An overall management plan, including monitoring plans, will be established and implemented as soon as possible.

As for management activity, conservation measures in Zone II must be prioritized because the existence of coral is only confirmed in Zone II and its coverage rate is severely small. Since the urban area is included in the zone, the control of runoff and wastewater discharge shall be strictly considered.

Table 8.1.8 Phasing of the Development of the Environmental Management Plan

		Short term	Mid term	Long term
Development of the management plan		- Intensive study of the ecosystem distribution is conducted - Management plan is established and monitoring is implemented continuously	Management plan and monitoring plan is modified based on the monitoring results.	Management plan and monitoring plan are modified based on the monitoring results
Management activity	Zone I	Regulations for a bird sanctuary are established	Number of migrating birds is identified and monitored	Bird sanctuary is designated as a protected area.
	Zone II	- Wastewater and runoff management is strengthened - Fishing regulation in the designated area is properly managed	Coral transplanting is considered, if necessary	Coral transplanting is continued by the local community and NGOs
	Zone III	- Control of access to the sandy beach by car is strengthened - Conservation strategy of scenery is established	Conservation of turtle egg laying is managed by the local community	The area is recognized as a nature contact area
	Zone IV	- Hara mangrove area management plan is established - Conservation activity of seagrass bed is considered	- Mangrove area is managed by the local community - Conservation activity of the seagrass bed is enhanced	Conservation activity of the seagrass bed is managed by the local community

Source: JICA Project Team

8.2 Inland Ecosystem Management

8.2.1 Existing conditions

(1) Flora

According to Udvardy's Biogeographic Province concept, Qeshm is located in the Anatolian-Iranian

Desert province[9]. The desertic inland of Qeshm Island mostly comprises sandy flats with scattered *Acacia spp.*, *Prosopis spp.* and other thorn trees, shrub and herbs. The outer margins of the Meydan River delta and the Kul/Rasul River delta on the northern shore of Qeshm are covered by significant mangrove stands.

Due to the limited altitudinal range and uniformed climatic conditions on the island, its inland vegetation is homogeneous. In comparison with other nearby islands in the Persian Sea, Qeshm has a decent amount of vegetation. More than 180 plant species have been identified (See Table 1, Section 1.4). Most of the species are herbaceous plants. Most of the vegetation covering Qeshm are shrubs and herbs, equating to almost 12 times the size of the forest and woodland. The area of grasslands on Qeshm is 110,018 ha, consisting of 9,433 ha of the regular grassland, 55,479 ha of sparse grassland and 45,106 ha of very sparse grassland.

The major inland tree species include native as well as exotic species, such as invasive *Prosopis juliflora*. Amongst these trees, konar (*Ziziphus spina-christi*) and lool (*Fucus bengalensis*) are considered useful, providing fruit, fodder, sources of honey, shade etc. Major tree species observed in the inland areas of Qeshm Island are listed below:

Native tree species	**Introduced tree species**
Prosopis cineraria	*Prosopis juliflora*
Acacia tortilis	*Azadirachta indica*
Acacia nilotica	*Conocarpus erectus*
Acacia ehrenbergiana	*Eucalyptus spp.*
Ziziphus spina-christi	*Acacia salicin*
Cordia myxa	*Ficus religiosa*
Tamarix spp.	*Delonix regis*
Salvadora persica	*Jasmine multiflorum*
	Bougainvillea glabra
	Nerium oleander
	Leucaena leucocephala

(2) Fauna

1) Mammals

Table 8.2.1 shows a list of mammals found on Qeshm and Hangom. All of the mammals are common species on a global scale and classified in terms of "least concern" on the IUCN Red List, which means that the species evaluated have a low risk of extinction. A recent genetic analysis of gazelles on Hangom Island suggested that the species there is *Gazella bennetti*[10], while the species of gazelles on Qeshm Island yet to be confirmed as *Gazella bennetti*.

[9] Miklos D. F. Udvardy, 1975, *A Classification of the Biogeographical Province of the World.*
[10] M. Mirzakhah et al, 2015, Phylogeny of gazelles in some islands of Iran based on mtDNA sequences: species identification and implications for conservation. In: *Caspian Journal of Environmental Science*, 13(1): pp. 21-30 (http://cjes.guilan.ac.ir/article_114_32.html, accessed on August 27, 2016).

Table 8.2.1 List of Terrestrial Mammals in Qeshm

No.	Scientific name	Common name	Category on IUCN Red List	Year of classification
1	*Paraechinus hypomelas*	Brandt's hedgehog	Least concern	2016
2	*Paraechinus aethiopicus*	Desert hedgehog	Least concern	2016
3	*Rousettus aegyptiacus*	Egyptian fruit bat	Least concern	2016
4	*Pipistrellus kuhlii*	Kuhl's pipistrelle	Least concern	2016
5	*Gerbillus nanus*	Dwarf gerbil	Least concern	2016
6	*Tatera indica*	Indian gerbil	Least concern	2016
7	*Meriones persicus*	Persian jird	Least concern	2016
8	*Meriones hurrianae*	Indian desert gerbil	Least concern	2016
9	*Meriones libycus*	Libyan jird	Least concern	2017
10	*Meriones crassus*	Sundevall's jird	Least concern	2016
11	*Rattus norvegicus*	Brown rat	Least concern	2016
12	*Rattus rattus*	House rat, Black rat	Least concern	2016
13	*Lepus capensis*	Cape hare	Least concern	2016
14	*Vulpes vulpes*	Red fox	Least Concern	2016
15	*Gazella bennettii*	Chinkara	Least Concern	2016

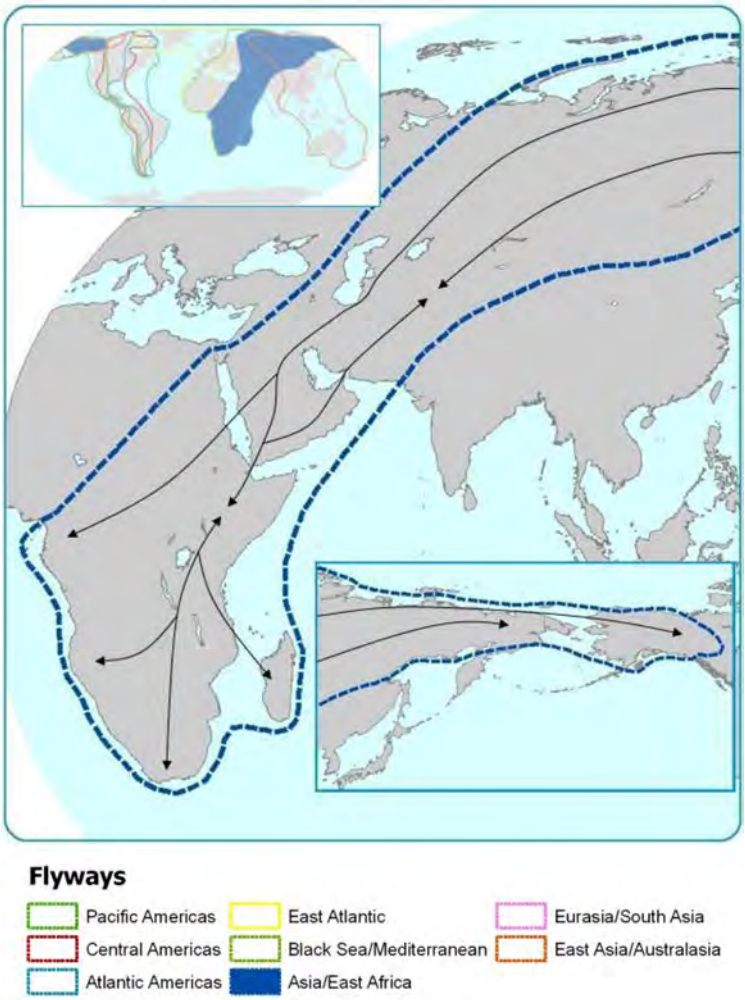
Source: JICA Project Team

2) Birds

More than 220 species of birds among the 517 species recorded in Iran have been observed on Qeshm Island. Among these numbers, 100 species are resident on Qeshm and the rest are migratory. Qeshm Island is on the Asia/East Africa Flyway, as identified by Birdlife International, and a suitable resting place for migratory birds moving from Africa to Siberia (Figure 8.2.1). A considerable number of Euro-Asiatic bird species migrate to Africa, including 43 species of wading birds. A migrating route passes through Southern Iran and crosses the Persian Gulf at its most narrow point, i.e., between Qeshm Island and Oman. The intertidal areas of the Khouran Straits act as the major resting and feeding habitat of the region for wading birds (and many other types of migrating birds as well).

The Khouran Straits, which are designated as a Ramsar site, as well as an important bird area, lie between the mainland and Qeshm Island. Depending on the source, the total number of recorded bird species varies between 93 and 103. The mangrove in the Khouran Straits supports substantial breeding populations for herons *(Ardeidae)*, notably great egret (*Egretta alba*), western reef heron *(Egretta gularis)*, Indian pond heron *(Ardeola grayii)* and goliath heron *(Ardea goliath)*, and also crab plover *(Dromas ardeola),* stone curlew *Burhinus oedicnemus* and tern *(Sternidae)*. According to Birdlife International (1994) [11],, the Khouran Straits are the only confirmed breeding site of *Ardea goliath* in Iran, though there is no report of breeding in recent decades, there is a small colony of *Casmerodius albus modestus* (South Asian race), which probably reaches its western limit in this region. The site holds Iran's largest colony of *Ardeola grayii* (at least 30 pairs) and a possible breeding site for *Butorides striatus*.

[11] http://datazone.birdlife.org/site/factsheet/khouran-straits-iba-iran-islamic-republic-of retrieved on 30 Mar. 2018.



Source: http://www.birdlife.org/datazone/userfiles/file/sowb/flyways/6_East_Asia_East_Africa_Factsheet.pdf, accessed on August 27, 2016

Figure 8.2.1 Asia/East Africa Flyway

In the winter, the wetland is of special importance as a feeding station for heron, plover and sandpiper *(Scolopacidae),* including grey heron *(Ardea cinerea)*, redshank *(Tringa tetanus)*, Terek sandpiper *(Xenus cinereus)*, bar-tailed godwit *(Limosa lapponica)* and curlew *(Numenius arquata)*, while wintering flocks of Dalmatian pelican *(Pelecanus crispus)*, spoonbill *(Platalea leucorodia)* and greater flamingo *(Phoenicopterus ruber)* have been recorded.

The inland desertic plains with scattered thorn trees and date gardens support a typical Baluchi avifauna with several primarily Indo-Malayan species.

Concerning endangered bird species, Great knot (Numenius tenuirostris), is categorized as Endangered (A2bc+3bc+4bc) by IUCN. Dalmatian pelican (vulnerable (A2ce+3ce+4ce) on the IUCN Red List) occurs in the Hara Protected Area in winter (not breeding). Egyptian vulture *(Neophron percnopterus)* (endangered (A2bcde+3bcde+4bcde) on IUCN Red List) is also observed with a population of more than 35 in Qeshm. Eastern Imperial Eagle (Aquila heliaca) and greater spotted eagle (Clanga clanga), which are both categorized as Vulnerable C2a(ii), were also spotted in Hara Protected Area.

3) Reptiles

One noteworthy and endangered terrestrial reptile is *Uromastyx aegyptia* (Egyptian spiny–tailed lizard), which is classified as Vulnerable (A2abcd+4abcd) on the IUCN Red List. Its population on Hangom Island is the largest in Iran.

4) List of endangered species in Qeshm

Table 8.2.2 shows terrestrial species listed on the IUCN Red List as vulnerable or more critical.

Table 8.2.2 Terrestrial Species Listed on the IUCN Red List as Vulnerable or More Critical

Scientific name	Common name	Category on IUCN Red List	Current living condition/threats (worldwide)
Bird			
Aquila heliaca	Eastern Imperial Eagle	Vulnerable C2a(ii)	Loss and alteration of breeding and feeding habitats, shortages of small and medium-sized prey species, nest robbing and illegal trading, shooting, poisoning, electrocution by power lines and collisions with vehicles.
Clanga clanga	Greater spotted eagle	Vulnerable C2a(ii)	Hybridization between this species and the lesser spotted eagle (*Clanga pomarine*), habitat destruction and disturbance, poaching, poisoning and electrocution.
Neophron percnopterus	Egyptian vulture	Endangered (A2bcde+3bcde+4bcde)	Disturbance, lead poisoning (from ammunition used in hunting game), direct and secondary poisoning, electrocution (by power lines), collisions with wind turbines, reduced food availability and habitat change
Numenius tenuirostris	Great knot	Endangered (A2bc+3bc+4bc)	There has been extensive drainage of wetlands in the Mediterranean and North African areas and potentially important areas in Iraq. The conversion of European wetlands and the Central European Steppes into arable farmland may have heavily impacted the species. Following the initial decline, a breakdown in social behavior patterns may have prevented recovery.
Pelecanus crispus	Dalmatian pelican	Vulnerable (A2ce+3ce+4ce)	Former declines were primarily caused by wetland drainage, shooting and persecution by fishes. Hunting is considered to be one of the main threats for the East Asian population. Other continuing threats include disturbance from tourists and fishers, wetland alteration and destruction, water pollution, collision with overhead power lines and overexploitation of fish stocks.
Reptile			
Uromastyx aegyptia	Egyptian spiny-tailed lizard	Vulnerable (A2abcd+4abcd)	This species has been regularly reported in the international pet and medicinal trade. There is A severe collection pressure on the species. The species is locally used for food and medicinal purposes (exported to Malaysia). Its habitat is also being lost due to overgrazing, human settlement, large-scale agricultural expansion, land reclamation, solid waste dumping and off-road vehicles.

Source: JICA Project Team, http://www.iucnredlist.org.

(3) Hara Protected Area and areas identified for conservation (under domestic laws and international initiatives)

Qeshm Island has one protected area, the Hara Protected Area, established by domestic law, along with nine National Natural Heritage sites identified by domestic regulation. Internationally, the Hara Protected Area is designated as a UNESCO-MAB Biosphere Reserve. The Khouran Straits, including the entire Hara Protected Area, are designated as a Ramsar Site. Additionally, the whole of Qeshm Island, together with the Qeshm part of the Hara Protected Area and Hangom Island, is proposed as a UNESCO Global Geopark. A list of protected areas under national laws and areas internationally recognized for their natural value on Qeshm is shown in Table 8.2.3.

Table 8.2.3 List of Protected Areas and Areas Internationally Recognized for Their Natural Values On and Around Qeshm

Name of protected area	Area	Year of designation/recognition	Basis of designation/recognition	Authority of designation/recognition	Administrative authority	Values/objectives for protection
Hara Protected Area	86,581 ha	1972	Environmental Protection and Enhancement Act (1974)	Government of Iran	DoE	No official statement found
Hara-e Khuran Protected Area	2,580 ha	2001	Environmental Protection and Enhancement Act (1974)	Government of Iran	DoE	No official statement found
Dolphin's Bay	unknown	2010	Foundation Law of the Cultural Heritage Organization (1988)	Government of Iran	ICHHTO	No official statement found
Turtle Beach (nesting)	Ditto	Ditto	Ditto	Ditto	Ditto	Ditto
Naz Islands	Ditto	Ditto	Ditto	Ditto	Ditto	Ditto
Dokoohak birds' wetland	Ditto	Ditto	Ditto	Ditto	Ditto	Ditto
Habitat of shrews	Ditto	Ditto	Ditto	Ditto	Ditto	Ditto
Stars Valley	Ditto	Ditto	Ditto	Ditto	Ditto	Ditto
Chahkooh Gorge	Ditto	Ditto	Ditto	Ditto	Ditto	Ditto
Old territory of the Geopark	Ditto	Ditto	Ditto	Ditto	Ditto	Ditto
Namakdan Salt Cave and Salt Dome	Ditto	Ditto	Ditto	Ditto	Ditto	Ditto
Hara Biosphere Reserve	85,686 ha	1976	UNESCO Man and Biosphere (MAB) Program	UNESCO	DoE	Situated in the Mehran River delta, it hosts the largest Avicennia mangrove along the Persian Gulf shoreline and, therefore, represents a center of

						biodiversity in Iran. The Strait of Khuran is also a Ramsar site, providing a habitat to two globally threatened species: a wintering habitat for pelicans (*Pelecanus crispus*) and a regular feeding place for green turtles (*Chelonia mydas*).
Khuran Straits Ramsar site	100,000 ha	1975	The Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat	The Secretariat of the Ramsar Convention (IUCN)	DoE	Shallow saline waters support the growth of red and brown algae, while the intertidal mangroves provide a habitat for crustaceans, an important food source for water birds. Particularly valuable for large nesting colonies of Ardeidae (herons, bitterns etc.) as well as passage and wintering water birds, including the endangered Dalmatian pelican.
UNESCO QIGG	206,300 ha	2017	UNESCO Global Geoparks	UNESCO	QFZO	UNESCO Global Geoparks are single, unified geographical areas where sites and landscapes of international geological significance are managed with a holistic concept of protection, education and sustainable

						development.
Khouran Straits IBA	100,000 ha	1994	Identification using an internationally agreed set of criteria	BirdLife International	No governmental agency identified as the administrative authority of the IBA	The mangrove supports substantial breeding populations of egrets and herons as well as some shorebirds and terns. The extensive mudflats are an extremely important staging and wintering area for shorebirds and gulls and many other species. At least 93 species have been recorded in the reserve.
Qeshm Island ICCA	400km of coastline	2012	Identification using an internationally agreed set of criteria	ICCA Consortium	No governmental agency found as administrative authority of the ICCA	Fishing to sustain livelihoods in the sea; pearl diving has been a part of the activities traditionally, and marine mammals are also part of the conservation practiced. The practices have been highly conserving of the sea, coastal zones and the coral reefs, while the communities' interest in conservation and sustainable practices has been very high.

Source: Department of Environment. Atlas of Protected Areas of Iran, 2006;
http://www.unesco.org/mabdb/br/brdir/directory/biores.asp?mode=all&code=IRA+05;
https://rsis.ramsar.org/ris/50;
http://www.unesco.org/new/en/natural-sciences/environment/earth-sciences/unesco-global-geoparks/list-of-unesco-global-geoparks/iran/qeshm-island/;
http://datazone.birdlife.org/site/factsheet/khouran-straits-iba-iran-islamic-republic-of;
https://www.cbd.int/pa/doc/ts64-case-studies/iran-en.pdf.

1) ICCA

In 2003, the IUCN defined indigenous peoples' and community conserved territories and areas (ICCAs) as "natural and/or modified ecosystems containing significant biodiversity values and

ecological services, voluntarily conserved by (sedentary and mobile) indigenous and local communities, through customary laws or other effective means"[12]. In the Worldwide ICCA Database prepared by the IUCN, Qeshm Island is listed as one of 13 ICCAs in Iran[13]. According to the database, the area encompassed by the ICCA on Qeshm is its 400-km coastline.

2) Global Ecoregions

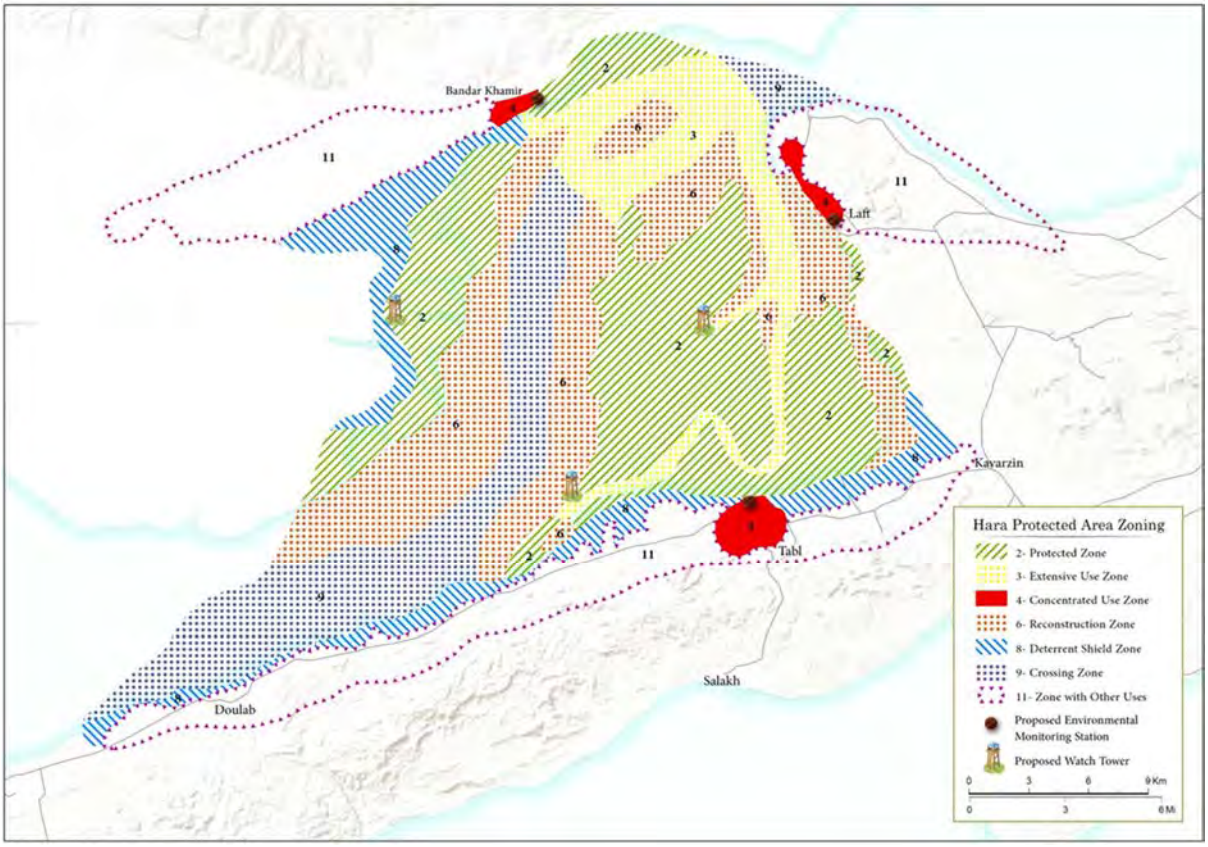
The Global Ecoregions refer to a science-based global ranking of the Earth's most biologically outstanding terrestrial, freshwater and marine habitats. It provides a critical blueprint for biodiversity conservation on a global scale, which was developed by WWF scientists in collaboration with regional experts around the world. At present, 238 Global Ecoregions are identified in the world such as the Arabian Sea (waters off the Arabian Peninsula, north of the Indian Ocean), including the waters around Qeshm Island[14].

(4) Management of the Hara Protected Area

The Hara Protected Area is state-owned in its entirety and protected under Iran's Environmental Protection and Enhancement Act (1974), which superseded all previous nature conservation-enabling legislation, and remains the main law covering national conservation.

The DoE intends to establish management plans for the Hara Protected Area, with the planning process underway and funding secured, as well as a desire to base the plan on consultations with environmental NGOs. However, to date, the planning process largely appears to be a centralized one. In 2002, the Iranian Bureau of Habitat and Area Affairs of the DoE prepared a draft management plan for the Hara Protected Area. However, the management plan has not been officially approved by the QFZO, nor distributed to other agencies involved in the management of the protected area.

[12] https://iucn.org/about/union/commissions/ceesp/topics/governance/icca/.
[13] http://cmsdata.iucn.org/downloads/qeshm_island_iran_icca_database.pdf.
[14] http://wwf.panda.org/about_our_earth/ecoregions/arabian_sea.cfm, accessed on August 26, 2016.



Source: DoE, 2002, Plan of the Hara Protected Area (Draft)

Figure 8.2.2 Zoning of the Hara Protected Area Proposed in the Draft Management Plan

A zoning system in the draft management plan (Figure 8.2.2) provides adequate levels of protection at the site level. In the zoning system, nine zones are proposed as shown in Table 8.2.4. This highly detailed zonation system appears to be based on a desktop analysis of soil types and other environmental characteristics without much consideration of the local resource use. Such an approach can be counterproductive in terms of securing community consensus on the management plan. A further concern relates to the ability to implement zoning management prescriptions, given the current management capacity. Finally, the definitions of zones for "extensive use", "concentrated use", "reconstruction", "deterrent shield", "crossing" and "other uses" are not clearly stated in the draft management plan and leave much room for interpretation, raising the question of the appropriateness of such a finely filtered approach.

Table 8.2.4 Zoning of the Hara Protected Area

Zone no.	Title	Objective
1	Strict nature	Fully protected
2	Primitive	Educational and research use
3	Extensive use	Extensive recreational use
4	Concentrated use	Educational uses, including visitor's center
5	Historic/cultural	To be confirmed

Zone no.	Title	Objective
6	Reconstruction	Mangrove plantation area to compensate for recent deteriorations
7	Special use	To be confirmed
8	Deterrent Shield	To be confirmed
9	Crossing	To be confirmed

Source: DoE, 2002, Management Plan of the Hara Protected Area (Draft) (translated by the JICA Project Team)

(5) UNDP-GEF Small Grant Projects

Since 2000, conservation programs have been implemented and supported by the UNDP- Global Environment Facility (GEF) Small Grant Program (SGP) and local communities. Out of the 240 SGPs in Iran, 25 SGPs have been implemented on Qeshm[15]. Many of the 25 SGPs are following up previous projects. Most of the 25 projects can be classified by the issue they address and their site, as follows:

(a) Projects for the promotion of traditional architecture to save energy
(b) Projects for the introduction of artificial reefs
(c) Projects for conservation and tourism regarding hawksbill turtles in Shibderaz
(d) Projects for conservation and tourism regarding dolphins around Hangom Island
(e) Projects for the documentation of indigenous knowledge through literature development and local libraries

8.2.2 Issues to be tackled

(1) Responsible organizations for the conservation of ecosystems

There are some concerns regarding the lack of coordination and confusion over the responsibilities and jurisdictions of agencies with regard to the management of the Hara Protected Area, as well ecosystem conservation in general, on Qeshm. As noted above, there are multiple agencies involved in the management of the protected area and, while there are working relationships in existence, there appears to be no overall management system or plan, nor any clear mandate regarding the coordination of the various institutions involved.

(2) Environmentally sensitive areas

The most environmentally sensitive areas of Qeshm Island are located in the intertidal areas. The biological productive zone of the intertidal areas, including the mangrove forest, is located on the surface of the substrate, which makes the zone particularly sensitive. Great caution must be applied in locating industries that may cause pollution near the important intertidal areas.

The main area of the land surface on Qeshm Island is desertic, with relatively low direct environmental sensitiveness. The major issues in relation to the conservation of inland ecosystems on Qeshm are as follows:

(a) One of the major issues affecting the achievement of the sustainable use of biological resources in the inland of Qeshm is the proliferation of *Prosopis juliflora,* which is invasive (causing deterioration of native plant species), exotic and less useful than native tree species for local communities.
(b) Another issue is grazing by livestock (camels and goats) on vegetation, in particular, on native tree species.
(c) The conservation of rare and endangered species (Egyptian vulture, Egyptian spiny–tailed lizard, gazelle etc.), along with their inland habitats, represents another major issue.

(3) Conservation of the Hara Protected Area

Based on the Environmental Protection and Enhancement Act of 1974, the Hara Protected Area is under the exclusive mandate of the DoE. The monitoring of the Hara Protected Area is under the jurisdiction of the Hormozgan County Environment office, which reports to the DoE of Hormozgan Province.

However, several other agencies are also responsible for and undertaking activities within the Hara Protected Area and the boundaries of other international designations, such as the Khouran Straits Ramsar Site, the Hara Biosphere Reserve and the Qeshm Geopark. The QFZO is involved in coping

15 https://sgp.undp.org/index.php?option=com_sgpprojects&view=allprojects&limit=50&limitstart=0&paging=1&Itemid=278, accessed on 20 May 2016.

with the environmental and tourism issues affecting Hara, while institutions involved in fisheries management appear to be active in the protected area as well. There are also mangrove restoration activities being undertaken by the Natural Resource and Watershed General Office of the Ministry of Jihad and Agriculture along the northern coast of Qeshm, including part of the protected area.

There are multiple agencies, therefore, involved in the management of the protected area and, while there are working relationships in existence, there appears to be no overall management system or plan, nor any clear mandate and coordination of the various institutions involved. The DoE was established in 1971 and provides technical guidance to provincial offices. However, agency coordination and jurisdictions within the protected area remain unclear.

The Hormozgan Provincial Office and the Qeshm County Office of the DoE are responsible for monitoring, but there is no director of the Protected Area. Rather, the responsibility of the Protected Area seems to be undertaken by a senior officer, as one of several other responsibilities. Likewise, other staff and equipment appear to be allocated to the wider tasks of the DoE, rather than exclusively for use in the protected areas.

(4) Threats to the Hara Protected Area (limited to the Qeshm Island side)

1) Development of jetties and access roads for tourism

If carefully developed, tourism could facilitate the sustainable usage of natural resources in the protected area, without significant negative impacts on the precious ecosystem. However, the ongoing evolution of the tourism sector in the protected areas is characterized by the uncontrolled development of infrastructure, such as the improvements to access roads, the construction of new jetties and the expansion of jetties by reclamation. Four access roads with asphalt pavement reaching the jetties in the mangrove forest in the protected area were identified. The jetty near Tabl Village and its access road were developed through local Tabl community initiative in the 1990s, with financial assistance from the QFZO. This jetty development itself seems to be in line with the zoning in the draft Management Plan of 2002, by the DoE to some extent, as it is close to the Intensive Use Zone (Figure 8.2.4). On the other hand, the other jetties are not compatible with the zoning, as they all fall into the "Protected Zone", with neither based on any long-term plan for conservation. The jetty near Sohil and its access road were developed without any permission from the DoE. In the reclaimed area around the jetty, many restaurants, souvenir shops and other permanent structures for tourism were constructed without the proper procedures stated in the EIA. The reclaimed area around the jetty has been expanded continuously (Figure 8.2.5). Since 2015, another jetty nearby Kovarzin has been reclaimed and its access road from the village has been fully paved (Figure 8.2.6). According to the QFZO, responding to requests from local communities, the President of Iran instructed the DoE to give permission for the development of the jetty and for the QFZO to improve access. The other jetty near Dourbani village is also fully paved with asphalt, but it has not yet been outfitted with a large reclaimed area for tourism infrastructure development.

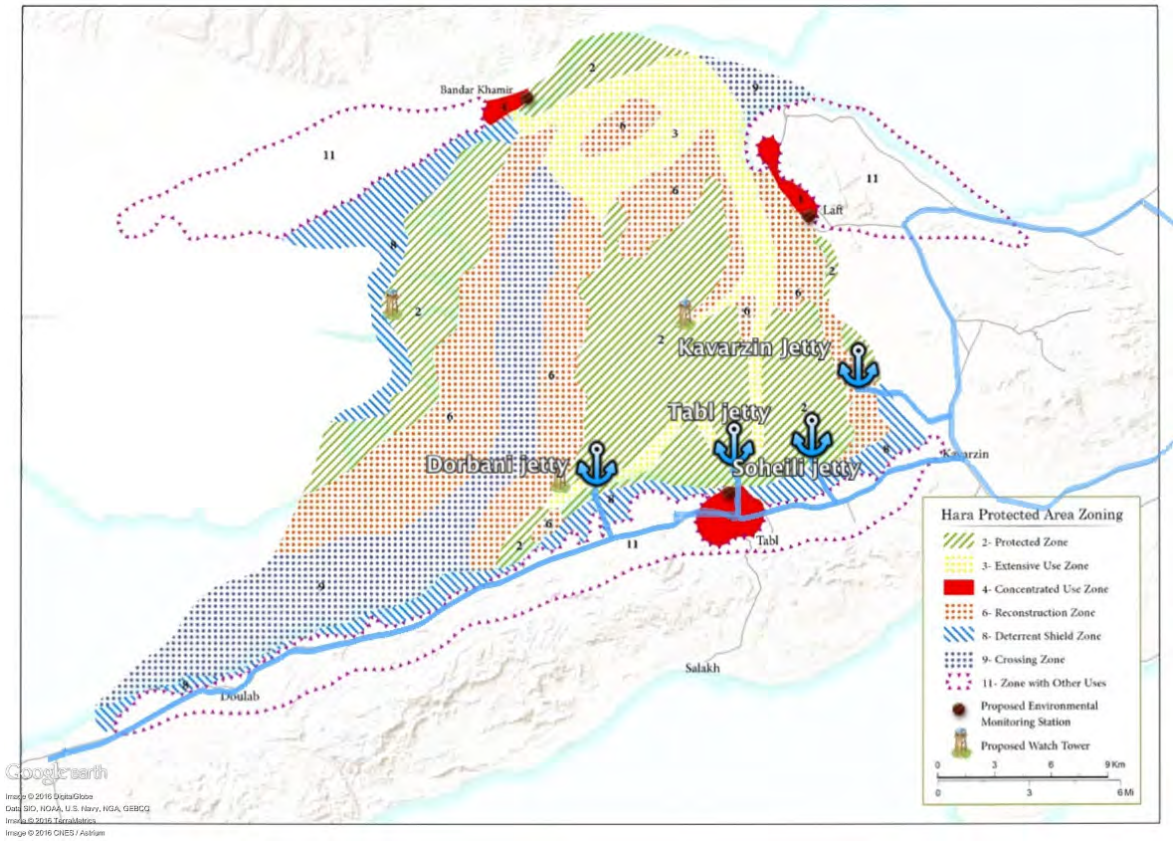
2) Natural resource use

The collection of branches and leaves as fodder for camels is an important resource use in the Hara Protected Area. The use must not exceed the capacity of *Avicennia marina* to regenerate, so as to prevent the degeneration or destruction of the mangroves. Given that the protected area is the basis for the local fisheries and livestock fodder in an otherwise scarcely vegetated desert area, there is strong local dependence on the resources of the protected area. This implies a need and a great potential to work with local communities to ensure sustainable practices, which do not adversely impact the values of the protected area.

Trimming of mangrove trees by the local residents for the purpose of feeding their livestock is often observed. Although the surplus behavior might lead to the degradation of the mangrove area, moderate trimming is considered favorable to maintaining the health of the forest because of better drafty conditions. The FRWMO of the Ministry of Jihad and Agriculture states that it supervises tree trimming by local residents. Neither management plans nor guidelines for other ecosystems have been obtained at this point.

3) Development

It is significantly of note that the northeastern part of the Hara Protected Area overlaps with the construction site of the Persian Gulf Bridge and a part of the Qeshm FZ (Figure 8.2.3). Some of the piers of the Persian Gulf Bridge that link Qeshm Island with the mainland have already been constructed. The construction site is in the FZ and also within the boundary of the Hara Protected Area. In addition, if completed, this bridge could dramatically alter access between Qeshm Island and the mainland in both directions and impact other parts of the protected area. Clearly, the possible implications of these developments will have to be carefully considered in the future management of the Hara Protected Area.



Source: DoE, 2002, Management Plan of the Hara Protected Area (Draft) (translated by the JICA Project Team); geotrack by the JICA Project Team

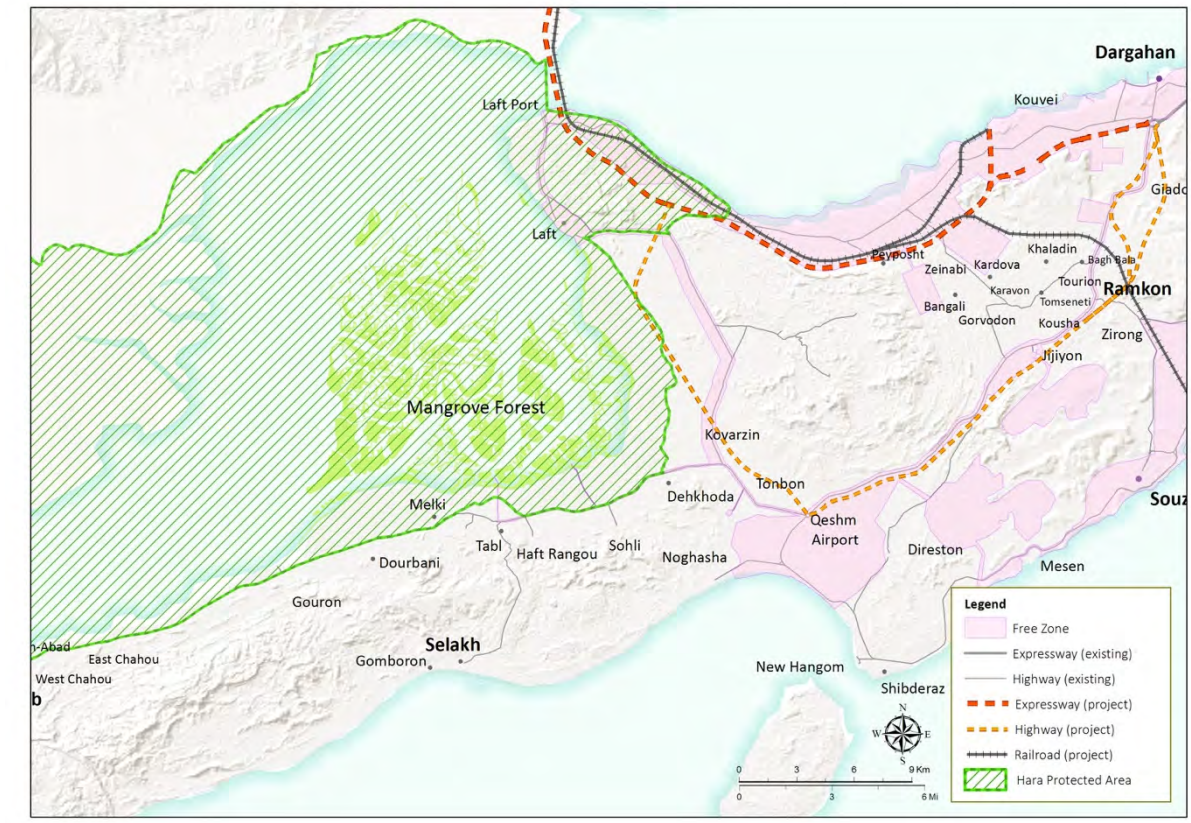
Figure 8.2.3 Identified Jetties and Access Roads and the Draft Zoning Plan for the Hara Protected Area

Source: Google Earth

Figure 8.2.4 Expansion of the Jetty in Sohil (Satellite Images from 2011, 2013 and 2015)

Source: Google Earth

Figure 8.2.5 Expansion of the Jetty in Kovarzin (Satellite Images from 2011 and 2015)



Source: JICA Project Team

Figure 8.2.6 Boundary of the Qeshm FZ and the Hara Protected Area

4) Oil and gas

While not site-based and largely beyond the control of the protected area management, oil- and gas-related activities represent one of the important economic activities in the region. The narrow Strait of Hormuz is located nearby with a substantial role in the global oil transportation network,

making oil spills an ever-present threat. Every effort should be made to ensure high safety standards for the transportation of oil cargo in the context of ports management, in particular, in the nearby port of Bandar Abbas. Monitoring plans and plans for quick and effective responses to disasters are indispensable.

8.2.3 Objectives and development targets

(1) QFZO roles for mainstreaming biodiversity conservation

The most important lesson regarding the previous efforts for biodiversity conservation was that the achievement of biodiversity conservation would not be possible until it had been fully integrated into other sectors. The concept of "mainstreaming" has been adopted in line with the Convention of Biological Diversity since 2002, which refers to the integration of the conservation and sustainable use of biodiversity in both cross-sectoral plans, such as sustainable development, poverty reduction, climate change adaptation/mitigation, trade and international cooperation, and in sector-specific plans, such as agriculture, fisheries, forestry, mining, energy, tourism and transport. Changes in development models, strategies and paradigms are also implied.

Following the above concept of mainstreaming, biodiversity conservation and protected area management on Qeshm should not be considered as separate issues from industrial development and improvement in the livelihoods of local populations. Through mainstreaming, biodiversity conservation will be internalized in the way that development efforts operate, shifting responsibility and ownership for conservation and sustainable use solely from the hands of the DoE to those of other economic sectors, including the QFZO. This sharing of ownership and responsibility about biodiversity conservation presents the opportunity to free up resources, which were traditionally used by environment authorities to counter and neutralize damaging policies and actions, and substantially increase the financial, human and technical capacity for biodiversity conservation.

(2) Application of the *Satoyama* Initiative adopted by the Convention of Biological Diversity

For the integrated management of Qeshm as both a geopark and an eco-island, the concept of *satoyama* is being applied. *Satoyama* means "historically managed area" in Japanese, where livelihoods harmoniously coexist with the ecosystems, and where both high-biological productivity and biodiversity are expected. This notion could be a countermeasure to the idea of controlling the environment solely for economic development.

Although the concept of *satoyama* is rooted in Japanese culture, it is now universal, as the *Satoyama* Initiative was adopted by the 10th Conference of the Parties to the Convention of Biological Diversity (CBD COP-10) in 2010 in Nagoya, Japan. This conference recognized the *Satoyama* Initiative as a potentially useful tool to better understand and support human-influenced natural environments for the benefit of biodiversity and human well-being. The *Satoyama* Initiative suggests the promotion of sustainable development and the pursuit of the intelligent utilization of biological resources, including genetic resources associated with traditional ecological knowledge (TEK), inherited by the communities on Qeshm. In CBD COP-10, the decision was also made to promote the synergy of the *Satoyama* Initiative with the above-mentioned UNESCO-MAB Programme and the ICCAs as follows:

> "[The conference recognizes] and supports further discussion, analysis and understanding of the *Satoyama* Initiative to further disseminate knowledge, build capacity and promote projects and programmes for the sustainable use of biological resources, and promote synergy of the *Satoyama* Initiative with other initiatives or activities including the Man and the Biosphere Programme of the United Nations Educational, Scientific and Cultural Organization, the International Model Forest Network, and other initiatives that include community-conserved areas that are developed and managed by local and indigenous communities to advance understanding and implementation of customary use in accordance with Article 10(c) of the Convention on Biological Diversity." (CBD COP-10 Decision X/32, Sustainable use of biodiversity 3(d))

By applying the *Satoyama* Initiative on Qeshm Island, its communities can utilize natural resources sustainably for local industries and services, such as ecotourism, in support of the island's integrated

management as a geopark and an eco-island. It is suggested that the *Satoyama* Initiative is applied to the integrated development of the island as a geopark and an eco-island under international cooperation between Iran and Japan.

8.2.4 Development plan

(1) Institutionalization of the QFZO's role and coordination with other agencies for nature conservation

To achieve the mainstreaming of biodiversity conservation and the *Satoyama* Initiative as discussed above, the QFZO's capacity and institution for the coordination with other concerned agencies should be enhanced. In policymaking and planning for the biodiversity conservation and management of the protected area on Qeshm, industrial and sectorial development, which is planned and implemented by the QFZO, should not be considered as "external factors". In consideration of the industrial development that may impact negatively on biodiversity and ecosystem services, enforcement of the conventional regulatory measures, such as requirements for the EIA, is the first countermeasure that will be achieved. Additionally, the SEA and other economic countermeasures, such as payment for ecosystems services for the conservation of biodiversity, should be considered.

(2) Integrated management of the Hara Protected Area

To achieve a better management of the Hara Protected Area as a geosite in relation to the Global Geopark, the Ramsar site and the UNESCO Biosphere Reserve, an institutional framework with an inter-organizational cooperation mechanism is required. The following activities are proposed to achieve this goal:

(a) Creation of a preliminary inventory of the biota and biological characteristics of the Hara Protected Area
(b) Establishment of a management committee composed of relevant organizations, with clarification of their roles
(c) Establishment of sub-committees (monitoring, tourism, fishery etc.)
(d) Preparation of a conservation and utilization framework, in accordance with the existing plans
(e) Provision of training for tourism operators on the functions of the mangrove ecosystem, and the introduction of various fauna species, their relations and conservation policy.
(f) Confirmation of related environmental laws and the responsible organization for small infrastructural development (wood decks and birdwatching tower) and its application
(g) Installation of information boards
(h) Preparation of environmental education materials
(i) Preparation of a promotional video (using a drone for filming)
(j) Other activities with high urgency, which could be models for others areas (e.g., prohibiting mangroves from being used as forage, restraining the use of set nets and reforestation).

(3) ICCA Promotion in Line with Documentation on TEK

ICCAs, in line with documentation on TEK and with the participation of local communities, shall be identified and promoted to enhance the management of the natural ecosystem. The following activities are proposed for a pilot project in order to achieve this goal:

(a) Support communities in identifying potential ICCAs, managing the existing ICCAs and establishing new ICCAs
(b) Support communities in presenting traditional knowledge (herb, food, handicrafts)
(c) Application of traditional knowledge to tourism
(d) Registration on the World Database on Protected Areas

(4) Control of invasive alien species

Adequate management for preserving existing ecosystems is required, including the control of

mesquite (*Prosopis juliflora*), which is an invasive alien species threatening the biodiversity on the island. The spread of this exotic tree is undesirable as it gradually competes with native tree species for water and changes the ecosystem. The invasive trees should be eliminated from the protected areas, as well as ecologically sensitive areas, on the island. In areas in the nearby villages, the control of mesquite by lopping, cutting and effectively using it as thorn barriers, fodder etc. should be promoted.

The following activities are proposed as a pilot project to achieve better management of vegetation by utilization and extermination of the invasive alien tree species:

(a) Identification of distribution, ecological effects and utilization methods
(b) Survey of the vegetation and utilization of alien species and indigenous species at candidate areas
(c) Survey of the awareness of the QFZO and the understanding by local residents
(d) Participatory planning of flora management
(e) Implementation and monitoring of flora management

8.3 Geopark Management

8.3.1 Existing conditions

(1) Qeshm Island's geological values

In terms of the geologies on Qeshm Island, it is a recognizable place. It includes salt diapirs attributed to the Precambrian eon known as the Hormuz Series, which has been active until now with a trend towards the upper formation levels of the Earth (Government of Iran, 2016, Dossier of Qeshm Island Geopark). The island embraces some gas and oil fields, salt domes, vast mud lands and intertidal areas, karst formations, and other historical eye-catching erosions, as well as excellent underwater phenomena and ecosystems in surrounding waters. All such geographical and geological values may provide chances for scientists to study the island in a way that is crucial to have a perfect geopark.

Further studies have shown that Qeshm Island was likely a settlement in the Paleolithic era (Stone Age) (Dashtizadeh, 2011). Darehshouri and Potts have surveyed the top of the mountains and proven that Qeshm Island had a booming history about 1,000 years ago (B. F. Darehshouri, 2009, *The Nature of Qeshm*).

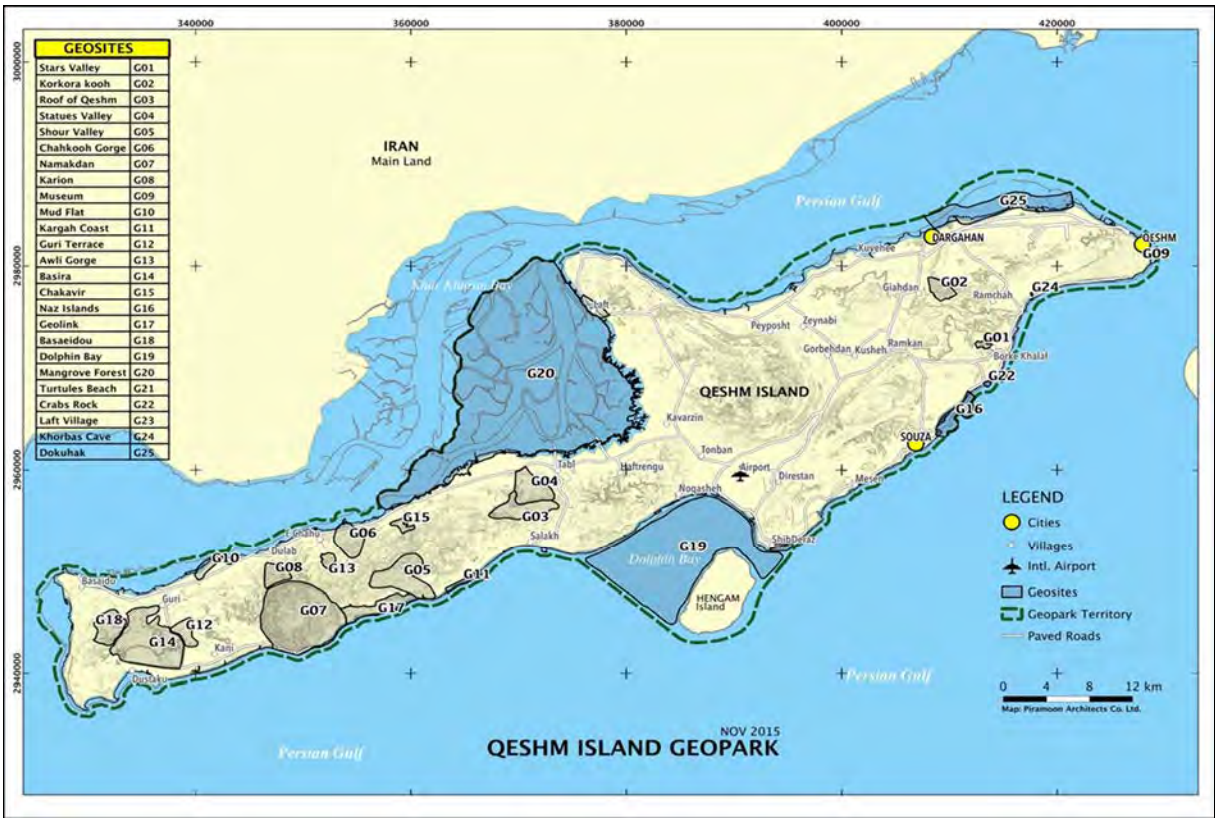
The majority of interesting and famous geosites in the Qeshm Island Geopark are the result of tectonic moves and erosion workouts. Anticlines are the general phenomena in the Zagros Mountain Range, especially in Southern Iran. The role of anticlines in the formation of Qeshm Island is very important. The Namakdan Salt Dome is exposed in the Selakh Anticline. Most of the major geosites are also located around the anticlines. There is an interesting age contrast in the formations of the island, while the oldest sedimentary formations date back 20 million years; in the Namakdan Salt Dome area, there are even formations aged 500 million years. A variety of rocks and minerals are exposed on the island, mainly around the Namakdan Salt Diapir: namely, crystallized dolomite, limestone (different types), gypsum, halite, anhydrite, hematite, oligist, limonite, rhyolite, marl, sandstone, epidote, tuff, pyrite, apatite, shales etc. (Government of Iran, 2016, Dossier of Qeshm Island Geopark).

The island is mostly rocky and has little vegetation, while the weather is very humid and hot, especially during the summer season. It rains rarely and scarcely on the island although floods do occur, while wind can be very strong and even typhonic for a few days on an annual basis. Such a climatic regime has created a unique geological and natural state over the past millennia, which has produced fantastically eroded structures.

Seawater has had a crucial effect on the shape of the island especially along coastlines. In fact, all sediments on Qeshm have marine bases, while almost all geosites have been effected by marine behaviors. There are also a few small natural sulfur springs on the island, which are mostly used by the locals. The springs' water is not hot but it is highly saline, with some people believing that it reduces bone aches.

A salt dome (Geosite G7) with plenty of exciting salt caves is the most important asset and natural

attraction on Qeshm, while the world's longest salt cave (6,500 m) in the Namakdan Salt Diapir is the most outstanding phenomenon from the Cambrian era. Figure 8.3.1 shows the location of 25 geosites designated in the Qeshm Geopark that encompasses Qeshm Island and Hangom Island. Areas of some geosites are overlapped with the international and national heritage designation. The international heritage designation includes UNESCO Biosphere reserve and Ramsar conservation. ICHTO designates nine national natural heritages in the island as shown in Figure 8.1.8.



Source: Government of Iran, 2016, Dossier of Qeshm Island Geopark

Figure 8.3.1 Qeshm Proposal to Become a UNESCO Global Geopark, 2016

(2) Geo-tourism

Despite the general believe that tourism is the best incentive for improving the economic conditions of the locals living in a geopark, it is not the only way. Sustainable agriculture, mining and fishing are good alternatives. It sounds as though geotourism is the best, or even the only, resource for job creation regarding young adults in the rural areas on Qeshm Island in recent years.

After Qeshm was recognized as a geopark in 2004 by the QFZO, followed by its approval as a Global Geopark Network (GGN) member in March 2006, many activities were undertaken by the QFZO, which increased the number of the visitors to the island with regard to the newly introduced attractions. According to a KPMG (2003) report, the island received around 630,000 visitors annually; this number increased to 3.7 million by 2015 (JPT estimation, 2016), of which 13.5% can be assumed to relate to the establishment of a geopark. This significant growth in visits has worried experts at the same time, since it may negatively impact on the cultural and social conditions of the locals.

Table 8.3.1 shows the increase in the number of visits in the last three years. The reason for a significant number of visits to the Visitors' Center is that it was free to visit before 1394 (according to the Iranian calendar). It also shows that Kovarzin Jetty received a large number in the same year, although there was a reduction in the number of visitors in Tabl and Sohil, which may lead to undesirable types of competition between the villages in the future.

Table 8.3.1 Number of Visitors at Major Attractions in Geopark in the First Five Months in the Iranian Calendar (From March 21 to August 21)

Geosites	Iranian Calendar		
	1393 (2014)	1394 (2015)	1395 (2016)
G1 (Site)	47,167	38,700	41,682
G6	8,047	13,819	18,704
G7	1,981	10,111	7,355
G9	4,279	6,098	1,858
G20 (Tabl Jetty)	24,102	23,232	16,176
G20 (Sohil Jetty)	23,412	28,788	23,448
G20 (Kovarzin Jetty)	0	0	39,798
Total	108,988	120,748	149,021

Source: QFZO, Qeshm Island Global Geopark
G1 Visitor center is separated since it is inside the Stars Valley (G1) site.

When geosite G1 (Stars Valley) was developed, Qeshm Geopark considered an entrance fee for this geosite and the number of the visits decreased for one year. In 2016, Qeshm Geopark no longer promoted geosite G7 (Namkdan Salt Dome) as a destination due to the risks of the visit for regular people. They highly recommended that visits to this geosite should be guided and individual visits must be controlled. The number of the visits of geosite G9 (Geopark Museum in Qeshm City) suddenly decreased since the museum was closed for a long time in order to refurbishing and it was reopened in 2017 more attractively. Geosite G20-3 (Mangrove Forest around Kovarzin Jetty) development shows that a new paved road can make a big effect to increase the number of the visits, but it can be the reason of the reduction of the number of the visits of adjacent geosites around mangrove forest, such as geosite G20-1 and geosite G20-2. The Table 8.3.2 proves the importance of the accurate statistics to plan the future of the geosites.

Table 8.3.2 Number of Visitors at Major Attractions in Geopark in the First Five Months in the Iranian Calendar (From March 21 to August 21)

Geosites	Persian Calendar		
	1393 (2014)	1394 (2015)	1395 (2016)
G1 Visitors' Center	42,938	18,149	14,398

Source: QFZO, Qeshm Island Global Geopark

Regarding the visitor centers in geosite G1, reconsideration should be made to let visits to the visitor center free of charge. The purpose of the visitor center is to familiarize the people with the geosites of the island and let them visit the western parts of the island to assist the economy in remote areas.

(3) UNESCO Global Geoparks

Thanks to efforts of four European Geoparks, the European Geoparks Network (EGN) established in 2000 that became the footstone of Global Geoparks Network in 2004. The GGN was dedicated to promote the concept of the geoparks through implementing many activities in many countries.

Right before submitting the QFZO's application to UNESCO in November 2015, 195 member states of UNESCO formally adopted the GGN, which designated the subscribed parks as UNESCO sites, during the UNESCO's 38th General Conference in Paris. This event in Paris is considered to give UNESCO Global Geoparks the status of the UNESCO's official programme, though the GGN was operated with the informal support of UNESCO previously.

Based on UNESCO's definition, geoparks are single, unified geographical areas where sites and landscapes of international geological significance are managed with a holistic concept of protection, education and sustainable development. These areas have to be able to attract the participation of local communities and follow a bottom-up approach.

UNESCO Global Geoparks Program (UGGP) encourages countries to create regional networks to collaborate closer together and Qeshm Island Global Geopark (QIGG) is going to be the torch bearer of the geoparks in the region as well. QIGG should always care about the UGGP brand to have

revalidations successfully that UGGP subjects to do for all the GGN members every four year. The next revalidation of QIGG will take place in 2021.

(4) Implementation of Qeshm Island Geopark

Qeshm Island has been subject to a partially rapid development since the QFZO was legally established in 1995 by a holistic master plan provided by SWECO to achieve the mission for promoting the industries and trades a year earlier. In 2003, the QFZO discussed the establishment of a Protected Area (or a National Park) in the western parts of the island in response to the SWECO master plan and the Qeshm Island Tourism Strategy (KPMG, 2003). However, the QFZO finally decided to create a geopark with an area of 300 km^2 in 2004 after the concept of the geopark was announced in 2004 at the First International Conference of Geoparks held in China.

The western parts of the island were significantly studied by the Geology Survey of Iran (GSI) and the National UNESCO Commission before the QFZO's geopark announcement in 2004. Although QFZO hired Dr. Abdolazim Haghipour and Dr. Suzan Turner to formulate a dossier for Qeshm Geopark membership of the GGN in 2005. The study identified 8 geosites with different geological characters on the island, most of which were located in the west, including two satellite geosites (G1 and G2). Eventually, the west areas of the island were designated by Global Geoparks Network (GGN) as a Global Geopark, which was the only geopark in the Middle East. Two of the problems of the dossier were excluding the villages from the territory of the geopark that rooted on the concept of the protected area; and assigning two gesosites outside the territory of the geopark.

In 2008, the Strategic Framework and Action Plan for Qeshm Geopark was submitted by Claudia Eckhardt, who had been dispatched to the island on behalf of the GGN Bureau. The Management Plan of the Geopark was completed in 2009 by Piramoon Architects Co., respecting the aforementioned plans. In October 2012, the GGN Bureau decided not to renew the Qeshm Geopark's membership of the GGN after revalidation process. In January 2016, QFZO submitted a new application to the UNESCO Global Geopark program through the Iran National Commission for UNESCO, to designate the whole of the Qeshm Island including the Hara mangrove forests and Hangom Island.

(5) Delisting and listing of the Qeshm Geopark from the GGN

QGG has good lessons to learn for other global geoparks. QGG has been designated at the national level for 12 years under the support of QFZO, and was a member of GGN for six years in total, before being delisted from the GGN in 2012. A brief history of Qeshm Geopark is as follows:

(a) 2004 Considered as national geopark by QFZO
(b) 2005 Applied for the GGN membership
(c) 2006 Membership for the GGN (membership: 4 years)
(d) 2010 First evaluation mission; outcome: Yellow card (Membership: 2 years)
(e) 2012 Second evaluation mission; outcome: red card (Delisted from the GGN)
(f) 2016 Reapply for the GGN and UNESCO Global Geopark program.
(g) 2017 Officially listed as a UNESCO Global Geopark Program and a member of GGN

The UNESCO Division of Ecological and Earth Science, in two letters regarding revalidation dated August 18, 2010, and October 15, 2012, referred to weaknesses in the management system of Qeshm Geopark. It should be noted that, during this period, the Government of Iran was in complicated conditions with the international society. Summarizing the aforementioned letters ought to be useful in terms of formulating a management plan and explaining the fate of the geopark. The letters pointed out these negative issues:

(a) From the 2010 letter:
  i) Insufficient progress of the geopark development
  ii) Low visibility of geosites
  iii) Poor use of the GGN logo in the geopark
  iv) Some attractions not included within the boundary
  v) Ignoring the 2008 Action Plan
(b) From the 2012 letter:

i) Lack of actual development of the geosites
ii) Shortage of interpreting boards for the geosites
iii) Temporary office
iv) Still ignoring the 2008 Action Plan

However, in the second letter, the evaluators referred to some improvements:

(a) Staffing
(b) Road construction
(c) Holding workshops
(d) Involving local communities
(e) Improved management
(f) Good planning regarding the geosites

In the second letter, the evaluators also left some comments with regard to the following:

(a) Close links with other GGN members
(b) Rebuilding a top-quality global geopark
(c) Requesting mentors from the GGN

(6) Re-registration of Qeshm Island on the list of UNESCO Global Geoparks Program

Since the GGN was upgraded from an ad hoc collaboration under the auspices of UNESCO to a UNESCO program in 2015, the QFZO has become more enthusiastic and supportive to regain the international designation of the geopark. This can be explained by the following two reasons:

(a) To support the island to promote sustainable tourism, and

(b) To guarantee sustainable development.

Despite the above reasons, the QFZO decided not to apply for the GGN immediately after the de-listing of Qeshm Geopark from GGN in 2012 because of the sensitivity of the issue. When the Geopark Office was established, most of senior managers of QFZO started to support the geopark with the aim of re-listing the geopark as a UNESCO Global Geopark. They took the action as listed below:

(a) To participate in many regional and international geopark events and communicate with the GGN Bureau Members as well as international scientists,
(b) To extend the boundary of the geopark to the whole island and wider, including the Hara mangrove area, Hangom Island and Dolphins Bay,
(c) To increase the number of the geosites from eight (2006) to 25 (2014),
(d) To employ staff who were previously volunteers for the Geopark in order to maintain the organization,
(e) To study the geomorphology of the island effectively, and
(f) To improve the quantity and quality of the information boards and signboards.

Two evaluators visited the island to evaluate the dossier in August 2016. QFZO, GSI and other related persons in Iran paid attention to the outcomes of the Seventh Conference of the Geoparks, which took place in Torquay, UK in September 2016. The GGN Bureau reviewed the dossier for Qeshm Geopark provided by QFZO and findings by the evaluators before the conference was commenced. The Executive Board made the decision whether Qeshm Geopark is listed or not on the UNESCO Global Geoparks at the UNESCO Session in Paris in April 2017.

Management of Qeshm Island as a UNESCO Global Geopark is considered an opportunity to facilitate the community-driven sustainable development which requires the preservation of cultural and natural heritages. Thus, it is worthwhile to register Qeshm Island as an UNESCO Global Geopark. QFZO must first clarify the status, rules and regulations concerning the proposed geopark to prepare the application dossier, supported by international and local experts. QFZO submitted the dossier in January 2016. Along with submission of the dossier, the Project took the promotion activities for geopark. The environmental technology seminars was held to discuss the management and utilization of the geopark, with reference to good practices from Japan. Moreover, the Project provided the training program including site visit in geoparks in Japan and implemented the pilot projects for

management of the geopark. The training program was carried out in September and October 2017 and included the subjects to utilize the geopark for promotion of ecotourism.

In the 3rd letter from UNESCO, it is mentioned that the Executive Board at the 201st session has successfully endorsed Qeshm dossier and gave some recommendations to further improve the quality of the Qeshm Geopark:

(a) Strong synergy to protect Hara Mangroves and avoid duplication of roles,
(b) Improve the quality of the website,
(c) Information Centers should be completed as soon as possible,
(d) Cooperation with local tourist agencies,
(e) Link between geological heritages and other aspects of heritages,
(f) Simplifying interpretation materials,
(g) Strengthen networking with other geoparks, and
(h) Strengthen the role of women.

8.3.2 Issues to be tackled

(1) Geopark concept for sustainable development

The main objective underpinning all the above documents is to guarantee sustainable development for the island and its surroundings with consideration to its fragile landscape and delicate environment. Sustainability can only be achieved by the consideration of all strategic objectives (Eckhardt, 2008). The JPT recommends the application of the QIGG regulations to all upstream plans and decision-making.

(2) Geosites

Each Geopark has several sites (so-called geosites) whose aim is to make the geology visible to the public. Meanwhile, as the concept of the Geopark is not only about rocks and mines, the GGN and UNESCO promote various assets, which reflect the respective features of culture, history, nature, geography, agriculture and even special restaurants as geosites. The QIGG has 25 geosites so far. Each geosite is selected and promoted because of its specific value, with most of them characterized by unique formations of geology and erosion. The QIGG must always search for and promote new geosites.

The QIGG should also revise the list of geosites to diversify the types of geosites; for instance, none of them has been selected from the point of view of food, natural gas fields or sulfur springs.

(3) Legal framework of QIGG

QFZO is legally established as a public company like a local government under jurisdiction of the Government of Iran according to the law of establishment of Free Zones in Iran in 1993. Geopark department should effectively use the capability which is exceptionally given to the organization in order to improve the existing managerial system.

The DoGE has planned and implemented several training courses and constructed infrastructure. It has been involved in promoting handicrafts, protecting geosite lands and publishing promotional materials to support geosite conservation. These activities have sometimes overlapped with activities carried out by other departments of the QFZO. The activities should be effectively demarcated according to the relevant departments to avoid the ineffective use of resources until to a steering or coordinating committee has been established.

The Geopark is a new concept in the bureaucratic system of Iran and still does not have a strong and clear meaning and associated tasks among the people. The DoGE must make more effort in raising awareness among departments of the QFZO.

(4) Territory of QIGG

The boundary, as well as the concept, of the QIGG has changed several times from the beginning,

alongside the understanding of experts. There are several lessons to learn from the history of the territory of the QIGG.

According to UNESCO, the maximum increase permissible to the area of a Geopark is stipulated at 10%, which was unclear from the original dossier for the QIGG submitted to the GGN. Hence, the QFZO preferred to prepare a new dossier that delineated boundaries to include all of its administrative areas and beyond.

(5) Scientific education island

Thanks to the established universities and vocational schools on the island, Qeshm can be a scientific education island. At the same time, the QIGG can start negotiating with international and national educational institutes to establish new Geopark courses, as well as training on geoproducts, geotourism, geoguiding, participatory management etc. Qeshm Island and its surrounding areas are perfect places to teach about geology and geomorphology, geography, fishery, oil and gas, the environment, rural planning, and all natural sciences because of the diverse culture, environment and scenery. The QIGG can exploit such advantages to attract many more young scientists to the island through conducting workshops and familiarization tours for schools and universities. Eventually, promoting the QIGG in the region of Persian Gulf can commence.

8.3.3 Objectives and targets

(1) Steering the national and regional prospective geoparks

The QIGG must always seek to represent all the Geoparks in Iran and the Middle East since it is a very important in brand terms for the QFZO to demonstrate its responsiveness to economic development projects internationally. This policy should commence with consensus reached by 1) all the deputies and departments in the QFZO, 2) all related organizations at the national level, and 3) the local community. However, the QIGG must always take actions in order to balance its daily activities with this important goal.

The QIGG has been alone in the region since being established in 2005 and should therefore promote itself as an inspiring pattern for other domestic and international Geoparks, so that the scope of its responsibility is not limited to the island but extends around the world. The QIGG should also focus on upstream issues instead of becoming involved with executive matters. It can push the Geological Survey of Iran, the National Commission of UNESCO or other authorities to speed up the establishment of the Iranian Geoparks Network (IRGN) in order to facilitate the process of identifying and registering new Geoparks in Iran.

Improving the quality of relations with all relevant departments within the QFZO is the first step to achieve this objective, which is possible by exchanging some MoUs with the DoE as well as the departments responsible for tourism, land, infrastructure etc., or by creating a special committee at the highest level of the QFZO for continuous improvement (the kaizen model), in addition to other approaches towards utilizing all the QFZO's existing features, which must be discussed in the organization and with local people.

(2) Acting professionally in the network

The UNESCO GGN contribute to the achievement of the 2030 Sustainable Development Goals (SDGs) through a clear approach. It is recommended to follow three main goals of the GGN in relation to conservation, education and sustainable development in line with the SDGs. The related SDGs that Geoparks support are mentioned in 8.3.4 (10). The QIGG should carry out a series of discussions within the QFZO and with locals to customize the SDGs, with the results considered as an agreement between the stakeholders and the basis for further upstream plans.

(3) Supporting the ECO-QESHM vision

The major vision of the JPT for Qeshm island is a creative and clean island. It seems that the QIGG has an acceptable capacity to apply the vision to its activities, especially if its experiences merge with

other departments. So far, the QIGG is the most capable, compatible and holistic department in the QFZO in terms of aligning the ECO-QESHM concept with UNESCO's goals for Geoparks, compared to other departments. However, all departments must cooperate and work together to achieve the objectives of the island.

8.3.4 Geopark development plan

(1) Master plan

The QIGG has inspired two documents, which function as upstream plans: 1) Strategic Framework and Action Plan (Eckhart, 2008) and 2) Qeshm Island Geopark Master Plan (Piramoon Architects, 2008). These are acceptable guidelines but are somewhat out of the date since a) the territory of the QIGG has dramatically expanded from 300 km^2 to 2,063 km^2, b) the regulations of the designation have changed greatly, c) new geosites are still without any plan or purpose, d) the relationship between the QFZO and other stakeholders is unclear, etc.

On the other hand, a master plan itself is essential in order to obtain the necessary scores during the four-year evaluations. The master plan must assess the situation of the QIGG, comparing favorable conditions with the revalidation criteria as the chief guidance.

All the suggestions made in Section 8.3 should include the following and be inspected and discussed in the master plan. Although the future master plan should explain the role of the county, FZ, special zone, marine areas, mangroves, and cultural, purely scientific or public geosites, women, ecosystem services for the Geopark, etc. It should also study all geosites well and prepare an specific plan for each since they require a series of bespoke interpretation materials. The bearing capacity of each geosite must be discussed with local people, scientists and managers.

Meanwhile, geohazards must be studied fully in the master plan and the results simplified then published for the benefit of locals and tourists.

The JPT highly recommends the QFZO to formulate and approve a new master plan given all the bittersweet experiences as well as survey the new conditions on the island. Another survey must be carried out to identify all the attractive geological, environmental and cultural sites according to a sense of worth shared by residents in the whole territory of the QIGG. The outcome of the survey will contribute to diversifying the range of attractions and enriching the purpose of visits.

Such a master plan must be prepared and agreed with a large group of stakeholders, rather than approved by the higher councils of the administration. It must be short, clear, pragmatic and understandable to ordinary people. The public will be more loyal to the master plan if they have participated in the process since the preparation stage.

Please note that all of the following items should be considered as general advice from the JPT in terms of formulating the master plan and thus double-checked by QFZO officers before implementation.

(2) Data collecting and analyzing

The Geopark should dedicate itself to collect and analyze data. Such information is vital to a Geopark of the future. To this end, the following section discusses statistics feedback and GIS issues.

- Statistics are the foundation of planning. Excluding the Geopark Museum, there are no statistics available on the geosites from 2006 to 2011, after which visit numbers for the four most popular geosites were collected. The statistics of the eight geosites were separated according to domestic and international types from 2016. In recent years, some digital methods for statistics have been created, which that QIGG can utilize for the geosites. We suggest that the QIGG collects more detailed visitor information, for instance, in the following areas, in order to plan more accurately:
  - ✓ Number of visitors (male, female, people with disabilities etc.)
  - ✓ Origin province or country (Isfahan, Germany etc.)
  - ✓ Means of travel (taxi, private car, bus, van etc.)

- ✓ Size of the tour group

- The JPT advise the QIGG to always distribute some paper and electronic documentation in order to collect feedback from visitors at the gateways of the island as well as inside the geosites. This will increase the quality of the service of the operators and be useful when planning in the future. A feedback form can be distributed via the QIGG website, which visitors can complete and submit to the administrator. The form can ask about the quality of the service, whether the entrance fee is reasonable, the amount of time at the QIGG, general feelings etc.
- Simplified GIS software is a very useful tool for the QIGG in order to plan visits, monitor trends and conserve the geosites. For this purpose, a staff member with the QIGG can be trained and linked to the GIS Department of the QFZO to input collected data from the rangers, feedback, statistics etic. Such a system could also help the QIGG to quickly respond to requests concerning developing projects.

(3) Low-season activities

Preparing for the next operational high season is the best activity that Geopark staff and partners can perform during the long low season on Qeshm, which begins in April and ends in October. Improving managing systems, meeting with locals, securing budgets, planning issues, education and training, promoting and marketing at mainland fairs, repairing damaged materials and publishing content, are some of the areas where staff and partners could become involved. However, affluent tourists may wish to experience the hot, humid and stuffy climate conditions on Qeshm while enjoying highly specialized marine sports or staying in the outdoors. In which case, the geopark should grab their attention and connect them with local people.

(4) Ecotourism Committee

The QFZO is the local government body in the territory and possesses a range of departments including the DoGE. As a matter of fact, some activities of the Geopark overlap with the activities of other departments, which may confuse outsiders and investors. In 2017, the JPT proposed to create a coordination committee for ecotourism to the Deputy of Culture, Social and Tourism in the QFZO, who agreed with the proposal and identified a Geopark employee to follow up on the matter in the ensuing months; however, no progress on the ground has been made. Such a committee should specifically align the policies of the departments, demarcate activities, diminish duplications, save the resources of the QFZO and facilitate investments by locals and others. The committee could extend to include other departments outside the QFZO after gaining appropriate experience.

As a midterm goal for the committee, it is recommended that the Geopark is relieved of its executive duties in order to focus on its expertise and delivering its main objectives, since the QFZO can cover most of these duties.

(5) Intangible heritage and bottom-up approach

The hospitality of the people on Qeshm is the most attractive element that can satisfy foreigners. In recent years, the number of guesthouses has surged in the island. They have now started to compete with each other by increasing the quality of service and paying commission to taxi drivers and tour guides. The QIGG should always be aware of such issues and support the Tourism Department.

Other examples of tangible and intangible heritage on Qeshm, such as food, music, handicrafts and games, represent other appealing activities that should be respected, protected and utilized to attract more niche visitors instead of mass tourism.

- Real participation
- Local ownership not local companies involved on the projects and subprojects
- Encourage locals to shape teams to support business creation
- Respecting traditions and local customs
- Promoting local music and recipes
- Prioritizing livelihood improvements in major investments

- Local ownership: creating a community-based system for involving the locals in bottom-up decision-making for the Geopark and its geosites

(6) Development of geosites

Each geosite must have a specific purpose and conditions for visiting. The QIGG should be aware that geosites need to be observed and monitored effectively. Managing, developing, promoting and maintaining each geosite would help to realize a specific objective. The following table covers all the geosites of the QIGG and areas for development by its officers:

Table 8.3.3 Purpose and Type of Geosite

Code	Name	Proposed purpose	Type	Comments
G01	Stars Valley	Tourism	Geology: erosion	The most popular and easily accessible geosite of QIGG; bearing capacity should be defined
G02	Korkora kooh	Education	Geology: erosion	Not promoted yet
G03	Roof of Qeshm	Ancient Qeshm	Environment	Need to study
G04	Tandis-ha (Statues) Valley	Art and events	Geology: erosion	Visitor center is under construction
G05	Shour Valley	Education	Geology: erosion	Need to explain the Selakh anticline
G06	Chahkooh Gorge	Tourism	Geology: erosion	Attractive; bearing capacity should be defined
G07	Namakdan Salt Complex	Tourism/ Education	Geology: diapirism	Visitor center is under construction
G08	Dulab (Karion)	Unknown	Geology: diapirism and erosion	Not promoted yet
G09	Museum in Qeshm City	Tourism	Public space	Under development.
G10	Mudflat	Protection	Environment	Not promoted yet
G11	Kargah Beach	Protected landscape	Environment	Not promoted yet
G12	Ghazi Terrace	Protected landscape	Geology: erosion	Not promoted yet
G13	Awli Gorge	Adventure	Geology: erosion	Not promoted yet
G14	Basira	Special tours	Geology	Not promoted yet
G15	Naz Islands	Tourism	Environment	Already in use
G16	Chahkavir Gorge	Education	Geology	Not promoted yet
G17	Geolink	Protected landscape	Geology	Not promoted yet
G18	Basaeidu	Protected landscape	Geology	Not promoted yet
G19	Dolphin Bay	Protected area	Environment	Already in use
G20	Mangroves Forest Area	Tourism	Environment	Already in use from three major jetties
G21	Turtle Beach	Protected area	Environment	Limited tourism
G22	Crab Rock	Protected area	Environment	Not promoted yet
G23	Laft Village	Historical fabric	Heritage	Already in use
G24	Dokuhak	Protected area	Environment	Not promoted yet
G25	Khurbas Cave	Tourism	Heritage	Already in use

* Protected areas and protected landscapes can be made available to a limited number of tourists.

Geosites must be inspected regularly by the Geopark staff and or other parties. The site visit report must be written in a specific logbook so that others can understand the outcome of the observations made by staff. That said, a monthly observation report should be expected.

So far, only G1, G4, G6, G7 and G9 have plans and come under the full control of the Geopark office, which the remaining geosites need more attentions. The environmental or heritage geosites will need more interdepartmental work; the Ecotourism Committee would be a good place for discussions to

take place in this regard.

The QIGG should always study existing geosites and identify future geosites. Some of the existing geosites may need to be divided into several new geosites (such as G4 or G20), while others may need to be minimized. Furthermore, some may need a conservation plan and others may need to suspend visits for a while.

Any modifications to the geosites must be communicated to residents in the nearest villages before being published and embedded in GIS data.

(7) More networking

In April 2018, an international meeting and workshop on the UNESCO Global Geoparks was successfully held in Qeshm City with the generous support of the QFZO, representing a golden opportunity for the QIGG to pursue the goal of "torch bearer" for all Geoparks. To achieve such a goal, the QIGG must collaborate more and build a strong network for domestic Geoparks in Iran. Basically, Qeshm cannot lead an international network of Geoparks until a domestic one has been set up in Iran.

Meanwhile, the Higher Council of the Free Zones of Iran is becoming more interested in the Geopark concept and advised the Aras and Chabahar FZs to establish proper Geoparks. At the same time, some provinces in Iran are interested in the issue, with the Government of Tabas County very eager to promote the Tabas Geopark. All in all, this is the right time for all prospective Geoparks in Iran to work together under an umbrella organization for domestic and international networking.

The JPT advises the QIGG of the QFZO to:

(a) Encourage other aspiring Geoparks in Iran through supporting other related authorities, such as the Geology Survey of Iran, the Iranian National Commission for UNESCO and the ICHHTO, in order to establish the Iran Geoparks Committee, followed by the Iran Geoparks Network
(b) Continue to host regional Geoparks in the framework of the UNESCO workshops for Qeshm Island
(c) Continue to participate in international events and conferences
(d) Create practical relations with other Geoparks, especially in Asian countries. The existing UNESCO Global Geoparks are concentrated in Europe and East Asia, but limited in Central Asia, South Asia and South East Asia, although there are organizations that are interested in becoming a member of the UNESCO Global Geopark Network (GGN). It is important to nurture these aspiring geoparks.

The QIGG should improve its regional and international relationships, targeting the membership of GGN and APGN committees, exchange documents with global and regional Geoparks, and bring together experts and volunteers in order to enhance its networking.

As all GGN are struggling to feed into the network, the QIGG should prove that is a good member of the family in this regard.

(8) Educations, science and public awareness

The Geopark concept comprises a series of endless activities and demands for creative attractions to satisfy tourists as well. People like to visit new places and learn from them, so they can be persuaded to visit the island and its unseen places on a repeated basis. To this end, the QIGG will need to engage with entrepreneurs and workers whom should be educated.

Although it looks as though all the staff of the QFZO have still not understood the meaning and goal of its Geopark, the organization has around 1,000 managers and other employees, who require in-service training. An inner targeted journal could support this purpose as well as the idea of a "scientific education island".

The QIGG has to work closely with the Bureau of Education in order to start offering educational opportunities to elementary schools. For older people, vocational schools in the county are suitable for collaboration as happened in previous years. At higher levels, the QIGG can plan and implement

agreements with other aspiring Geoparks in Iran or the region, as well as universities, whilst Qeshm Island itself can be an education center for other Geoparks.

Furthermore, public awareness is an important role played by the Geoparks in several fields, such as the essentials of conserving geosites, job creation by Geoparks, bottom-up approaches, women and children's issues, and geohazards.

Designing several incentives such as voluntary activities for Geopark partners and making connections with local NGOs, NPOs and charities are also useful ways of raising public awareness.

Organizing a series of scientific activities run by experts and geologists, such as publishing a magazine or journal, improving the quality of the website, arranging free Geopark courses, implementing supervised field trips and working with universities, is highly recommended. Promoting the island to GGN members as a wonderful place to educate young people about geology and geography is also advised and could involve the Salt Dome, Hormuz Island, different local cultures and the gas fields.

Another suggestion is to establish several supportive committees for enthusiastic people and arrange regular meetings between them, comprising, among others designers and artists, representatives from geo- and ecotourism, entrepreneurial women, scientists, young geologists, QFZO staff, cleaners, statisticians, fundraising experts, military aficionados, local leaders and GGN brand protectors.

Targeted interpretation materials for students, local families, ordinary tourists and experts should be prepared in both English and Persian, as well as published on the QIGG website.

(9) Hormuz Island

Geologically, Hormuz Island is a salt dome offering more visible forms and information from the depth of the earth, as well as a history full of interesting ups and downs. On the other hand, some parts of Hormuz Island are gradually coming under the control of the QFZO. Many tourists visit the island to enjoy its natural and geological features, which, in some cases, are more attractive than those on Qeshm Island. However, in the absence of professional tour guides, information centers, leaflets and signage, visitors cannot understand the geological values of the island. It is recommended that the QIGG support Hormuz Island along with other stakeholders, especially from Bandar Abbas City.

Hormuz Island has the special feature of being a globally reputable geological complex and is a well-known destination, which could be linked with geotourism activities on Qeshm island.

(10) Revalidation preparation team

The next revalidation of the QIGG will happen in May 2020. The QIGG should be ready for that day since it may receive either a yellow or a red card if the progress made falls below the expectations of evaluators. The JPT recommends the QIGG to establish a committee in order to make sure that all activities are in line with the recommendations of UNESCO, such as in relation to the Hara Mangrove Area, cooperation with local tour agencies and greater involvement of women (see pp. 8-36). The team will be expected to understand the application process, its timing and method of evaluation very well and hand over to QFZO managers at the proper time.

(11) Protecting natural landscapes

Apart from the Salt Dome (the Namakdan geosite), the geology on Qeshm is not a wonderfully unique phenomenon, but it is valuable since it is interwoven with a very intact culture that mirrors old Iranian customs.

The beautiful natural landscapes of Qeshm, as an intergenerational capital, are so fragile that even a very small building or a signpost could easily spoil the view. It is suggested that the QIGG studies all the geosites in terms of aesthetics in order to comply with specific regulations for protecting scenery.

(12) International responsibilities

The QIGG is a knowledgeable and agile department within the QFZO but it has some new responsibilities because of the international GNN brand and UNESCO. It has been promoted, with the

QFZO, to an internationally reputed organization, such that it is expected to perform internationally recognized activities. The 2030 UNESCO SDGs provide the best guidance in this case. UNESCO recommends that GGN members should collaborate more than in the past in order to achieve the following goals by 2030:

- Goal 1: End poverty in all its forms everywhere
- Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
- Goal 5: Achieve gender equality and empower all women and girls
- Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
- Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable
- Goal 12: Ensure sustainable consumption and production patterns
- Goal 13: Take urgent action to combat climate change and its impacts
- Goal 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development

Rather than meeting the SDGs, it is expected that the QIGG will participate in addressing climate change issues. For this purpose, the QIGG can collaborate on mutual projects with the DoE, the QFZO, the Bureau of Fishery, the marine research centers, the Biotechnology Center of the Persian Gulf etc., especially to manage its environmental-type geosites.

Since the Hara Mangrove Forest Area on Qeshm has been recognized by the Ramsar Wetlands Convention and the MAB Program, the QIGG must collaborate in order to conserve it with national and local authorities. This could establish a remarkable reputation for the QIGG.

(13) Geopark for branding purposes

QIGG must use the UNESCO and the GGN brand in all cases to form its own cooperative identity and receive recognition of its geoproducts.

A slogan is the key to marketing but the QFZO has change its own several times in recent years, which means it suffering from a lack of clarity in this regard. Perhaps this problem is rooted in the fact that the purpose of the organization in the mind of the central government differs from that in the mind of island residents and what happens on the ground. The following sets out the slogans used in the last 10 years:

- Promote the Salt Dome as the main asset of the QIGG (Marketing, branding?)
- Qeshm: the island of seven wonders!
- Qeshm: an island for the kids!
- Qeshm: the land of energy, oil and trade!
- Geopark: the land of beauty
- Sustainable development with people at Qeshm Geopark!
- Qeshm: the gateway to Iran!
- Clean island

Many of the women of Qeshm Island are gradually becoming involved in the business of handicrafts, which, according to the Geopark literature of geoparks, are so-called geoproducts. Such products can be found everywhere on the island. This should encourage visitors to remember Qeshm and their good memories there when they look for souvenirs or find reminders of the different food and tastes they experienced on Qeshm.

In this context it looks as though the Geopark itself could be a good slogan for the QFZO, since it embodies all of the above phrases. This issue and the possibility of a Geopark brand must be discussed within the QFZO and among related parties.

(14) Less dependent on the QFZO

As the bureaucratic system in Iran is very slow and the Geopark is still not a recognized authority in the government, none of the above ideas can be implemented unless the QIGG has enough freedom to

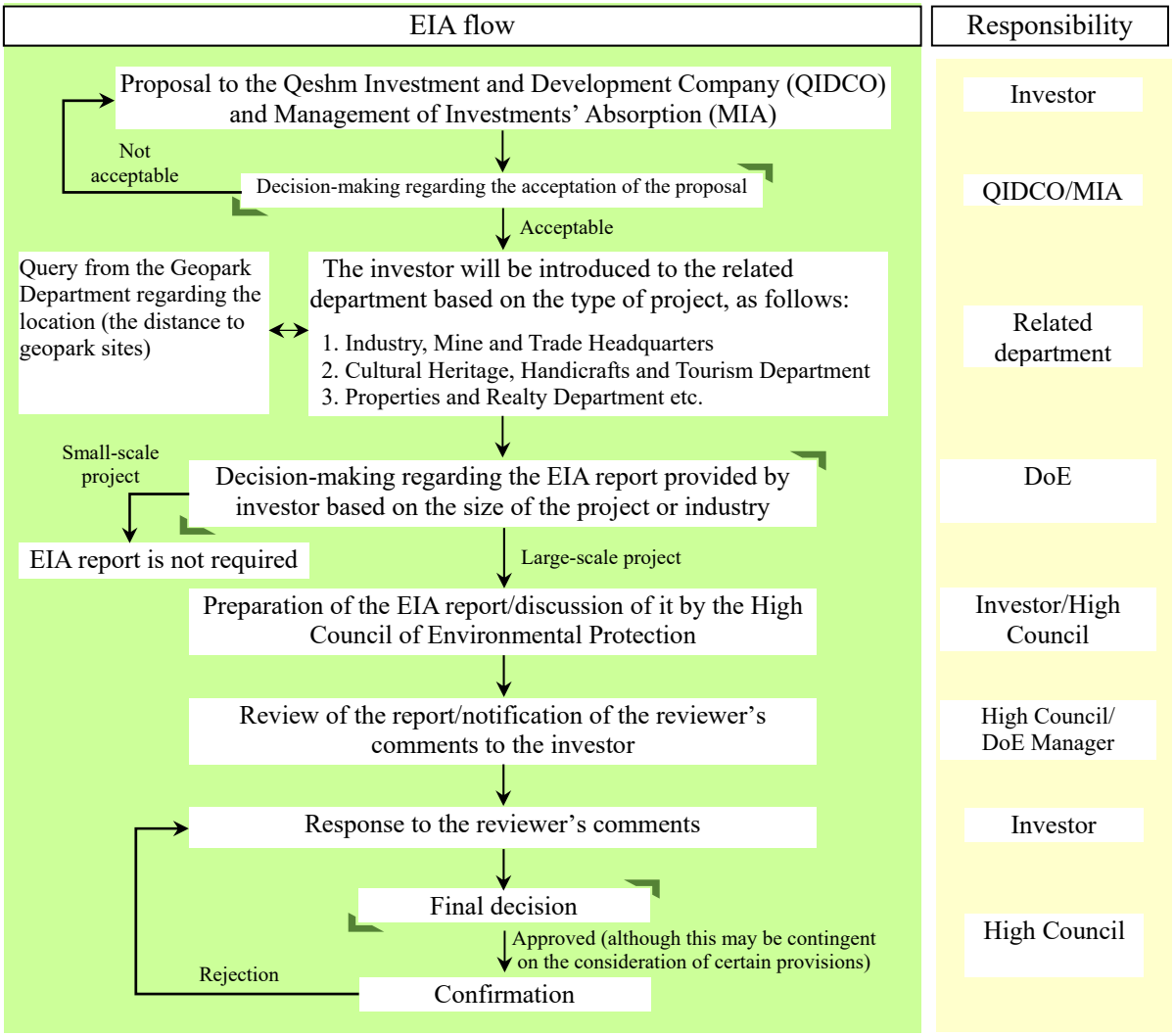
work. Of course, it is true that the QFZO is an effective sponsor of the QIGG; but, in the course of working on the QIGG for 12 years, it is clear that the DoGE suffers from a fragile structure. On the other hand, as the Geopark is not a well-established authority within the structure of Iran, it needs another agile management system, which complements the relevant visions and goals. The Geopark is a community-based concept and should ideally by separated from the QFZO step by step. If this happens, there would be a unique opportunity to try a bottom-up approach because the QFZO has enough power and experience to ensure the quality of operations.

8.4 Institutional System for Environmental Management

8.4.1 Existing conditions

The Department of Geoparks and Environment (DoGE), which is one of the subsidiary bodies reporting to the Cultural, Social and Tourism Deputy of the QFZO, was established with the responsibility for environmental management of 300 km^2 on the east side of Qeshm Island. Its jurisdiction was extended to the entire island when Qeshm was designated as an SEZ. As of September 2016, the DoGE has jurisdiction over Qeshm and Hangom.

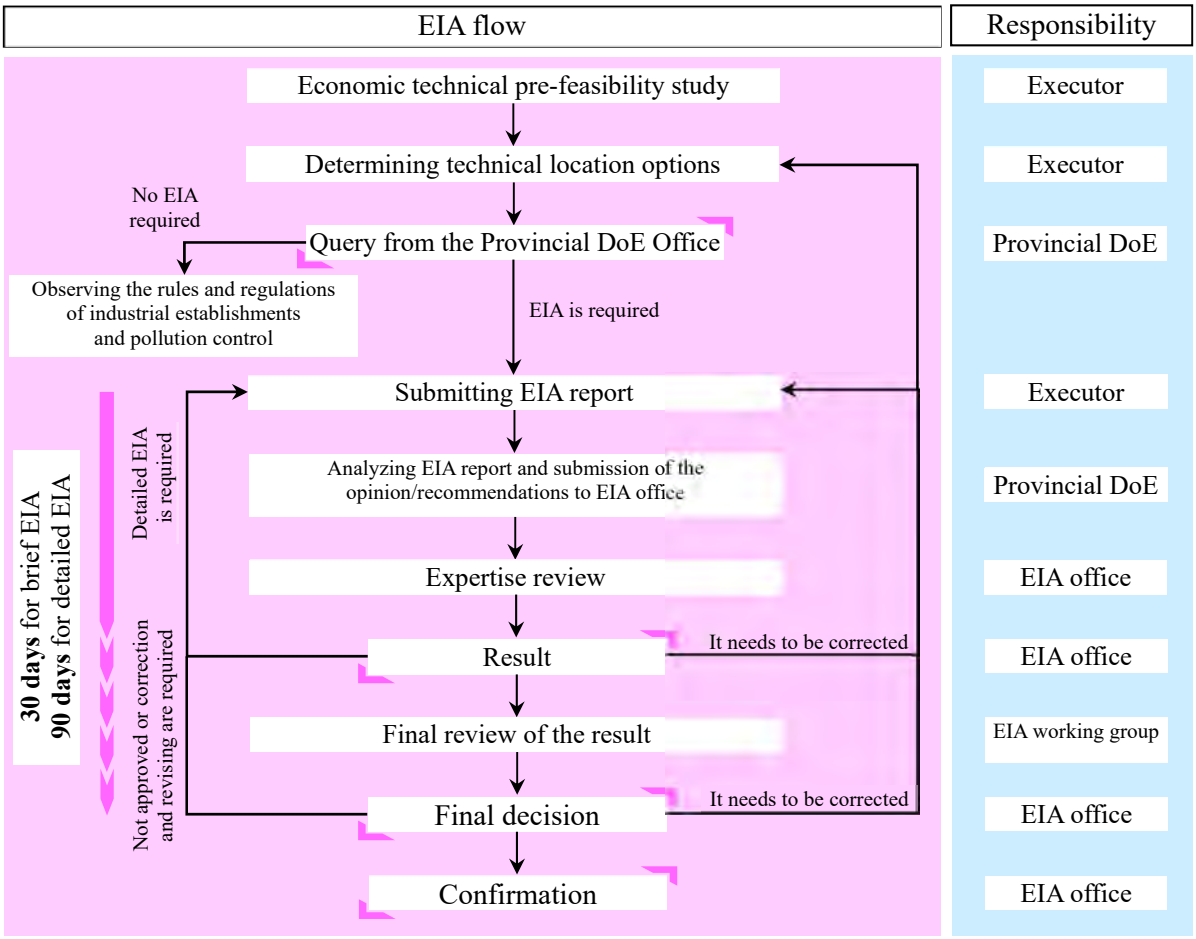
The DoGE has its own EIA procedure on the island, which is different to the procedure of Iran's national DoE due to the former being under the direct control of the President. It is simplified by the omission of certain steps in order to give priority to the island's special status as a FZ, including the areas for development, investment and trade promotion. The DoGE has the authority to arrange and simplify the EIA procedure, while the final decision must be undertaken by the High Council of Environmental Protection, which is composed of the member of central ministries and agencies. Although the simplified EIA procedure has been adopted, the DoGE has stated that it compares favorably with the other EIA in terms of quality due to the high level of expertise from council members.



Source: DoE of the Qeshm Free Zone Organization

Figure 8.4.1 EIA Procedure Implemented by the DoE of the QFZO

On the other hand, the DoE of Qeshm County, which is an organization under the DoE of Hormozgan Province, has three divisions: Human Environment, Natural Environment and Marine. It administered the EIA procedure on Qeshm Island before the DoGE of the QFZO was founded. Furthermore, even now, the DoE of Qeshm County has jurisdiction over the entire island because it simply transferred its authority for the evaluation of EIA report to the DoGE of the QFZO due to staff shortages (only four staff members were dispatched by the Department of Environment of Hormozgan Province).



Source: DoE of Iran, 2012, Human's Environmental Laws, Regulation Criteria and Standards

Figure 8.4.2 EIA Procedure Implemented by the DoE of Iran

8.4.2 Issues to be tackled

(1) Administrative jurisdiction for the EIA

It became obvious that the demarcation of environmental jurisdiction on the island was uncertain and that there were discrepancies between the DoGE of the QFZO and the DoE of Qeshm County. Concretely, the DoGE of the QFZO insists that it had the jurisdictional responsibility for the entire island because it administers the island as a FZ. On the other hand, the DoE of Qeshm County emphasizes that it essentially had environmental authority over the entire island.

(2) EIA procedure

These two organizations also have different views regarding the EIA procedures. The DoGE of the QFZO emphasizes that the simplified EIA procedure was regarded as a legal formality because of the direct approval by the President. On the other hand, the DoE of Qeshm County, expressing its view that the DoGE of the QFZO should also obey the EIA procedure implemented by the DoE of Iran, does not approve of the EIA procedure implemented by the DoE of the QFZO.

It is a fundamental problem that there was no discussion regarding the environmental administrative demarcation between both DoEs in 1998, when the DoGE of QFZO was established. As a matter of fact, the project proponents are confused and struggle because they do not know to which DoE they should refer their inquiries regarding the EIA. For example, the manager of a cement company, which started operating in 1997, when the DoGE of the QFZO had still not been established, explained that he always submitted all of the company's EIA reports for new operation phases and business expansion phases to the DoE of Hormozgan Province, and not to the DoGE of the QFZO. In addition,

no issue had been raised by the DoGE of QFZO, nor had received any communication regarding the matter. On the other hand, regarding the EIA procedure for construction of a shopping center in Dargahan, the DoGE of the QFZO received the construction plan by a project proponent and rejected the permits to implement the project due to insufficient environmental countermeasures. Afterwards, the project proponent submitted the same construction plan to the DoE of Hormozgan Province and received a conditional permission. From the above, it is said that there is no administrative demarcation regarding the authority for EIA procedures on Qeshm Island.

(3) Closed EIA system

There is no mention in the EIA procedures of both the DoE of QFZO and the DoE of Iran regarding public consultation meetings nor disclosure of EIA report. Therefore, no meetings for exchanging ideas between local government and residents are being held, and neither are techniques for EIA being shared or accumulated. This is a great loss not only for the future of Qeshm Island but also for the whole of Iran.

8.4.3 Objective and targets

In order to address the issues raised in previous section, the objectives and targets for Environmental management in Qeshm Island are identified as follows:

(1) Objective 1: establishment of an unequivocal and efficient administrative system for the EIA

In order to implement adequate environmental management on Qeshm Island smoothly, the ambiguous environmental administrative demarcation between the DoGE of the QFZO and the DoE of Qeshm County should be clarified and demarcated appropriately. As there are some projects in which the DoGE of the QFZO or the DoE of Qeshm County would be investors themselves, neither organization should have monopolistic authority regarding the EIA procedure.

Target 1

As a vital first step, a discussion opportunity between the DoGE of the QFZO and the DoE of Qeshm County should be provided to establish consistency regarding the environmental demarcation and the EIA procedure. The demarcation for environmental administration between the two organizations should be determined after various discussions. This is seen as building a framework for mutual cooperation.

(2) Objective 2: ensuring transparency for the EIA procedure

Information disclosure systems, such as a "public consultation meeting and public information browsing system for the EIA reports" (hereinafter referred to as an information disclosure system), should be included in the EIA procedure for Qeshm Island.

When the procedure of EIA is reviewed, efficient and effective coordination among the related departments will be discussed to refine the EIA procedure. The current procedure specifies the MIA decides if a proposal from an investor is accepted or not in advance to distribute the departments. One option for improvement is the proposal will be shared with departments related to environment and geopark in the early stage to exclude the proposal causing the environmental deterioration.

Target 2

The holdings of public hearings should be obligated by the EIA procedure to give opportunities to local residents and local communities to express their opinions, as well as to reflect on these opinions in relation to the project. The responsible organizations for the EIA should not evaluate their respective projects, but should assess the impact of the entire development strategy with a view to disclosing the broad direction of development by considering one of the Project objectives, "Introducing an SEA of the SWECO master plan". In order to realize this, organizations should use the EIA reports as one of providing general information to inform decision-making decisions via wide

disclosure. Therefore, the current system for EIA reports, which prevents these reports from being published, should be changed.

8.4.4 Development plan

In the early phase, the benefits of implementing an information disclosure system should be presented at an environmental seminar regarding international environmental administration, which will highlight some advanced cases from Japan and other countries.

In the next step, the responsible departments for the EIA should in effect realize an information disclosure system by implementing the pilot project concerning the "ecotourism package" and technical cooperation projects formulated by international organizations, in compliance with both EIA procedures implemented by the QFZO and by the JICA or other international organizations, respectively. By raising awareness of an information disclosure system through actual projects, the benefits ought to be comprehended by the responsible departments.

In the final stage, experts from international organizations will be dispatched to assist in incorporating an information disclosure system within the EIA procedure implemented by the QFZO.

(1) Cost estimate

The cost of the above-mentioned development plan is identified as follows:

Table 8.4.1 Cost Estimate of the Proposed Development Plan

Item	Implementing body	Estimation cost (USD)
Environmental seminar in Qeshm regarding international environmental administration	QFZO	10,000 to 12,000
Pilot project on ecotourism package	QFZO	50,000 to 60,000
Technical cooperation project	International organization	Depends on the project scale
Dispatch of experts on environmental policy	International organization	Depends on the activity's content

Source: JICA Project Team

(2) Phasing

The phasing of the above-mentioned development plan is identified as follows:

Table 8.4.2 Phasing of the Proposed Development Plan

Item	Phasing		
	Short term	Mid term	Long term
Environmental seminar	X		
Pilot project on ecotourism package	X		
Technical cooperation project		X	
Dispatch of experts on environmental policy		X	

Source: JICA Project Team

CHAPTER 9 INVESTMENT PROMOTION PLAN

9.1 Existing conditions

9.1.1 Current organization and activities of the Qeshm Free Zone Organization

The QFZO comes under to the Presidential Office. Its mission includes the following seven areas.

(a) To improve the quality of people's life on the island
(b) To conserve and manage cultural, natural and man-made resources on the island
(c) To develop the island by exploiting the comparative advantage of the island
(d) To interconnect the island and the national economy with the global economy
(e) To serve interested groups by attracting and facilitating their participation on the island with resource management and investment activities
(f) To provide opportunities for all citizens

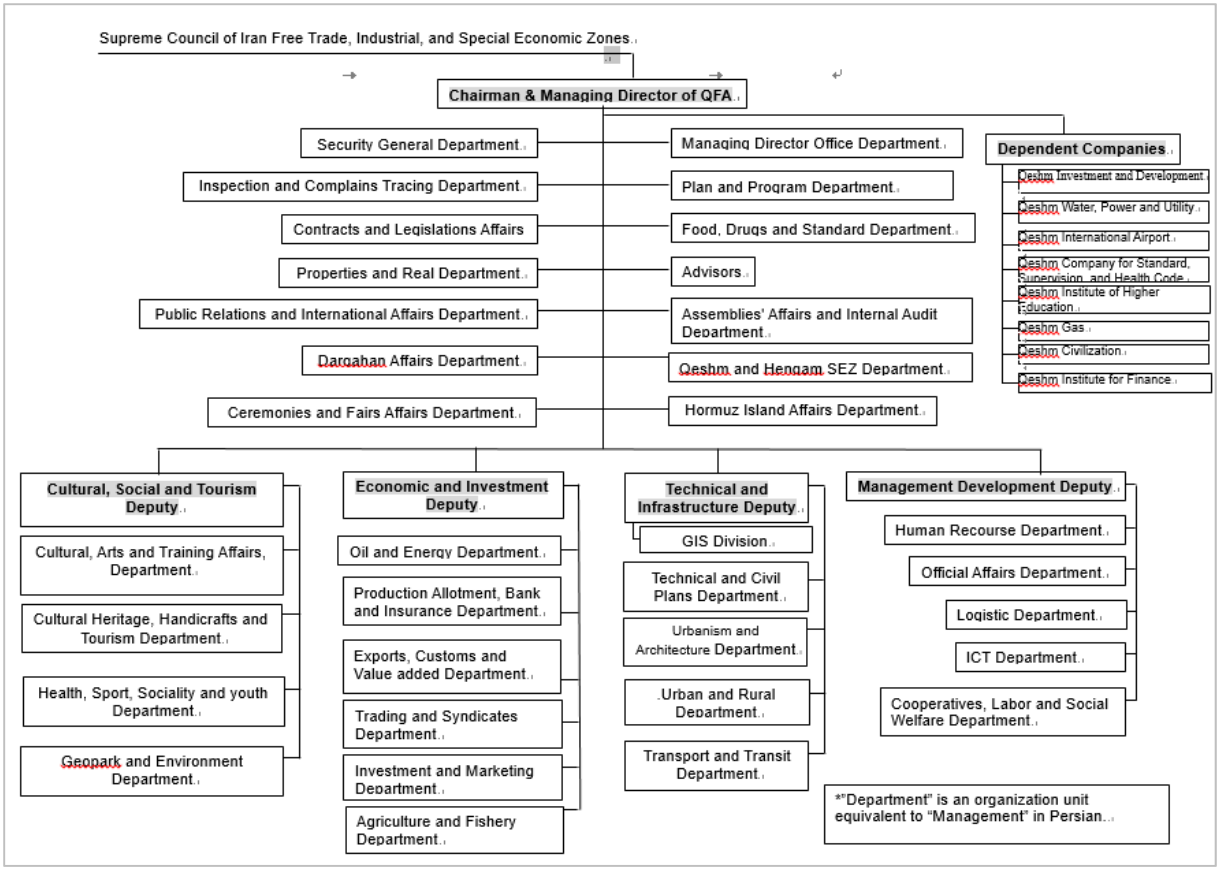
The QFZO has an Investment & Marketing Department, which belongs to the Economic and Investment Division and is managed by the Deputy Managing Director of the QFZO, who is responsible for investment promotion, as shown in Figure 9.1.1. Those who are interested in investing on Qeshm can receive various information from the department concerning the investment environment, incentives, project licenses, the availability of land, land-leasing prices with payment terms, etc.

Regarding investment promotion activities for foreign investment, the QFZO has, to a limited extent, undertaken activities on the mainland and Qeshm. No investment seminar has been held overseas, such as in the EU, Russia, Asia and UAE.

The QFZO also acts as an actual licensing body for investment in the FZ and SEZ, although there is another licensing body known as the Organization for Investment, Economic and Technical Assistance of Iran, which comes under the Ministry of Economy and Finance. The number of investment applications from the mainland and overseas is limited due to the economic sanctions.

The QFZO has a subsidiary company, called the Qeshm Investment and Development Company, whose aim is to develop the industries, commerce and infrastructure of the island by attracting foreign and domestic investors, as well as providing support in various fields to businesses and investors in the FZ and SEZ, in coordination with the QFZO.

The QFZO cannot unilaterally approve investments in specific projects, such as oil and gas development projects, petrochemical projects, large-scale heavy industries, such as steel mills, the metal smelting industry, shipbuilding, ship repairs, airlines, banking, insurance, and currency exchanges, and these areas are handled by the respective ministries on the mainland. That said, the QFZO provides various information to prospective investors, which may be useful when researching their potential investments.



Source: Qeshm Free Zone Organization.

Table 9.1.1 Organization of the Qeshm Free Zone Organization

9.1.2 Current foreign investment on Qeshm

(1) General industry

Due to the current economic sanction, the number of foreign investors involved in the industrial sectors is rather small. In 2016-17, only seven foreign investors invested in Qeshm and their total investment amounted to 337,617 million IRR, which is equivalent to 33,778,000 USD.

There are three existing industrial parks on Qeshm: Towla, Kouvei and Alvand. But even now, less than 50 tenants operate in these parks. It is difficult for the QFZO to attract new prospective investors. Therefore, it is eager to invite domestic and foreign investors by carrying out marketing campaigns and upgrading the infrastructure of industrial parks.

Table 9.1.1 Foreign Investment (General Industry) in 2016-17

Company Name	Products	Investment Value (IRR millions)	Country (share ratio)
1. Dimag delavaldez Oil Service	Repair improvement of various turbine	107,000 (2,700.000 USD)	UK, Germany (99.81%)
2. Tiab Baran	Aquaculture of fish	130,000 (3,282,000 USD)	France (45%)
3.Satrab sanat Qeshm	Thermal system by carbon fiber	15,000 (378,000 USD)	Japan (49%)
4. Net Lub Iran	Lubricant oil	564,300 (14,250,000 USD)	UK (51%)
5. Super Pipe International	Super pipe		Germany (74.99%)
6. Naft Sazeh Qeshm	Steel structure	337,317 (8,518,000 USD)	UK (49%)
7. Siman Qeshm	Cement	184,000 (4,446,000 USD)	UAE (60%)
Total		1,337,617 (33,778,000 USD)	

Note: Exchange rate: 1 USD=36,676 IRR.
Source: Investment and Marketing Department of the Qeshm Free Zone Organization

(2) Estate

Many estate projects, such as for apartments, commercial buildings and shopping centers, have been invested in by local investors, but most of them have suspended construction work due to a fall in market demand and financial problems. Meanwhile, a South Korean company has recently invested in a commercial building project in Qeshm City, while a local company is planning to develop a new city with total land area of 200 ha in the Abraj area, located about 20 km from Qeshm City.

(3) Infrastructure

Table 9.1.2 presents the main investment projects being encouraged by the QFZO, but there is no actual movement on the part of realistic foreign investors. An Italian company however has invested in a PV solar electric power project with a capacity of 100 MW.

Table 9.1.2 Main Planned Infrastructure Projects

Project	Outline	Current situation
1. Persian Bridge	Total length 2,220 m (sea side) and 3,430 m (land side) connecting Rajai Seaport on the mainland to Kouvei Port on Qeshm	Invested 15% from Iranian Government and 85% from China as of 2016, but suspended due to lack of funds
2. Qeshm International Airport	2,000 ha (2 arrival and departure terminals, control tower, power plant, gas station, fueling, facilities, restaurant, power substation, etc.)	Being planned but no actual prospective investors found
3. PV solar electric power	100 MW PV solar electric power project	Italian private company has invested
4. Wastewater treatment	No specific master plan	Urgently required, but no specific planning and funding source at present

Source: JICA Project Team.

(4) Heavy industries and petrochemical complex

Qeshm would like to welcome prospective foreign investors in heavy industries, such as shipbuilding, ship repairing yards, steel mills and metal smelting plants, as well as a petrochemical complex to produce up- and downstream products from natural gas or crude oil. At present, however, no prospective foreign investors have come to the fore.

(5) Investment on Qeshm by country

According to the QFZO, investors from the following countries' have expressed interest in investing on Qeshm and made approaches to the QFZO.

(a) Thailand: Fishery Field (aquafarming)
(b) Italy: PV power station
(c) China: infrastructure project, shopping malls/deep-sea port/ship repairing
(d) Korean: IT industries, data center
(e) France: petrochemicals, baby brood stock farming
(f) Norway: airport development
(g) Oman: marine line
(h) India and Malaysia: looking for investment projects

9.1.3 Comparison of investment environment with FZ and SEZ in other countries

The foreign investor will select a country to invest in by comparing labor, land-leasing and utility costs (electricity and water) with other countries in addition to the country risk, such as political stability, occurrence of natural disasters, safety and security, guarantees for foreign investments, restriction of currency transfers, logistics costs and various incentives, such as tax exemption, treatment of foreign expatriates, infrastructure and life support facilities.

Qeshm's investment environment is compared with other countries. A strong competitor with Qeshm is UAE, which has a population of 4.5 million and a total land area of 83,600 km^2, while having similar natural resources of natural gas and oil. UAE has the largest number of FZs in the world, with a total of 35 locations (Abu Dhabi: 2, Dubai: 26, Sharjah: 2, Ajman: 1, Fujairah: 1, Um Al-Quwain and Ras Al-Khaimah: 2), as well as offers many incentives to foreign investors, such as a 100% allowance for foreign investments, a 100% tax-free arrangement, free remittance of profit and the provision of sufficient infrastructure and utilities.

For reference, the following sets out the main differences in the investment environment of Iran and UAE.

(a) Country risk: Current rating for country risk in the case of Iran is D (high) according to the analysis by Euler Hermes (which reports on country risk for international trade) due to the secondary economic sanctions and/or restriction of foreign currency transfers etc., as well as conflicts with other countries. Although Iran has the second-largest natural gas reserves and the fourth-largest oil reserves in the world, which will last for 100 years, and very low external debt obligations, due to having foreign currency reserves in respect of nearly 11 months of imports, this rating is a week point for investment promotion compared with other neighboring countries such as UAE (rank: BB, low) and Turkey (rank: C, sensitive). This is also bad news in terms of investment insurance for the investor due to high premium rates.
(b) Logistic advantage: Qeshm is located in a convenient place for the export and import of products and materials via Kouvei Seaport, Bahman Seaport and Dargahan Seaport, and also Shahid Rajaee Seaport on the mainland. Qeshm has an airport, which offers convenient access to UAE, Qatar and the mainland via air cargo transport. This logistic advantage is almost equal to that of UAE, as competitors expect seaport and airport facilities.
(c) Infrastructure: Qeshm has a good road network, seaport, electricity network and water supply, but does not have life support infrastructure for foreigners, such as hotels, apartments and auxiliary service facilities. UAE has better infrastructure than Qeshm.
(d) Labor cost: Qeshm's population in 2016 was only about 140,000, can it can access an abundant labor force from the mainland through Bandar Abbas. Labor costs are generally five times cheaper than in UAE (although two to times higher than Southeast Asia) as shown in Table 9.1.3, because UAE mainly uses foreign expatriates as its labor force. Therefore, Qeshm has advantages in terms of the availability of a capable labor force and cheaper labor costs, compared to UAE.

(e) Land cost: Land costs (land-leasing costs) are lower on Qeshm than in Southeast Asia, Turkey, UAE and Egypt.
(f) Utility costs: Qeshm's utility costs are attractive to foreign investors and lower than in Southeast Asia and UAE etc., while the island can also guarantee the supply volume of electricity and water.

Table 9.1.3 Comparison of Investment Environment

Country	Average monthly wage			Land-leasing costs (USD/m^2/year)	Electricity (USD/kWh)	Water (USD/m^3)
	Unskilled worker	Engineer	Manager			
Indonesia	186	357	854	3.5-4.0	0.08	1.38
Thailand	263	588	1,423	6.89	0.12	0.31
Philippines	179	314	858	4.80	0.19	0.34-1.1
Vietnam	100-120	150-500	500-800	50-100 (50 years)	0.07	0.4-1.5
China	671-867	399-609	650-1,096	1.52-6.83	0.03	0.2-0.49
Bangladesh	86	264	563	2.20	0.08	0.3
Egypt	284	1,472	1,757	1.75-19.00	0.032-0.06	0.13-0.8
Turkey	433-2,476	1,052-5,075	2,786-7,427	3.75-6.00	0.093	2.97
UAE (Dubai)	2,435	3,612	6,085	5.4-8.1-21.7	2.10-2.76	-
Iran (Qeshm)	450-550	850-1,000	1,000-1,500	0.82-2.74 (Towla: 1.37)	0.02	0.82<250m^3/month 1.42>250m^3/month

Source: Guide Book of the Special Economic Zone by the JICA Project Team.

9.2 Issues to be Tackled

9.2.1 Strengthening the organization and capacity building of personnel in the Qeshm Free Zone Organization

The organization of the QFZO shall be reviewed and reformed if necessary to match the current investment environment. The capacity of the QFZO' s personnel for management and other staff needs to be improved. In fact, many countries that possess FZs or SEZs, including industrial parks, have always sought to improve their organization and enhance the capacity of personnel, which is important to the success of investment promotion. Governmental sectors in Japan, China, Malaysia, Singapore etc. are now assisting and supporting many developing countries by providing funds to reform the organization and provide training to employees of FZs and SEZs.

For example, the JICA has been providing technical assistance to strengthening the organization and capacity building of the Palestinian Industrial Estates and Free Zone Authority (PIEFZA) since 2010. The JICA has contributed much to the development of the Jericho Agro-industrial Park in Palestine and helping many investors overcome the various difficulties associated with lands occupied by Israel.

(a) To establish the functional structure of the QFZO
(b) To allocate staff to each functional division
(c) To organize a training program for management and other staff (domestic and overseas)
(d) To create an operational business environment (one-stop shop service and business service)
(e) To build up a marketing structure
(f) To freely open the doors to prospective tenants for easy access to the QFZO

9.2.2 Concentration on investment promotion work

There are many categories of investment in industries and projects, such as oil and gas development, the petrochemical industry, heavy industry, general industry, agro-industry, the fishery industry, the tourism industry, estate industries and service industries. The QFZO needs to offer more comprehensive

guidance to prospective investors. In the first instance, investors will make contact with a specific department. If a desk is made available in the Investment and Marketing Department to be the first point of contact for all potential investors, then it must coordinate with other departments experienced in the respective category of industry. Since the current number of prospective investors is relatively small, the QFZO should concentrate on investment promotion in the form of the following activities.

(a) Preparation of all the information required for foreign investments: The QFZO will prepare and provide all the documents and data that may be requested from investors at the desk of the Investment and Marketing Department. An appropriate number of well-trained staff, who are expert in marketing work, is required.
(b) Strategy planning for investment promotion: The QFZO does not have a marketing action plan for the short to long term. A marketing action plan should be prepared for promoting investment from the mainland and overseas. This marketing action plan will be made following consensus and coordination among all the departments of the QFZO and will be surely helpful for accelerating investment promotion work in an efficient manner. The marketing action plan will be made for each workstream as categorized below. The target range for likely prospective investors for investment promotion purposes should be established. An overseas network is also required:
    i) Preparation for marketing materials and establishment of database required for investments
    ii) Actual marketing activities including seminars or workshops for domestic and overseas investors
    iii) Training of staff and undertaking of overseas survey
    iv) Improvement of various incentives
    v) Coordination with other organizations
    vi) Frequent contact with business firms as prospective investors
(c) Providing new services for the investor: The QFZO should provide new services to investors in order to assist them in obtaining various certifications, such as ISO, GPS and halal, which may be required for their products.

9.2.3 Simplified procedures for obtaining investment licenses

(1) Current procedure for obtaining investment licenses within a required period

The foreign investor will be highly concerned with the procedures for obtaining an investment license and other permissions, with a preference for simplified procedures with a short processing time. Thus, it is important for the QFZO to deliver a presentation to the investor in this regard as one of the investment promotion activities.

The following sets out the current procedure for obtaining an investment license from the QFZO for the general manufacturing industrial sector. When a foreign investor follows the below procedures to establish a new factory or new project in the industrial zone on Qeshm, it sometimes takes about five to six months from the application of the company's name registration until receiving project approval and a construction license. The foreign investor must also obtain permission from other ministries or authorities other than the QFZO, depending on the category of the specific manufacturing sector, such as the agro-industry or fish-processing industry. Currently, the QFZO has no single desk to receive applications for foreign investment in the form of a one-stop shop service. Such a service should be established to shorten the period for obtaining various licenses and simplify the procedures for foreign investors.

(a) Registration of a company's name
    ✓ Application: Registration Office of the QFZO
    ✓ Required time: Two to three days
(b) Project application
    ✓ Application: Investment Department of the QFZO
    ✓ Required time: One to two months (evaluation period)

- ✓ Documents: investment application form, feasibility study report, financial report

(c) Issuance of investment certificate
- ✓ Application: Investment Office of the QFZO
- ✓ Required time: Two days

(d) Registration of company
- ✓ Application: Registration Office of QFZO
- ✓ Required time: 10 days or more
- ✓ Remarks: In the case of foreign investment, more than 10 days are required for security checks by the different authorities

(e) Land-leasing contract
- ✓ Contract party: Infrastructure and Civil Department in the Land Use Section of the QFZO
- ✓ Required time: One week
- ✓ Remarks: In the case of an Iranian company, investors can buy the land; but, in the case of new company, which is a joint with more than 51% of foreign capital, the contract should be based on land-leasing

(f) Construction license
- ✓ Application: Industrial and Civil Department of the QFZO
- ✓ Required time: A minimum of two months
- ✓ Documents: Drawings, technical data etc.

(2) Analysis of licensing procedure and design of new one-stop shop system

For establishing a new one-stop show system, it will be necessary for the QFZO to review and analyze the current licensing procedures. Based on the analysis results, the QFZO will design the new system in cooperation with the related authorities. Meanwhile, many countries are now adopting electronic application and permission systems in the process of licensing, as they save time. For this purpose, the application format should be reviewed so that it is compatible with the electronic application system.

9.2.4 Urgent requirements for an attractive investment environment

The following works shall be realized at the earliest stage with support from central government in order to meet the expectations of all foreign investors by overcoming current difficulties and obstacles for promoting investment.

(1) Aviation agreement between Dubai, Qatar and Qeshm

There is no aviation agreement between Iranian Airlines and Emirates Airlines and other airlines; but, in order to improve the smooth movement of businesspeople between Dubai, Qatar and Qeshm Airports, it is urgently required for Iran Airlines to enter into an aviation agreement with Emirate Airlines and/or other airlines with more flight services offered between Dubai, Qatar and Qeshm. It is also desired to have an international airline service between Qeshm and other overseas airports, such as in Asia and the EU.

(2) Supporting facilities for foreign investors

Qeshm is lacking in auxiliary facilities for welcoming foreigners to work on Qeshm such as hotels with good services, restaurants and recreation center. These facilities are essential for encouraging foreign investors. Indeed, it has been difficult to find well-appointed hotels (with an international grade of four or five stars) on Qeshm when overseas investors or economic missions have visited in the past.

In the 1980s, Dubai was not developed and had no adequate auxiliary facilities such as hotels, apartments restaurant and recreation centers, in comparison with Abu Dhabi. Due to such poor facilities, there were few investors. But, as Dubai gradually developed such facilities, the number of investors in the various fields increased.

9.3 Objectives and Targets for Investment Promotion

9.3.1 Focus of prospective investment projects and industries

It may be rather difficult for the QFZO to deliver investment promotion campaigns for every industry and project at the same time. Therefore, it is preferable to create a road map in order to focus with priority on each category of the project and industry to be invited, taking into consideration the local conditions on Qeshm. This road map should explain the priority project and industry, the period of concentrated terms, such as short term (two years), middle term (five years) and long term (10 years), the method of promotion, etc.

(a) To protect, control and supervise the environment in one territory
(b) To expect economic development by providing special incentives in line with the FZ and SEZ by inviting investors whose target is to manufacture products for export
(c) To create jobs, equating to more than 100-200 people in employment per hectare
(d) To transfer technology for foreign investors
(e) To make use of the efficiency of utilities, such as electricity and water, rather than independent firms

9.3.2 Targets for investments on Qeshm

(1) Targeting investors

Targeting investors should be focused both on foreign investors and on those from the mainland. Therefore, investment promotion should be carried out on Qeshm as well as the mainland. For example, the success of the Jericho Agro-industrial Park in Palestine, which became full occupied within two years during Stage I with 42 tenants as of 2017, was due to the fact that, with support from JICA experts, the PIEFZA initially focused on inviting local investors, because Palestine finds it very difficult to attract foreign investors due to Israel occupying its lands and imposing many restrictions on business.

In addition to investment promotion on the mainland, it is recommended to target Asian investors such as those from Japan, China, Taiwan, Singapore, Malaysia, Indonesia and Thailand, as well as from EU countries, such as Germany, French and Italy.

(2) Targeting investors for projects and industries

The QFZO will select top priority projects and industries and target prospective investors accordingly in the initial stages.

(3) Investment amount target

The amount of investment on Qeshm for the last three years is rather small due to the poor investment environment in Iran. The QZFO is advised to set an investment amount target for the coming years and successive years for Qeshm in each category of project and industry, which wants to attract investment.

9.3.3 Successful and unsuccessful examples of investment promotion

The success of FZs and SEZs depends upon marketing skills. The followings are relevant successful and unsuccessful examples from around the world.

(1) Successful examples

Country	SEZ	Case
Palestine Agro-industrial Park (FZ)	Project owner: PIEFZA Location: Jericho, Palestine Land area: 150 ha Start of development: Stage 1 commenced in 2013 with support from the Japanese Government and from the JICA from 2010 to present	1. Before selecting a developer and starting development in 2013, the PIEFZA conducted investment promotion among local investors, and obtained expressions of interest from more than 41 investors. 2. Currently, 41 investors have signed a leasing contract with the developer and all the land in Stage 1 is full occupied. 3. Skills in investment promotion have been much enhanced through the JICA's support.
Vietnam VSIP Hi Phong Industrial Park (SEZ)	Project owner: Vietnam-Singapore Industrial Development Company (VSIP) Location: Hi Phong SEZ, Vietnam Land area: 2,500 ha Start of development: 2010	1. The VSIP's industrial park is a first-class industrial park located in the SEZ with various incentives near to the seaport. 2. The VSIP has a superior marketing department with well-trained management. This marketing team targets not only Asia, but also the EU, the Middle East, the US etc. 3. The VSIP has also a good operations and management system 4. The VSIP can now attract international investors.
Vietnam Thang Long Industrial Park	Project owner: Sumitomo Corporation (SC), Japan Location: Hanoi, Vietnam Land area: 300 ha Start of development: 1996~2000	1. Thanks to excellent work in investment promotion, SC signed up 89 tenants. This industrial park has generated a total of 2.5 billion USD in products and created 60,000 jobs.

(2) Unsuccessful examples

Country	SEZ	Case
Cambodia Sihanoukville SEZ	Project Owner: Government Location: Sihanoukville, Cambodia Land area: 60 ha Start of development: 2000~	1. Due to poor investment activities and inflexible pricing structure of land, the owner has only found a few tenants in nearly 10 years.
Bangladesh Various SEZs	Project owner: BEZA and developer approved by BEZA Location: various locations Land Area: 100 ha~ Start of Development: 2006~	1. Due to an unstable political situation and poor security, each SEZ is finding it difficult to find foreign investors. 2. Each SEZ has a poor investment promotion organization, while offering good incentives.
Vietnam Private investor	Job owner: Private foreign developer Location: Hi Phong, Vietnam Land area: 150 ha Start of development: 1995~	1. Due to a weak marketing team and high land-leasing costs, there have only been a few tenants in nearly 10 years. 2. Tenant services have a poor reputation, which is another reason why there are only a few tenants.

9.4 Action Plan for Investment Promotion

(1) Function and organization of investment promotion

Investment promotion is a vital activity performed by the QFZO to encourage not only Iranian investors but also overseas investors to Qeshm Island. In advance of drafting an investment promotion plan, a well-organized "Investment Promotion Department" should be established in the QFZO with the following functions:

(a) To attract investment into Qeshm
(b) To create a marketing policy, strategy and tactics and review them
(c) To look for and locate investors and provide them with available information
(d) To produce materials and tools for marketing activities

(e) To carry out advertising and promotion work through investment seminars and workshops
(f) To solicit inquiries from investors including about land-leasing costs
(g) To check and investigate the financial capacity, project execution capability and project suitability of prospective investors
(h) To set up an "investment promotion bureau" as a visitor center in the QFZO, providing an exhibition room, a conference room for meetings and presentations, materials to introduce the FZ and SEZ, as well as the industrial parks, and other necessary data/information for investors

(2) Management and staff of the Investment Promotion Department

All the management and other staff involved in investment promotion shall acquire knowledge of marketing work by undertaking training.

The scale of the Investment Promotion Department in the case of the QFZO will require a minimum of 10 persons, including management, who must have knowledge of investment promotion especially to encourage foreign investors.

(3) Investment promotion bureau as a visitor center

This should be located in the QFZO head office building and be freely accessible and available to any parties interested in investment on Qeshm at any time, so that they can obtain all the necessary information about investments in one place. As the following information must be provided by the bureau, all staff working there should be appropriately knowledgeable.

(a) All information related to Qeshm Island
(b) Various laws and regulations related to investments, such as foreign investment law, company law, labor law, tax law, environmental law, construction law, and incentives related to the FZ and SEZ
(c) Application and permission procedures for investment on Qeshm Island
(d) Detailed information on the existing and planned industrial parks on Qeshm Island
(e) One-stop shop of the QFZO
(f) Logistics information including transportation costs by air and sea for exporting products
(g) Life support information for the investor

9.5 Industry and Business Targets for Investment

(1) Advisable target

The QFZO should target industries and businesses to identify prospective investors for Qeshm in view of the characteristics and advantages of the investment environment on the island. The following lists the recommended targets for Qeshm:

1) Manufacturing industry

Industries and businesses to be invited to the FZ and SEZ on Qeshm Island are divided into the following six categories.

Oil, gas and petrochemical industries

Oil, gas and petrochemical industries are important industries for Qeshm Island as well as the whole of Iran; thus, focusing on inviting foreign investment for these industries is critical. However, these industries will generally need a huge investment in utilities including electricity and water. They also require environmental protection, rather than normal nonpolluting industries. Table 9.5.1 shows the potential types of investment projects and products.

Table 9.5.1 Potential Types of Investment Projects in Oil, Gas and Petrochemical Industries

Category of industry	Types of investment projects
A: Oil and gas industry	- Development of offshore oil and gas project - Crude oil and gas storage project - Petrochemical product storage project - Bunkering project - Oil and gas pipeline project
B. Petrochemical and fertilizer industry	- Methanol, formaldehyde, acetic acid, methyl methacrylate, polymathic methacrylate, methyl chloride, polyacetal copolymer, polyol, ethylene amines, HMDA (hexamethylene diamine), PVAC (polyvinyl acetate), EVA (ethylene-vinyl acetate), CMC (carboxymethyl cellulose), acetic anhydride, monochloroacetic acid, phenol, nonylphenol, pure isobutylene, polyisobutylene, phthalic anhydride, isophthalic acid, styrene polymer, anhydride maleic, acrylic acid, polyacrylic acid, acrylate esters, acrylate production complex, 2-ethylhexyl acrylate, SAN (styrene acrylonitrile), PAN (phthalic anhydride), met xylene, xylitol's and cresols, cyclohexane, cyclohexane and cyclohexanone, resorcinol, polymeric alloys, polyphenylene-ether/polystyrene alloys, ERR and EDPM (ethylene propylene diene monomer), adipic acid, isoprene, petroleum cokes, composite carbon fiber, carbon fiber, isophthalic unsaturated polyester resin, anion-exchange resins, cation-exchange resins, tetrahydrofuran and butane diol - Fertilizer: ammonia/urea, ammonium sulfate, triple superphosphate, di-ammonium phosphate (DAP), NPK (nitrogen, phosphorus and potassium)

Source: JICA Project Team based on Investment Opportunity on Qeshm Free Zone (Oil, Gas and Petrochemical) 2014 by the Qeshm Free Zone Organization.

Heavy and chemical industries

Heavy and chemical industries are also appropriate for prospective investment projects involving foreign investors, but they also need a huge investment in utilities, such as electricity and water, as well require environmental protection. Meanwhile, the location of the projects will be decided carefully so as not to cause any environment destruction to the island. Table 9.5.2 shows the potential types of investment projects and products.

Table 9.5.2 Potential Types of Investment Projects in Heavy and Chemical Industries

Category of industry	Types of investment project
A. Heavy industry	- Shipbuilding - Shipbreaking - Steel mill (including deformed and round steel bar.) - Aluminum refinery - Electric cable and wire - Coil center
B. Chemical industry (large scale)	- Caustic soda - Agricultural chemicals

Source: JICA Project Team based on Investment Opportunity on Qeshm Free Zone (Oil, Gas and Petrochemical) 2014 by the Qeshm Free Zone Organization.

Fishery industries

Qeshm is surrounded by sea with rich fishery fields, while there are five fishery ports on the island. Foreign investors will surely be interested in investing in fishery industries, although the lack of modernized fishing boats (for coastal and deep-sea fishery) with fishery technology is a constraint. Fishing boats are not equipped with refrigerators, cooling facilities and storage facilities. This insufficient provision of equipment is another constraint on the value chain of fish products.

Table 9.5.3 Potential Types of Investment Projects in Fishery Industries

Category of industry	Types of investment projects
A. Fishery	- Fresh sea fish, shrimp, lobster, shell etc. for export
B. Farming	- Fish, shrimp, lobster, sturgeon
C. Seafood-processing	- Processing and canning/refrigerated packing after processing

Source: JICA Project Team based on Investment Opportunity on Qeshm Free Zone (Oil, Gas and Petrochemical) 2014 by the Qeshm Free Zone Organization.

Light and normal manufacturing industries

Light and normal manufacturing industries will be deemed as appropriate for prospective investment projects as shown in Table 9.5.4.

Table 9.5.4 Potential Types of Investment Projects in Light and Normal Manufacturing Industries

Category of industry	Types of investment projects
A. Automobile and motorbike	- Assembly - Parts manufacturing, wire harnessing, measurement, engine parts, shaft, light, handle accessories, sheets etc.
B. Metal and nonmetal processing	- Prefabricated steel structure for building - Aluminum processing products, such as aluminum frames for building, aluminum die-cast, etc. - Various processed metal parts for equipment
C. Plastic products and parts	- PVC piping - Plastic chairs, tables, plastic molded products etc. for office and home appliances - Plastic precision, such as connectors/switch boxes, for automobile wire harnessing, plastic lenses for optical equipment, parts for electronics and electric equipment - Plastic film for food or agro-products, plastic shock absorbers, plastic bags etc. - PET bottles, plastic lamps etc.
D. Electric and electronics products or parts	- Electric and electronics products, such as assembling electric home appliances, IT equipment - Various parts of the above
E. Medical equipment	- Assembly of medical equipment - Sanitary equipment
F. Agro-industry	- Refrigerated vegetables - Beverages (mineral water and various kinds of juices) - Daily food - Food - Seed oil or vegetable oil - Cosmetics (including soap) - Health supplement - Tissue papers, wet tissues etc.
G. Garment and textile	- Garment and textile products
H. Packing materials	- Carton boxes etc.

Source: JICA Project Team based on Investment Opportunity on Qeshm Free Zone (Oil, Gas and Petrochemical) 2014 by the Qeshm Free Zone Organization.

Infrastructure

Infrastructure development will bring about opportunities for investment as shown in Table 9.5.5.

Table 9.5.5 Potential Types of Investment Projects in the Infrastructure Project Sector

Category of industry	Types of projects
A. Transportation	- Airlines services between Dubai and Qeshm - Ferry services between Dubai and Qeshm Island - Airport development
B. Electricity and desalination	- Power station involving a combined cycle with a desalination plant - PV solar power project
C. Hotel	- Hotels - Serviced apartments
D. Tourism	- Aquarium - Leisure facilities - Marina - Sightseeing enterprise (with sightseeing bus/rental car/sightseeing boat and tour guide system) - Restaurant with a souvenir shop - Shopping mall

Source: JICA Project Team based on Investment Opportunity on Qeshm Free Zone (Oil, Gas and Petrochemical) 2014 by the Qeshm Free Zone Organization.

Services

Services will be important investment opportunities to foreign investors.

Table 9.5.6 Potential Types of Investment Projects in Service Industries

Category of service	Types of projects
A. Bank	- Foreign bank branches
B. Insurance	- Foreign insurance company branches
C. Logistics	- Logistic companies
D. Informatics technology	- IT design company - Computer company
E. Hospital	- Modernized international hospital and clinics

Source: JICA Project Team based on Investment Opportunity on Qeshm Free Zone (Oil, Gas and Petrochemical) 2014 by the Qeshm Free Zone Organization.

(2) Inappropriate industries and businesses

The following industries and businesses are not recommended for Qeshm:

(a) Pulp industries and woodchip manufacturing (due to the nonavailability of materials)
(i) Explosive products
(j) Manufacturing industries that cause heavy pollution, such as large amounts of hazardous waste and wastewater

(3) Evaluation of project

Evaluation and acceptance of the project proposed by an investor shall be made by the relevant committee in the QFZO, comprising, but not limited to, members of the Investment Promotion Department and the DoE.

9.6 Action Plan for Investment Marketing

(1) Materials for marketing promotion

Internal manual

An internal manual must be prepared by the QFZO in English and Persian and other languages. This will be used for marketing work and to facilitate an understanding of the investment environment on Qeshm Island. Staff in charge of investment promotion will use the internal manual to deal with prospective investors and understand their concerns accurately and informatively. The internal manual

will be periodically reviewed and revised. The QFZO will use information about other SEZs and industrial parks in other countries to inform the manual's content.

The following materials must be prepared, as well as continuously improved and updated.

- Pamphlet (Persian, English, Japanese, Chinese etc.)
- Website/Facebook
- PowerPoint
- DVD
- Data for the QFZO
- Up-to-date laws and regulations related to investments for use by prospective investors
- Various media publications regarding Qeshm Island

List of prospective investors

After establishing the Investment Promotion Department in the QFZO, it will have its own investment promotion work to perform, using the skills of its members, in order to find prospective investors, not only from the mainland but also from foreign countries. If an individual investor contacts the QFZO or through a seminar or workshop initiated by the QFZO, the department will follow up the investor.

The QFZO itself will be advised to conduct an analysis of prospective investors. This kind of work should be carried out on an ongoing basis. The following must be checked by the QFZO in the selection of the most prospective investors and tenants:

- Category of company and scale
- Financial status
- Intention of their sales market and targeted products for export and/or business and service activities in the case of business firms
- Requirements in terms of utilities such as electricity and water
- Requirements in terms of financial aid or technology

List of tenants and investors

If prospective investors and tenants decide to invest, the QFZO must also compile a list of tenants with personal as well as project information. The list format must be prepared.

Newsletters

The QFZO should issue newsletters to promote the activities and events of the QFZO from time to time, both in Persian and in English. For this purpose, the Investment Promotion Department must cooperate with other departments in the QFZO.

(2) Marketing activities

It is recommended that the QFZO employs the services of a foreign marketing consultant, who has rich experience and is versed in marketing work, for the FZ and SEZ and/or industrial parks, as well as various foreign investment opportunities in the respective fields.

Kick-off meeting

Once the QFZO establishes a well-organized Investment Promotion Department in the organization, a kick-off meeting will be convened immediately to discuss and proceed with the following marketing work in cooperation with the foreign marketing consultant.

- To produce a marketing action plan for the short/medium/long term
- To produce marketing materials
- To produce a pro forma letter to respond to interest from prospective tenants
- To create regulations related to the industrial parks, the SEZ and the FZ on Qeshm
- To create pro forma contracts related to foreign investment, such as a subleasing contract, a reservation contract and a utilities contract

- To compile a pricing schedule for the leasing costs of land use rights in the industrial zone, other area of the SEZ or FZ, service fees, maintenance fees and utilities connection fees for electricity, water, wastewater etc.
- To establish criteria to evaluate investors and put together a committee to evaluate investors and their projects

Seminars/workshops

The QFZO will hold seminars and workshops from time to time, not only in domestic but also in foreign countries, which have prospective investors. This must be linked with the marketing action program. The purpose of the seminars is:

- To inform various organizations, investors, developers and individual investors of the advantages of investing on Qeshm compared with other parts of the world
- To introduce the QFZO's organization and function, so that investors are clear that the organization will help them on licensing procedures through its one-stop shop

The recommended countries in which to hold overseas seminars in the next three years are Japan, China, Taiwan, Hong Kong, Singapore and EU countries (mainly France, Germany and Italy).

Training

All staff in the Investment Promotion Department of the QFZO must be comprehensively trained in marketing knowledge methods and skills by the foreign marketing consultant, who will give lectures related to the FZ and SEZ, as well as industrial parks, and assist in the overseas survey, to be conducted by the QFZO, on similar types of FZs and SEZs.

During these overseas training events, attendees will receive information on actual development, environmental protection, the one-stop shop for tenants, types of investment project and incentives, which are very important topics to explore when emphasizing the advantages of investing on Qeshm Island.

Incentives

An important marketing activity is to offer incentives to investors in order to encourage them to invest on Qeshm as per below:

- To establish a desk for receiving any contacts and enquiries from foreign investors easily without any official appointment and for arranging a site survey for their planned projects
- To establish an OSS desk to receive applications to register a company and seek approval for a project, as well as a construction license etc. (for this purpose, an analysis of current procedures and a well-designed system are required)
- To bring clarity to the incentive packages for various taxes (corporation income tax, individual tax including for expatriates and national employees, VAT, tax holiday, tax discount etc.) and other formalities (visa for foreigners, work permit etc.).

Logistics study

As most investors will be concerned about logistics, the QFZO must quickly start to collect information that will be required by prospective investors concerning logistic routes and costs (land transportation to the mainland, air cargo costs to overseas, sea transportation costs to overseas, etc.).

Islamic standards for agro-industrial products

If the QFZO is able to assist in the issuance of certificates to show that certain agro-products meet Islamic (halal) standards, this will encourage foreign investors to export to other Islamic countries. This needs to be studied in more detail.

Coordination with other organizations

The Investment Promotion Department of the QFZO is advised to have a close relationship and effectively coordinate with the following public and private organizations in finding prospective

investors:

- Iranian embassies or other Iranian Government offices located overseas
- Foreign embassies in Iran
- Foreign government sectors in Iran
- Chambers of commerce in Iran and overseas
- Banks