ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED AGRICULTURAL PROJECT ON VAVATHI, NOONU. ATOLL

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Declaration of the Consultant:

I certify that the statements made in this Environmental Impact Assessment are true, complete and correct to the best of my knowledge and available information at the time of writing this report.

Dr. Mahmood Riyaz (EIA P03/2007)
13th July 2018

Acronyms used in the text

BOD	Biological Oxygen Demand
BOH	Back of the House (all the utility function and its services on the resort)
CAM	Complementary and Alternative Medicine
CDE	Commerce Development and Environment Pvt Ltd.
COD	Chemical Oxygen Demand
DNP	Department of National Planning
EPA	Environmental Protection Agency
EPAA	Environmental Protection and Preservation Act
MBR	Membrane Bioreactor
MHTE	Ministry of Housing, Transport and Environment
MoFA	Ministry of Fisheries and Agriculture
MoFT	Ministry of Finance and Treasury
MoEE	Ministry of Environment& Energy
MoTAC	Ministry of Tourism, Arts and Culture
MPL	Maldives Ports Limited (a state-owned enterprise)
MRC	Marine Research Centre
MSL	Mean Sea Level

1. ސާރާ ޚުލާސާ

-1 މިއީ ސ. އައްޑޫ ވަވަތީގައި ދަނޑުވެރިކަން ތަރައްޤީކޮށް ހިންގުމުގެ ސަބަބުން ތިމާވެއްޓަށް އަސަރު ފޯރާމިންވަރު ބަލައި ވަޒަންކުރުމަށްޓަކައި އެކަރުގެ އެދިޔާރު އަލްފާޟިލް އިބްރާހީމް ޚަލީލް، ސ. މަރަދޫ ދިރިއުޅޭ ފަރާތުން ތައްޔާރުކޮށް ހުށަހަޅާ ތިމާވެއްޓަށް އަސަރުކުރާ މިންވަރު ބަލާނެކަމަށް (އީއައިއޭ) ރިޕޯޓެވެ. ސ. ވަވަތީގައި ދަނޑުވެރިކަން ތަރައްޤީ ކުރުމަށް ހުށަހަޅާ މިމަޝްރޫޢުގެ މުހިންމު ތަރައްޤީގެ ބަރާބަރު ތަކުގެ ތަފުސީލު ހިމެނޭ ތަކެތި އަގާ ޚަރަދުވާ މިންވަރާއި، މުދަލާއި ތަކެތި އަގުތަ ބޭނުންކުރާ ގޮތަށް އުޅުމާއި، ގޯތިން ހައްދާ ދަނޑުވެރިކަން، އޯގޭނިކް ދަނޑުވެރިކަން، ހައިޑްރޮޕޯނިކްސް ޕްރޮޖެކްޓް އަދި ކުރިއަށްގެންދާ ގެންގުޅުން އަދި މަސްވެރިންގެ އަތުން ހޯދާ ގެން ހިސާބުތަކާއި މާކެޓުތަކަށް ވިއްކުމުގެ ބޭނުމުގައި ފިހާރަތަކާއި ބެލެނިވެރިންގެ ތަކެތި އުފައްދާ މާލޭގެ މާކެޓުތަކަށް ވިއްކުމާއި، ހެދުމާއި ގުޅިގެން ކުރެވޭ ހަރަކާތްތަކާއި، ކާނާ ރައްކާކުރާ ތަންތަނާއި ހިމެނޭ ގޮތުން ކުރިއަށްގެންދާ ތަރައްޤީކުރުމުގެ ބައިތަކާއި މާލިއްޔަތު ބެލެހެއްޓުމުގެ ރޭވުމާއި ބަޔާންތަކެވެ. (އީއައިއޭ) ރިޕޯޓަކީ ތަރައްޤީކުރުމުގެ މަސައްކަތްތައް ފެށުމުގެ ކުރިން ތިމާވެއްޓަށް އަސަރު ފޯރާ މިންވަރު ބަލައި ކަނޑައަޅާ ދިރާސާއެކެވެ. އަދި ދިރާސާތަކުގެ ނަތީޖާތައް ބަލައި ތަރައްޤީކުރުމުގެ ކުރިން ހުއްދަ ހޯދަން ޖެހޭނެއެވެ. އަދި ރިޕޯޓުގައި ތަރައްޤީކުރުމުގެ މަސައްކަތްތައް ތިމާވެއްޓަށް ހުރި އަސަރުތަކުގެ ނަތީޖާތައް ތަފްޞީލުކޮށް ބަޔާންކުރަން ޖެހޭނެއެވެ. ނަންބަރު (93/4) ތިމާވެއްޓާ ބެހޭ ޤާނޫނުގެ ދަށުން ތަރައްޤީގެ މަޝްރޫޢުތަކުގެ ސަބަބުން ތިމާވެއްޓަށް އަސަރު ފޯރާ މިންވަރުބަލައި ވަޒަންކުރަންޖެހޭނެއެވެ.

-2 މިޕްރޮޖެކްޓުގެ ގައި ހިމެނޭ 3 ހެކްޓަރުގެ ދަނޑުބިން ގެންގުޅުމާއި މަސްވެރިންގެ އަތުން ހޯދާ ގެން ހިސާބުތަކާއި މާކެޓުތަކަށް ވިއްކުމުގެ ބޭނުމުގައި ފިހާރަތަކާއި ބެލެނިވެރިންގެ ތަކެތި ތައްޔާރުކޮށް މާލޭގެ މާކެޓުތަކަށް ވިއްކުމާއި، ހެދުމާއި ގުޅިގެން ކުރެވޭ ހަރަކާތްތަކާއި، ކާނާ ރައްކާކުރާ ތަންތަނާއި ހިމެނޭ ގޮތުން ކުރިއަށްގެންދާ ތަރައްޤީކުރުމުގެ ބައިތަކެވެ. ސ. ވަވަތީގައި ތަރައްޤީކުރުމުގެ ރާވާފައިވާ ހަރަކާތްތަކުގެ ތެރޭގައި ބިން ސާފުކުރުން، ގަސްތަކާއި ބިމުގެ ވަސީލަތްތަކާއި ބެލުމާއި، ގޯތިތަކާއި، ތަރައްޤީކުރުމުގެ ބައިތަކާއި، އިމާރާތްކުރުމާއި އަދި ބޭނުންކުރާ ބިމުގެ އެހެނިހެން ބައިތައް ހިމެނެއެވެ. އަދި ކުރިއަށްގެންދާ އިމާރާތްކުރުމުގެ މަސައްކަތްތަކާއި ތަކެތި ބެލެހެއްޓުމާ ގުޅޭ ހަރަކާތްތައް ރާވާފައިވެއެވެ. މީގެ އިތުރުން ހައިޑްރޮޕޯނިކްސް ޕްރޮޖެކްޓް އަދި ކުރިއަށްގެންދާ ގެންގުޅުން އަދި މަސްވެރިންގެ އަތުން ހޯދާ ގެން ހިސާބުތަކާއި މާކެޓުތަކަށް ވިއްކުމުގެ ބޭނުމުގައި ފިހާރަތަކާއި ތަރައްޤީކުރުމުގެ ބައިތަކާއި ހިންގުމުގެ ވަސީލަތް ހަމަޖެހިފައިވެއެވެ.

-3 މިރިޕޯޓް ތައްޔާރު ކުރެވިފައިވަނީ 2012 ވަނައަހަރު މިނިސްޓްރީ އޮފް އެންވަޔަރަންމަންޓް އެންޑް އެނަރޖީއިން ގެޒެޓްކޮށްފައިވާ ތިމާވެއްޓަށް އަސަރު ފޯރާ މިންވަރު ބަލާނުކުރާ ޤަވާއިދާ އެއްގޮތްވާގޮތުގެ މަތީންނެވެ. ސ. ވަވަތީގައި ދަނޑުވެރިކަން ތަރައްޤީކުރާ މިޕްރޮޖެކްޓުގެ ސަބަބުން ތިމާވެށީގެ ގޮތުންނާއި އަދި އިޖްތިމާޢީ-އިޤްތިޞާދީ ގޮތުންކުރާ ރަނގަޅު އަދި ނުރަނގަޅު އަސަރުތައް މިރިޕޯޓުގައި ވަޒަންކޮށް ހިމަނާފައިވާނެއެވެ. މިރިޕޯޓުގެ މައިގަނޑު ހޯދުންތައް ބަޔާންކޮށްފައިވަނީ މިރަށުގައި މިކަމާގުޅޭގޮތުން ކުރެވުނު ސާވޭތަކުން އެއްކުރެވުނު މަޢުލޫމާތާއި ، އެކަމާގުޅޭ ޤަވާއިދާއި، ކަމާބެހޭ ފަރާތްތަކާ

ލުއި ކުރުވުން މަޝްވަރާތަކާއި ތަމްރީނުތަކުގައިހުރި މިންވަރު މުރާޖަޢާކޮށް ހާއްސަގައި މީގެކުރިން ދަނޑުވެރިކަން ތަރައްޤީ ކުރުމުގެ މަޝްރޫޢު ތަކުން ލިބިފައިވާ ތަޖުރިބާގެމައްޗަށް ބަރޯސާވެގެންނެވެ.

4- ހުރަހަގާފަދަ ޕްރޮޖެކްޓުގެ ހުރި މަސައްކަތްތައް ހިނގަނީ ނ. ވަވަތީގައެވެ. މިއީ ނ. އަތޮޅުގެ ހުޅަނގުފަރާތުން އަތޮޅުތެރެ ވަޒަން ފަޅުގެ ބޮޑުކަމައި އަކަރަ ފަޅުރަށްތަކެވެ. ވަވަތީ ފަޅަށް 900 މީޓަރު ދިގު 500 މީޓަރު ފުޅާ އިރުމަތީ-ހުޅަނގުދިގުކޮށް މިސާރާބަން ކުޑަކުރެވިސް ބަންޖަހަން އަށްނަ ރަށްކަވެ. ރަށުގެ ގަސްހުރިފަދަ ސަރަހައްދުގެ ބޮޑުމިނަކީ 17 ހެކްޓަރު އެވެ. ބޯދުރުން ހިކިދާފައި ފުންނަން ހުންނަ ހިސާބުން ބަލާނަމަ 19 ހެކްޓަރު އެވެ. މުޅި ފަޅުގެ ބޮޑުމިނަކީ 42.4 ހެކްޓަރު އެވެ.މިހެންކަމުން ފަޅުގެ 40% އަކީ ގަސްކަރަދެވެ. މިހެންކަމުން މުޅިފަޅުގެ ބޮޑުބައެއް މިވަނީ ފެންފަދެވެ.

5- މިރަށަށް ކުރިމަތި ދަނޑުވެރިކަން ކުރުމަށް ބޭނުންކޮށްފަވާ ހަރުކަ. މިހެންކަމުން ހަރުގެ ހުވަނދުފާތު ބޮޑުބައެއް ވަނީ ގަސްތައް ކަނޑާ ދަނޑުހެއްދުމަށް ސާފުކޮށްފައެވެ. އަދި ފަހުން ވެލާ ރަސްމީ ހުރުމުގެ މަސައްކަތް ކުރިއަށް އަރަހުގައި މަސައްކަތް ކުރިއަށް ބޭއްވުމަށް މިހަރުގެ އިރުމަތީ ފަޅުގައި ގެއަޅައިގެން ބޭނުން ކުރުވެނެވެ. މިދުވަސްވަރު ބޭނުންކުރުވުން ގެތައް ޗާނގފައި އަދިވެސް އުހަރުގައި އެބައުޅޭވެ.

6- މި މަޝްރޫއު ގެ ދަށުން މިހަރުގައި ދަނޑު ގޮވާންކުރުމާއި އިމާރާތް ކުރުމަށް ބޭނުން ކުރުމަށް ގަސްދުކުރުވިފައިވަނީ މާލީވެސް ގަސްކަނޑާ ސާފުކުރުފައިވާ ބިމެވެ. މިހެން ކުރުން މިމަޝްރޫއު ގެ ދަށުން އެއްވެސް ވަރަކަށް އިތުރު ބޮޑުތި ގަސްކަނޑާ މިހާރު ސާފުކުރިފައިވާ ބިންތައް ބޭނުން ކުރުމަށް އިސްކަންދީފައިއެވެ.

7- ހުރަހަގާފަދަ ޕްރޮޖެކްޓުގެ މަސައްކަތްތަކުގެ ސަބަބުން ތިމާވެއްޓަށް އަސަރުކޮށްފާ މިންވަރު ބެލުމަށް ޖަހައި އިމްޕެކްޓް ގެޖިސްޓް އެސެސްމަންޓް އަކީ އާއްމުގޮތެއްގައި ތިމާވެއްޓަށް އަސަރުކޮށްފާ މިންވަރު ދިރާސާކުރުމަށް ޖާމިއުކޮށްފައި ވާ އިޒްނަދިންނަ ބާރެއްގައި ކުރާ ދިރާސާއެކެވެ. މިދިރާސާއިއެވެ. އީއައިއޭ ގެ ދަށުން އެއްވެސް އިމާރާތެއް އަށައިގެން (ރަށްއެއް) ހޯދޮބޭނީ މިހެނަކީ ހަރުގައި ހުރަހަކާފަދަ މަޝްރޫއު ތަރައްޤީކުރުމުގެ ދަނޑުވެރިކަން ކުރުން ފުރުޞަތުގެ މަސައްކަތްތަކާއި ކުންފުނިތަކެވެ. ދަށުން އެތެރޭގައި (އީއައިއޭ) ހޯދޮބޭނީ މިފަދަ ޕްރޮޖެކްޓްގެ މަސައްކަތް ތަކުގެ ސަބަބުން ތިމާވެއްޓަށް އަސަރު ކުރާނެ ގޮތްތަކާއި ތަފާތު ގޮތްތަކާ ހުރެ އަސަރުތަކާ ގުޅޭ މިންވަރު ވެއެވެ.

8- ޕްރޮޖެކްޓްތަކުގެ ކުރުމުގެ މަސައްކަތާއި ދަނޑުވެރިކަން ކުރަން ފެށުމުން ރަށުގެ ތިމާވެށީގެ ހާލަތަށް އަސަރުކުރާ ތަފާތު އެއްޗެހިތަކާއި ބޯފެނާއި ވަޞީލަތްތައް ބޭނުންކުރުމާއި ވެއްޓަށް ދިމާވާ ގެއްލުންތައް ދެނެގަނެ ދިމާވާނެ ގޮތްތަކާއި ހުށަހަޅާ ކުރުމަށް ތަދުބީރުތައް ދިރާސާކުރުމާއި އެފަދަ ގޮތްތަކަށް ހަލުވިކަމާއި ގޮތެއް ދެއްކުމެވެ. ތިމާވެށީގެ ގޮތުން މިފަދަ މަޝްރޫއުތަކުގެ ސަބަބުން އަސަރުކުރާ ނުރައްކާތައް ދަނޑުވެރިކަން ކުރުމަށް ބޭނުންކުރާ ބިމާއި އަކީ ބޭނުންކުރާ ގަސްތައް ދަނޑުކޮށްގެ ތިމާވެށީގެ ހިފެހެއްޓުމާ ގުޅިގެން ދަނޑުވެރިކަމުގެ ދިރާސާތަކެއް ކޮށްފައިވެއެވެ. ޕްރޮޖެކްޓުގެ ތަރައްޤީކުރުމުގެ ތިމާވެއްޓަށް ނުރައްކާ ކުރުމާއި ދަނޑުވެރިކަމުގެ ދަށުން ދިރާސާކުރުމުގެ ސަބަބުން ހޭލުންތެރިކަމާ ދުރު ގޮތެއް (ސެޕްޓިކް ޓޭންކް) ކޮންޕޯސްޓު ހަރުއަޅައިދިނި ކުރި މިބާވަތުގެ ގޮތްތަކާއި ހުރި ސަބަބުން

ތިމާވެއްދެވެ. ކުންފުނިން ދެއްވާ ހުއްދަ ދަށުގައި ކުރިއަށް ގެންދާ ކަންތައްތަކުގެ ތެރެއިން ކޮންމެ ކަމެއް ކުރުމަށް ކުންފުނިން ކުރިއަށް ގެންދާ ކަންތައްތަކުގެ ތެރެއިން ކޮންމެ ކަމެއް ކުރުމަށް ކުންފުނިން ކުރިއަށް ގެންދާ ކަންތައްތަކުގެ ތެރެއިން ކޮންމެ ކަމެއް ކުރުމަށް ކުންފުނިން ކުރިއަށް ގެންދާ ކަންތައްތަކުގެ ތެރެއިން ކޮންމެ ކަމެއް ކުރުމަށް ކުންފުނިން ކުރިއަށް ގެންދާ ކަންތައްތަކުގެ ތެރެއިން ކޮންމެ ކަމެއް ކުރުމަށް

9- ލ. ކުންފުނިން ކުރިއަށް ގެންދާ ކަންތައްތަކުގެ ތެރެއިން ކޮންމެ ކަމެއް ކުރުމަށް

- ތިމާގެ ކައުންސިލް ތެރެއިން ދެ ބައިތަކުން ކުރިއަށް ގެންދާ ކަންތައްތަކާ ގުޅިގެން ކަންތައް ކުރުމަށް ކަނޑައެޅިފައިވާ ކޮމިޓީ ތަކުގެ ލީޑަރުންނާ ދެ ބައިވަންތަ ކަންތައް ކުރުމަށް ކަނޑައެޅިފައިވާ ކޮމިޓީ ތަކުގެ ލީޑަރުންނާ ދެ ބައިވަންތަ ކަންތައް ކުރުމަށް

12- ތިމާގެއިން ތަނަށް ފާހަގަކުރަން ބޭނުންވާ ތަނެއް ނަގާ ހިނދު ކުރިން ކައުންސިލް ތަކުގެ ކަންތައް ކުރުމުގެ ދަށުން ކުރިއަށް ގެންދާ ކަންތައްތަކާ ގުޅިގެން ކަންތައް ކުރުމަށް ކަނޑައެޅިފައިވާ ކޮމިޓީ ތަކުގެ ލީޑަރުންނާ ދެ ބައިވަންތަ ކަންތައް ކުރުމަށް ކަނޑައެޅިފައިވާ ކޮމިޓީ ތަކުގެ ލީޑަރުންނާ ދެ ބައިވަންތަ ކަންތައް ކުރުމަށް ތިމާގެ ކައުންސިލް ތަކުގެ ކަންތައް ކުރުމުގެ ދަށުން ކުރިއަށް ގެންދާ ކަންތައްތަކާ ގުޅިގެން ކަންތައް ކުރުމަށް ކަނޑައެޅިފައިވާ ކޮމިޓީ ތަކުގެ ލީޑަރުންނާ ދެ ބައިވަންތަ ކަންތައް ކުރުމަށް

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2 NON TECHNICAL SUMMARY

1- The report constitutes the Environmental Impact Assessment (EIA) study carried out for Mr. Abdul Latheef, Dhildhaaruge S. Maradhoofeydhoo for the proposed agriculture related development in Vavathi Island Noonu Atoll. The EIA was prepared as fulfilment of the requirement by the Ministry of Fisheries and Agriculture (MoFA) for granting permission for the project. Environmental Impact Assessment (EIA) of development projects is a requirement by the Environmental Protection and Preservation Act (EPPA) (law 4/93) of the Government of the Republic of Maldives.

2- The project mainly involves the construction, operation and management of 3 hectares area of agricultural land and reef fish vacuum packaging process in Noonu Vavathi with all the ancillary facilities including island access jetty, greenhouses, staff accommodation and water and fuel storage facilities, energy generation and desalination etc.,. All key systems will be contained within bunded enclosures, such as the generators and fuel and water storage.

3- The proposal is to develop Noon Atoll Vavathi as an agricultural island where climate-smart advanced agriculture approaches will be used to produce high quality products. Vertical hydroponics growing of crops and open field farming will be the main agriculture related development in the island. Mainly herbs, microgreens, cucumber and melon will be grown in vertical hydroponics systems. Pumpkin, watermelon, banana and papaya will be grown in the open field. The farms will be established in agroforestry systems. The most common produce in the Maldives (not in order of importance) is watermelon, cucumber, lettuce, cabbage, chilly, papaya, pumpkin and banana etc. Free range poultry farming of Chicken and Turkey. Also reef fish cleaning vacuum packing, storing facilities will be developed in the island.

4- This report has been prepared in accordance with the Environmental Impact Assessment Regulations published by the Ministry of Environment and Energy 2012 and considers a wide range of negative and positive environmental and socio-economic impact arising from the proposed project (development and operations) in the island. Major findings of this study was based on information gathered during the field inspection of both the existing environment and possible effects of the project activities, and on-going agricultural projects through extensive literature review and experiences gained from similar projects elsewhere in the Maldives.

5- The proposed project activity will take place on Vavathi Island Noonu Atoll. Vavathi is and uninhabited vegetated island situated inside the western part of Noonu Atoll. Vavathi reef is over 900m long and 500 wide and NE- SW oriented. Approximate area of the vegetated part is 17 hectares and the area from the beach end is estimated to be 19 hectares and the total area of the reef from the outer edge is 42.4 hectares. The island occupies approximately 40% of the reef, which makes the reef a largely saturated reef.

6- The island has been used for open field agriculture in the past; hence, vegetation has been cleared from large part on the western half of the island. During the Velaa resort construction period Vavathi island was used as a construction workers accommodation camp. The accommodation camp and the necessary facilities were construction on the north eastern part of the island. At

present ruins of accommodation blocks and other equipment, wares and abandoned stuffs left by the workers can be found on the island.

7- All the facilities and farms proposed will be developed in the existing footprints as much as possible, therefore it is unlikely that extra-large trees or palm trees will be cleared or removed.

8- In the process of EIA study an impact matrix, which is a standard tool for identifying the possible impacts of project activities, was assembled for the proposed development project in Vavathi Island Noonu Atoll. The activities carried out during the construction and post-construction or operational phases are arrayed against a selection of environmental factors that may be affected directly or indirectly as a consequence of project activities.

9- The report has identified and described in detail possible change that would occur to the existing condition of the environment caused during the construction phase and have suggested appropriate mitigation measures for each and every impact identified in the report. The study has identified that most severe negative environmental impact for the island would be from clearance of vegetation reef-flat and lagoon excavation for access jetty development. Liquid, solid and other forms of wastes and particularly hazardous waste generated during the construction and operational phase has also been identified as significant impact associated with the project and appropriate mitigation measures are suggested for each and every waste related impact identified in the study.

10- The study has evaluated alternative options for the project activities and has suggested alternative energy generation water production and alternative use of fish waste. In order to gather consistent data on possible changes taking place it is proposed to undertake an extensive post-development monitoring programme that will keep on monitoring the environmental changes associated with the development and make necessary adjustment to the activities of the project based on the findings of various measured environmental parameters suggested in the monitoring plan.

11- The study has identified the following beneficial effects form the proposed agricultural development project in Vavathi Island:

- Creation of competitive agriculture market for locally grown fruits and vegetables;
- Availability of locally grown high quality agricultural produce that can cater for the high-end tourist resort and to meet local demands
- Employment: Temporary (10-30 job opportunities during construction period) permanent (over 10-20 jobs during operational phase);
- Development of business opportunities in supply and services; and
- Capacity building and technology transfer opportunities in modern farming practices.
- Improvement of public facilities and infrastructure, general improvement of social conditions and service industry activities, in addition to the increased national agriculture and economic infrastructure.
- Better guardianship of the terrestrial and marine resources of the island;
- Improvements in environmental quality of the island;
- Stimulation of local economy, cultivation and small business opportunities within the nearby island communities; and

- Increased government revenue and increased GDP.

12- The study found no evidence that the project requires or involves:

- loss of unique habitat or wilderness areas;
- resettling of local communities;
- removing or destroying cultural properties;
- contravening national government of the Republic of Maldives, or island community policies, regulations, criteria, customs or aspirations concerning environment, economy, employment, cultural traditions or life styles.

13- On the basis of this environmental impact assessment study and the impact mitigation measures proposed in the report will be duly implemented and recommendations are given due consideration, it is concluded that the benefits of the proposed agriculture development project in Noonu Vavathi Island will substantially outweigh an unwelcomed demand of burden on the environment.

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3 INTRODUCTION

3.1 BACKGROUND AND CONTEXT

Noonu Vavathi island is located on the western part of Central Noonu Atoll on its own house reef. The island has been on long-term lease, to Mr. Abdul Latheef, S. Maradhoo Dhildhaaruge (proponent), under clause 5 of uninhabited island regulation which deals with the development of uninhabited island for industrial purposes other than tourism. The proponent is proposing to develop agriculture and fisheries related developments in the island.

Vavathi is a vegetated island situated inside the western part of Noonu Atoll. Vavathi reef is over 900m long and 500 wide and NE- SW oriented. Approximate area of the vegetated part is 17 hectares and the area from the beach end is estimated to be 19 hectares and the total area of the reef from the outer edge is 42.4 hectares. The island occupies approximately 40% of the reef, which makes the reef a largely saturated reef.

The proposal is to develop Noon Atoll Vavathi as an agricultural island where climate-smart agriculture approaches will be used to produce high quality products. Vertical hydroponics growing of crops and open field farming will be the main agriculture related development in the island. The open farms will be established in agroforestry systems. Mainly herbs, microgreens, cucumber and melon will be grown in vertical hydroponics systems. Pumpkin, watermelon, banana and papaya will be grown in the open field. Agriculture is the fastest growing primary sectors. The most common produce in the Maldives (not in order of importance) is watermelon, cucumber, lettuce, cabbage, chilly, papaya, pumpkin and banana etc. Free range poultry farming and reef fish cleaning vacuum packing, storing facilities will also be developed in the island. Chicken and turkey will be farmed in the free range poultry farm.

Owing to the small and scattered nature of the land a new and innovative environmentally friendly technique that use little space and does not require applying fertilizers are required. One such approach introduced to the Maldives in the early 2000 is hydroponics that has now become popular. The proposed farming method in this project is vertical farming which combination of large scale farming on small land area and hydroponics to produce high quality products to be sold for resorts and to Malé. The proposal is to have series of green houses that grow the crops (plants) in vertical hydroponic systems.

The likely environmental impacts are short term during the construction phase. Since the proposals is a phased development the impact may be repeated during the second phase. The island has been used for open field agriculture in the past and the proponent proposes to develop the green houses and open field farms on the same footprint to reduce the impact associated with vegetation clearance. Similarly a large part of the north eastern side of the island has been cleared to construct a workers camp during the construction of Velaa Resort nearby. Disposal of sewage and solid waste is minor environmental impact but can be reversed by adopting more sound methods. The agricultural practice is expected to produce little waste and will be of minor impact.

Maldives is very vulnerable to the projected adverse impacts of climate change including sea-level rise, increased water temperature, ocean acidification and an increase in the frequency and intensity of droughts, storms and natural disaster. To address climate related risks facing Maldives and strengthen the country's resilience to these risks on several fronts including the agriculture sector the Government has been promoting "Climate-smart agriculture", an agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes greenhouse gas emissions (mitigation) while contributing to achieve national food security and sustainable development goals.

3.2 PURPOSE OF THE EIA

Given the potentially adverse environmental impacts associated with the proposed agricultural development work at Noonu Vavathi the proponent has requested for services of freelance EIA consultants; Dr. Mahmood Riyaz to prepare and submit the Environmental Impact Assessment (EIA) report to EPA in compliance with the Environmental Protection and Preservation Act (4/93) and EIA Regulations 2012.

The objective of the EIA study was:

a) To provide an assessment of the potential environmental effects of the proposal and to determine which of these, if any are likely to result in a significant effect on the environment and to propose ways and means of avoiding, mitigating and or compensating the perceived negatives effects of the project;

b) To provide necessary information to EPA applicable to the proposed development; and

c) To assess how the proposals have been developed to achieve a satisfactory level of environmental performance in line with the EIA Regulations

3.3 EIA REPORT AND EIA IMPLEMENTATION PROCESS

In general the objective of an EIA study is to address the environmental concerns of the proposed development project. The EIA will help to achieve efficient planning, aid in identifying impacts and their potential mitigation measures. The EIA report will also help to promote informed environmental and sound decision making during the development of the project.

The aim of the EIA is to identify, describe and assess in an appropriate manner, proposed development, in accordance with the provisions of guidelines and regulations of the GoM, the direct, indirect and residual effects of the project on the following factors:

- Physical and chemical characteristics of the earth (soil and landform,), water (marine and underground), atmosphere (air quality and climate);
- biological conditions including flora (trees/shrubs and endangered species), fauna (coral and endangered marine species) habitats (environmentally sensitive areas protected area etc);
- cultural factors including aesthetic and human interest (scenic views and vistas, wilderness qualities, landscape design, historical and archaeological sites and objects), and cultural status (employment); and
- Ecological relationships including eutrophication, disease and insect vectors etc..

This EIA report has been prepared by the EIA consultants selected by the proponent. Approved ToR of the Environmental Impact Assessment for agricultural development in Noonu Vavathi is given in Annex 1. A check list of EIA preparation process is given below:

- ✓ The consultant prepares EIA application form with necessary relevant documentations along with a draft TOR for the proponent for submission to EPA, and the proponent submits the application along with necessary documentation from the Ministry of Fisheries and Agriculture (MoFA).
- ✓ EPA calls for a scoping meeting with proponent, consultant and relevant stakeholders from government agencies to determine the scope of the EIA study

- ✓ During the scoping meeting the drafts ToR is finalized by EPA and send to the proponent and consultant
- ✓ The consultant undertakes literature review and gathers relevant data and information on the project.
- ✓ Consultant undertakes the field assessment work and stakeholder consultation
- ✓ The consultant analysis data and information gathered and identify environmental impacts, determine mitigation measures, rationally evaluate and suggest alternatives and limitations and propose a monitoring plan.
- ✓ The consultant discusses major findings with the proponent and suggests possible changes to the project/project component.
- ✓ Based on the discussion with the proponent the consultant reviews the EIA and makes necessary changes to the document.
- ✓ The proponent should provide written commitment to undertake mitigation measures and post-development environmental monitoring as per the EIA report.
- ✓ The consultant submits the final EIA to the proponent who subsequently will submit to EPA for review and to issue decision note.

Once the decision note is issued from EPA the proponent is obligated to implement the EIA and matters highlighted in the decision note. Also the proponent shall implement the agreed monitoring programme during construction and operational phase of the project and submit monitoring report as indicated in the EIA report.

3.4 PROJECT SETTING

The proposed project is the development of Vavathi island as agricultural island. The four development aspects of this island may be described as follows:

a) The main commercial objective of the development is growing herbs, microgreens, cucumber, lettuce and melon and other types of fruits and vegetables in climate-smart agriculture using vertical hydroponics systems. The North western section of the island will be devoted for this activity. Three green houses have been proposed with the plans for extending up to 6. The main market would be the resorts and if necessary retail outlets in Malé

b) Pumpkin, watermelon, rock-melon banana, eggplant (brinjal) and papaya will be grown in the open field. Central and south western part of the island will be designated for the open field agriculture. A small nursery will also be established in this area.

c) Densely vegetated areas on the western and south western side will be fenced and used for free range poultry farming of chicken and turkey.

d) Vacuum packaging and processing of reef fish will be located on the central part between the accommodation blocks and farming areas. Two reefer containers, 20 foot each for fish storage and a small hut for cleaning fish will be established in the fish processing facility.

The proponent has no plans for developing structures other the minimum necessary structures required such as the arrival jetty, which will be developed on the foot print of the existing jetty on the eastern side of the island. The island will be fully self-contained and as such water production and generation of electricity will be established in the powerhouse. Employees and senior staff accommodation block will be developed on the north eastern part of the island/It is expected no more than 15 people will be permanently on the island at any given time.

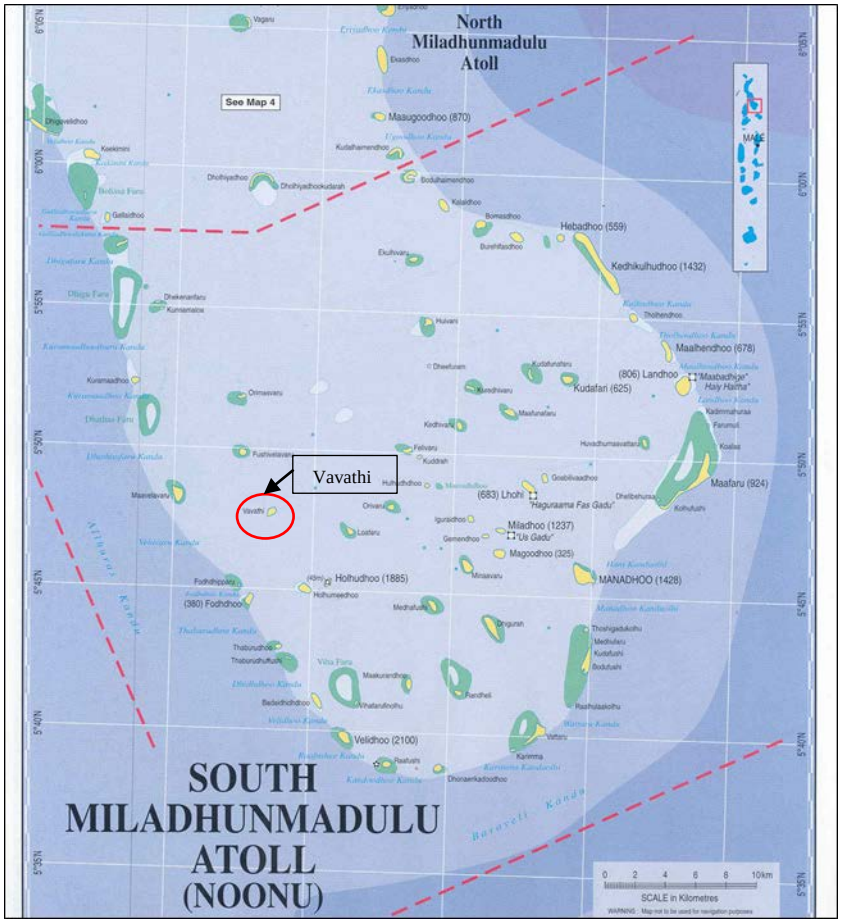


Figure 1: shows location of Vavathi island in Noonu Atoll, main study area for the proposed project, Figure 25 shows anticipated impact footprint of the proposed development.

3.5 PROJECT RATIONAL AND OBJECTIVE

According to the 2014 census, the imports of fresh agricultural crops that are mainly produced in the Maldives exceeded 9.5 million kg (value over 302 million MVR) in 2014. Imports of fresh agricultural crops mainly produced has been increasing from 2007-2014 annually 16% on average. According to the published statistics from MoFA locally produced agricultural products that are traded in the local market in Male declined 18% from 2009 to 2013, (i.e: 8.1 million kg, value over 144 million MVR in 2009 to 1.4 million kg, value over 34 million MVR in 2013). This clearly indicates that local agricultural production is decreasing while the import of fresh agricultural crops mainly produced in the Maldives is increasing steadily. This indicates the need for agriculture development in order to supress dependency on imports and to achieve self-sufficiency and food security.

Agriculture is important to a large sector of the population that are marginalized from the country's commercial fisheries and tourism industries. Nevertheless, agriculture plays a vital role in the livelihood of the rural population. The two-thirds of the population of the Maldives residing in outer islands are involved in fisheries activities and home-garden agriculture.

Although agriculture's contribution to the Maldives' (GDP) is below 5%, its contribution to the economy is underestimated because production is mostly subsistence in nature and usually not measured for purposes of national accounting.

The small size of the population and in most cases the small area of the islands suggest the need to explore different markets and add value to production activities. Agriculture is an important economic activity in almost all of the inhabited islands. Agriculture still retains traditional subsistence characteristics due to the constraints that exist for this activity to expand into fully-fledged commercial activity. This pattern is particularly more protuberant in the field of agriculture where there has been limited intervention in the form of programs that would help the subsector to become commercial.

Limited number of Small and medium scale commercial agriculture has developed over the years, and is most notably present in several larger islands. It is present in both the long term leased agricultural islands, as well as in the larger inhabited islands that have better soil and water resources. The development of agricultural islands is the responsibility of the lessee and the high investment cost on the basic preliminary infrastructure such as harbour jetty etc., which is considered necessary for the transport of agricultural produce to local markets and the import of tools and equipment, is an obstacle to attract large scale commercial agriculture investments.

Commercial agricultural development is a priority in the Sixth National Development Plan (2001-2005) which aims at import substitution of crops that can be grown successfully and competitively in the Maldives, as well as to increase food security of its people. The Government's agriculture policy is to increase production and income through more efficient use of the limited land resources, improve the quality and quantity of production, and promote a balanced development in the rural areas through strengthening agriculture. Improving logistic and institutional capability for agriculture development and investment in tourism has boosted agriculture by providing a reliable market.

The Government has also implemented policy and institutional changes to create more efficient competitive and adaptive private sector involvement in agriculture and related activities to generate employment and income to the rural population. This has been playing a supportive role in food production in the country by diversification of agriculture, enhancement in agricultural production through improvement of market, credit and providing agricultural support services.

Maldives is a world famous high-end tourist destination where world's rich and famous spend their fortune for a holiday in a resort in the Maldives. Most of the fruits and vegetable needed to cater for the niche market of tourist is imported to ensure reliable quality and consistent supply that meets the needs of resorts. With the expansion of resort to out island in north and south of Maldives, delivery of perishable fruits and vegetable through the existing transports system is time consuming and further degrades the quality of the produce. Therefore, there is a need in the tourism industry for high quality agricultural products at competitive prices that can be delivered on a regular and reliable basis and the tourism resorts offer an opportunity for the marketing of agricultural products. The proposed project is design to tap on the niche tourist resort market to provide locally grown vegetable and fruits to resorts.

The primary target of the proposed agriculture development project in Vavathi is to produce vegetable and fruits locally for the growing tourist industry followed by the domestic market. The aim is to substitute expensive imported products with higher quality, locally grown items. The objective is to offer provision of both skilled and un-skilled employment opportunities for locals and provide an efficient distribution and sales channel for domestic farmers in the atolls whilst increasing domestic food security and climate resiliency.

Overall the proposed agriculture development project will introduce a climate proof and more resilient and sustainable method to grow vegetables and salad crops in the Maldives. The development will contribute to achieve strategic targets towards achieving food security and overall agricultural development in the Maldives and to create employment opportunities particularly for locals. The project will also generate much needed foreign currency and contribute to the economy through tax revenue and annual rent.

3.6 PROJECT SCOPE SUMMARY

The project mainly involves the construction, operation and management of 3 hectares area of agricultural land in Vavathi. The proposed project covers the following activities

- Construction of access jetty on the footprint of existing jetty ;
- 1 hectares of advanced hydroponic greenhouses;
- 2 hectares of open field farms
- Fencing free range poultry farm area
- Construction of advanced vertical hydroponic greenhouse systems;
- Powerhouse and desalination plant;
- Rainwater harvesting system and water storage;
- Infrastructure construction including power house, oil storage tanks, waste management facility staff accommodation etc.;
- Construction and operation of accommodation, green houses and other facilities;
- Operation and management of 3 hectares of farm land in the island

3.7 REVIEW OF RELAVANT STUDIES

As part of relevant literature review and preparation of the report, the following EIA studies on agriculture development in various parts of the Maldives have been reviewed and used as reference;

EIA For Agriculture Development In Gdh. Hulhuvaarulaa, Menthanhoo Golhaalaa And Dhoonirehaa, Gaaf Dhaalu Atoll by Dr. Mahmood Riyaz and Dr. Mohamed Shiham Adam, August 2016
EIA for Mariculture, hydroponics aquaponics and boatyard development in AA Vihamaafaru by Mohamed Zuhair, November 2015
EIA for the proposed Agricultural Project in Dhaandhoo, Baa Atoll Maldives, by M.S. Adam and & Mahmood Riyaz, March 2013
EIA for the proposed Agriculture Island, Lhohi island Dhaalu Atoll by CDE, July 2012
EIA for Agricultural Development in Noonu Felivaru, by CDE. Pvt. Ltd, December 2012
EIA for Ha Madulu for Agricultural Development, Ihavandhippolhu Atoll, Maldives, by Ecad Associated Pvt. Ltd. July 2008
EIA Ga Funadhoo for Agricultural development, North Huvadhu Atoll, Maldives, Ecad Associated Pvt. Ltd. December 2007
EIA for Agricultural Development, Shaviyani Medhukunburudhoo, by CDE Pvt. Ltd December 2007

Some of these are commercially operational agriculture related projects in the Maldives. Most of the activities that will be undertaken by the proposed project will have similar components and activities, hence could be considered as relevant and appropriate reference material to understand the types, degrees and magnitudes of environmental impacts and potential mitigation measures for the proposed development in Vavathi, Noonu Atoll.

3.8 EIA IMPLEMENTATION METHODOLOGIES

This study was based mainly on data collected during a field investigation mission from 15-16th July 2018 by the consultants. Field studies have been undertaken using methods generally employed for EIA studies in the Maldives. The field assessment methodologies are briefly described in Section 6.3 of this report. Environmental impacts were assessed based on the input, process and output. Environmental impacts are predicted by use of widely used descriptive checklists and its significances are evaluated by the use of Leopold matrices. Expert judgment and professional opinion as well as review of relevant EIA studies have also been widely used throughout the impact assessment and evaluation process. These methods are described in detail at the relevant section of this EIA Report.

4. DESCRIPTION OF THE PROJECT

4.1 THE PROPONENT

The proponent of the project is Mr. Abdul Latheef, Dhildhaaruge S. Maradhoofeydhoo, who is a very successful businessman and also shareholder of local business giants such as Silversand, EVO, Seagear etc. Ministry of Fisheries and Agriculture has leased the island to Mr. Latheef for a period of 21 years. The acquisition fee (995, 670.00) of the island has been paid by the proponent.

4.2 PROJECT COST

The estimated total investment of the project is MVR 10 million within the 21 year lease period. The proponent is going to develop the island in two phases. In the first phase approximately 7 million MVR will be invested and 3 million MVR in the second phase Table 1 gives an indicative breakdown of costs for the proposed agriculture development project Vavathi. Major part of the investment will be on development of necessary initial infrastructure such as power and dessalnation plant, accommodation, greenhouses, water and fuel storage, jetty etc., and other main infrastructures and equipment.

Table 1: Investment cost (construction Phase) of Agriculture development project

Development	Cost in MVR millions
Jetty and initial mobilisation	1.5
Land clearance and earthworks	0.4
Vertical hydroponic systems	1.5
greenhouse	1.5
Power and desalination plant	3.5
Cold storage	0.8
Staff accommodation and service area	0.8
Total	**10**

4.3 MAIN DEVELOPMENT FEATURES OF THE PROJECT

The project mainly involves the construction, operation and management of 3 hectares area of agricultural land and reef fish vacuum packaging process in Noonu Vavathi with all the ancillary facilities including island access jetty, greenhouses, staff accommodation and facilities etc. Table 2. gives requirements to operate and sustain 3 hectares of farm land in the island.

Table 2: Requirements for the proposed development

Requirement	Details
Access jetty	60m long and 3m wide access T-jetty with 15m long 5m wide T; The jetty will be standing on pillars.
Powerhouse and Desalination plant	3 Gen sets 30kW each, 1 RO plant 30 Tons/day
Advanced hydroponic greenhouses	1 hectares of advanced hydroponic greenhouses;
Open Field Agriculture	2 Hectares of Open field Agriculture
Water Storage	100,000 liter storage capacity will be established

Fuel Storage	400,000 liters storage capacity will be established with appropriate bund
Sewerage and waste water	Self-contained electrochemical individual units
Fencing	Free range poultry area ---
Accommodation	2 workers accommodation buildings (1 floor building 5.6 x 22 x 2.85 m, 2 Senior staff accommodation buildings (9.1 x 12 x 3 m)

4.3.1 Site Planning and Design

All the facilities and farms proposed will be developed in the existing footprints, therefore no extra large trees or palm trees will be cleared or removed. Areas used for farming and to accommodate construction workers during the Velaa resort construction in the past is covered with bush and building ruins. These areas will be cleared and accommodation blocks and other facilities will be developed on the north eastern part of the island while the bush and grass covered areas on the westerns side will be used for farming

The staff accommodation and building infrastructure are equally sustainability designed. All effluent (black and grey water) will be treated by using septic tanks. Domestic water supply is from combination of rainwater harvesting and desalinated water produced from the plants, and energy needed for the island will be produced from diesel generators sets.

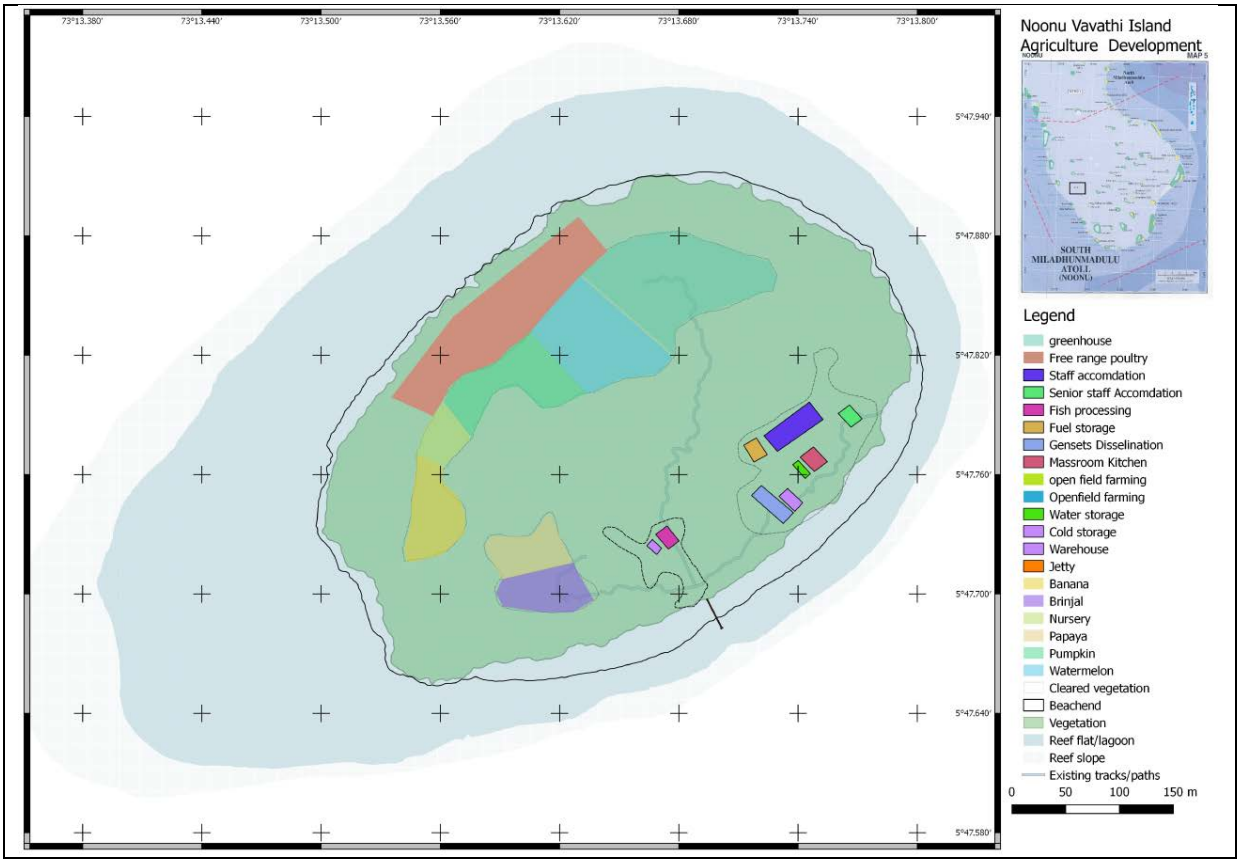


Figure 2: Noonu Vavathi Agriculture development land use plan (A3 size map is provided in Annex)

4.4 AGRICULTURE PRODUCTIONS

4.4.1 Vertical Hydroponics Systems

Hydroponics is a subset of hydroculture and is a method of growing plants using mineral nutrient solutions, in water, without soil. Terrestrial plants may be grown with their roots in the mineral nutrient solution only or in an inert medium, such as perlite, gravel, mineral wool, expanded clay or coconut husk.

Vertical farming is the growing of crops in vertically stacked layers. Vertical hydroponics, as is the combination of hydroponics and vertical farming. In a vertical hydroponics grow system will have several stacked levels, with plants being grown on each level. It is closely associated with gardening and farming in urban areas like cities. Main advantages and disadvantages of vertical hydroponics are compared in Table 3 below.

Table 3: Advantages and disadvantages of vertical hydroponics

Advantages	Disadvantages
Compact & Space Saving Design Can grow more produce even in small indoor spaces, making this ideal for urban farming and places with limited space.	**Water Flow Challenges** When plants are stacked, getting water to the top layers might require higher powered pumps. And unless carefully designed, the lower levels may get drowned. But Delivering water and nutrients equally to all plants is easy.
Does not require soil Lack of soil minimizes the growth of weeds or pests. Vertical hydroponics is the lightest and most practical form of vertical gardening.	**Light Supply Issues** Issue in indoors plants to get equal amount of lights. Installing separate grow lights for each layer might be required in some cases.
Efficiency & Productivity Space required for one plant can grow at least 3-4, if not more. High growth can be achieved by using the right nutrient mix and proper lighting.	**Resource Intensive** More costly More energy Constant monitoring of water in closed flow systems.
Minimal Wastage & Maintenance Have a closed nutrient+water flow system No runoff as the water keeps circulating reduces resource wastage. can be automated to reduce maintenance	But the advantages of vertical hydroponics outweigh these challenges particularly in areas where land and cultivable soil is more scarce.

There are many different hydroponic techniques like ebb and flow and nutrient film technique (NFT). Due to the dynamics of a vertical system, NFT is most commonly used.
NFT involves having a constant thin stream of water flowing over the root system of the plants. This is a closed, constant flow system, which makes it perfect for a vertical tower design. NFT will be used in Vavathi vertical hydroponic systems.

Figure 3: Vertical hydroponic systems

Vertical hydroponics systems will be established in 2X20,000 Sqft green house, initially two houses will be increased up to 6 in a later stage of development.

4.4.2 Open field

Fruit crops will be cultivated in the open fields. Hybrid varieties will be used and intercropping will be practiced to maximize land use and productivity. Crop rotation techniques, growing soil enriching crops will be adopted. Main focus will be on Pumpkin, watermelon, banana, papaya and tropical fruits which easily grows on Maldivian soil. The farms will be established in agroforestry systems to enable environment friendly production. Each field will be 100 x 200 feet area of cropping.

4.4.3 Nursery

A nursery will be set up to propagate quality seedlings and nurture plants before transplantation to the main fields. A total of two Nurseries of 200 × 200 in size will be developed in the first five years of initiation of the project activities.

4.4.4 Free range poultry

Chicken and turkey open poultry farm is mainly for the production of much needed meat for the Tourism and local industry. The process will be mechanical whereby the live poultry will be transported to the recipient. The open poultry farm will be fenced and western side of the island will be used for farming, where the trees will not be cleared, chicken and turkey will be left freely but designated feeding areas that will be renewed and cleaned daily will be established in inside the fenced areas. Farming activities will be initiated after a year of operation of the agricultural farming. Poultry droppings will be used in composting and producing fertilized which will be used on the open field farming.

4.4.5 Fish Processing and Supporting Infrastructures

Sourcing of fish will depend on the local reef fishery. The fishery is targeted entirely for local (Male and resorts) market in the form of cleaned, reef fish loins, fillets (normally processed according to the Customer needs). Two 20 feet reefer containers will be used as cold storage to store fish and finished product. The containers will be capable to maintain temperature between -4o to 0oC. Also Gel ice production capacity will be established to maintain the appropriate temperature while transportation. Below is the product flow diagram:

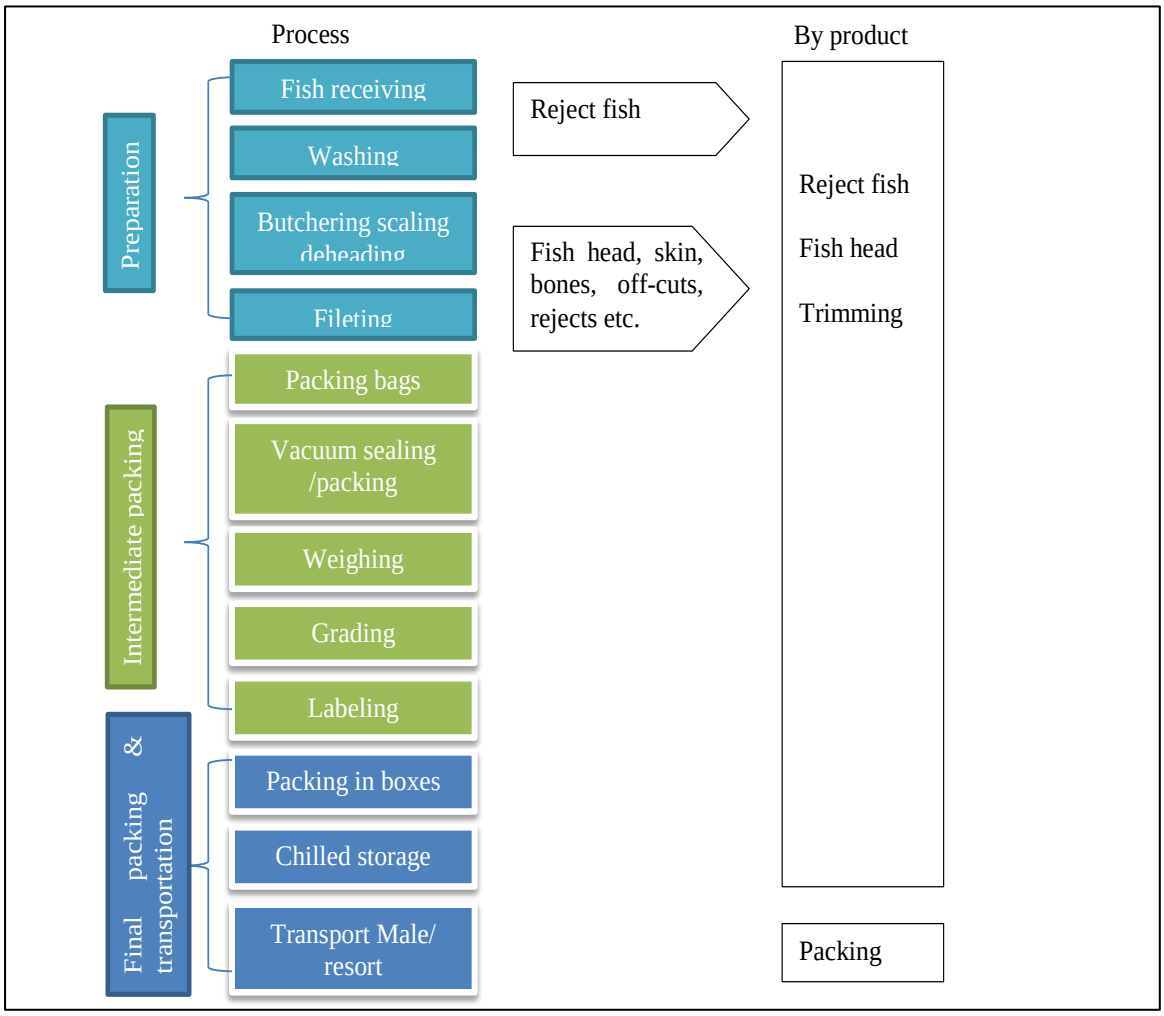


Figure 4: General fish processing product flow diagram.

4.5 MAJOR CIVIL WORKS

4.5.1 Initial Mobilisation and Site Preparation

Site mobilization and construction equipment, materials and workforce to the island can be brought in after EIA approval and completion of the jetty construction. Workforce facilitating construction of temporary jetty, access and other preliminary facilities will be accommodated in the island. Construction work will commence after establishment of the necessary facilities such as access jetty.

Construction work requires use of heavy machinery and special equipment. Some of these include excavators, lorries, trucks, and the like. A practical solution would be to bring these equipment after creating a small landing area on the eastern side, where a flat top barges, landing crafts or roll-on-roll-offs with the machinery can reach close to the beach. An approach that is commonly used is to create a sand bed from the beach to the deck of the barge. The heavy machinery can then simply drive over the bed on to the island.

4.5.2 Access jetty

To gain access for the island a 60m long, 3m wide T-jetty will be constructed. The shore parallel section of T jetty will be 15m long and 5m wide. The jetty will be standing on pre-casted concrete pad-column foundation. The Jetty will be constructed on the same footprint of the existing jetty (Figure 5). A typical jetty section that is constructed by the MHI in inhabited island is shown in Figure 6.

Figure 5: Condition of the existing jetty, looking seawards (left) and land wards (right)

All the concrete beams and pad-columns that will be used for construction of the jetty will be pre-casted on land and brought to the site by using excavator and crane. To lay the foundation pad of the column, the seabed will be excavated 1-1.5m and the precast pad-column foundation will be placed inside the excavated area by using a mini-crane or an excavator and buried.

Column density in the jetty structure area is approximately 1 column/2m^2 and. Column density will have impact on the water and sediment flow through the columns.

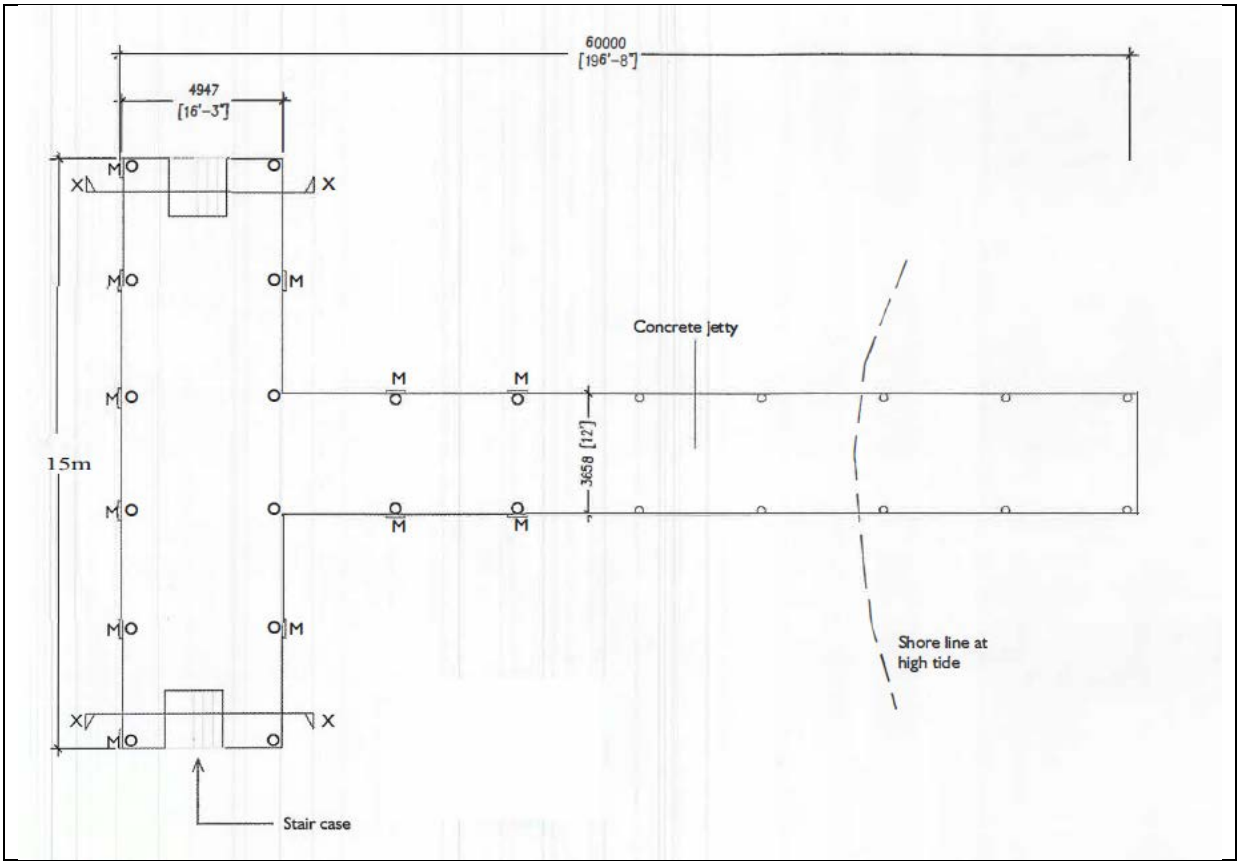


Figure 6: Typical T-jetty section used in inhabited islands of the Maldives.

4.5.3 Excavation, Foundations and Construction Systems

For construction of greenhouses and accommodations conventional building methods that do not require deep foundation structures. Such shallow foundation based structures does not require any dewatering and removal of soil and will have negligible impact on the environment. Therefore all buildings would consist of masonry work, reinforced concrete and structural steel work using manual labours and a mini excavator. In water structure such as foundation of the jetty would be constructed using pre-casted concrete pad-column which can be easily installed in the seabed by using an excavator. Although some damage to the substrate and alteration is expected during this process this is expected to be insignificant and short-term.

For the building such as accommodation buildings, powerhouse etc., beam foundations are most common and probably most cost effective foundation type being adopted in the Maldives. Since low rise buildings do not require withstanding heavy loads. Beam foundations however, require excavations along the beams with larger footings at the columns. This would mean some excavations and piling up of sand around the building footprint. The normal practice in the Maldives has been to excavate about 0.3 – 1.2 m for foundation for single storey buildings. They are sufficient and are known to last for 20-30 years.

Power cables, sewer, drainage and water pipe grids will be connected through underground trenches. Mini excavators will be used for trenching work.

4.5.4 Workforce and Services

Relatively small construction workforce will be maintained on the island during the construction period. In this regard, around 20-30 construction staff will be stationed in Gadhdhoo island and on site.

4.5.5 Site Office and Temporary Accommodation

A site office and temporary accommodation blocks will be constructed on the eastern side of the island. In locating temporary accommodation as well as material storage and other construction-related infrastructure and services in the island special attention would be given to ensure the all the vegetation clearance will be maintained within the already established clearance boundaries.

4.5.6 Utilities

At the early stages of construction work portable water for drinking will purchased from nearby inhabited islands, Holhudhoo Island. Since most of the workforce will be stationed in rented houses in Holhudhoo island , electricity from a gen set will be used for construction equipment operations. 1500-2000 litre rain water tanks will be kept on site for rainwater collection from the roofs of temporary accommodation blocks. Electricity during the construction period will be generated through two 30-kW Generator set which will be installed at the commencement of initial mobilization.

4.5.7 Services Health and Safety

Construction workers will be provided with daily meals and necessary entertainments facilities. The contractor will ensure that the construction activities are carried out under the supervision of a suitably experienced person and reasonable precautions and safety measures are implemented at the site throughout the construction period. Warning signs barricades or warning devices will provided for all the worker and will be obligated to wear them at the construction site at all times.

4.5.8 Construction Waste Management and Disposal

General domestic waste generated from material consumption by construction workforce and the construction will be managed according to the waste regulations. The proponent will ensure that all construction related waste during demobilizations along with other wastes is properly transported using a licenced vessel from EPA and disposed-off as per the waste regulations and EPA guidelines.

4.5.9 Pollution Control Measures

The following pollution control measures will be strictly implemented during the construction stage:

- All the machinery and equipment will be properly tuned and maintained to reduce emission leakage and spill;
- Proper fuel paints, lubricants, and other chemicals handling and transport measures will be strictly implemented and the fuel storage will be bunded;
- To handle any accidental liquid spills, spill kits will be maintained in the construction site.

4.5.10 Fire Prevention

Water based fire extinguishing will be preferred during the construction period. Pumps connected to the sea will be installed prior to commencement of major construction activities and other fire

extinguishing equipment would also be readily available and employees will be trained to use it in case of fire breakout in the construction area. Potential fire prone activities such as welding and cutting will be carried out by experienced personnel and proper precautionary measures will be strictly followed in the construction site

4.5.11 Fire Detection and Protection System

Fire detection systems will consists of smoke / heat detectors, manual calls points and Fire alarms with repeater panel. Warehouse, accommodation buildings with will be fitted with manual call points and smoke detectors in common areas. All plant rooms will be fitted with detectors.

Fire protection system will consist of ring main distribution with one diesel, one electric fire pump and one jokey pump with hose reels and hose cabinets as per local regulation.

4.5.12 Accidents and hazards

Hazards and likely incidents that will compromise the environment are negligible, both during the construction and operational phase of the project. Health and safety issues relating to handling plant material and growth solution and or fertilizers will be regularly briefed to staff. Necessary instruction and warning signs will be posted in the work areas where appropriate.

4.6 PROJECT ACTIVITIES – OPERATIONAL PHASE

Key activities identified throughout the operation of the proposed project would cultivation in greenhouses, processing, seawater cooling system and brine reject disposal, waste water and sewerage system, water production, pest control and power generation and management. These activities will have environmental impacts; therefore, there will be regular environmental monitoring to understand the environmental impacts of the proposed project during the operational phase

4.6.1 Cultivation

Most of the crops from Vavathi agricultural farms will be grown in enclosed vertical hydroponic greenhouses with no pathways for nutrient discharge. For the open field agriculture no chemical fertilizers will be used. The proposed development will be environmentally sustainable development where advance technology will be employed.

4.6.2 Transport

Sea transport will be the mode of transport to and from the island. Necessary supplies to the island will be transported from Male'. As the main target of the project is to cater for the resort markets all sea transport facilities will the access T- jetty which can accommodate along-side berthing of large Dhonis for loading and unloading goods. Transport on the island pick-up trucks, island trucks and other small vehicles. Relevant road infrastructure will be developed in the island.

4.6.3 Waste Management

The island will have a Solid Waste Management Plan. All green and organic wastes will be recycled to create fertilizers. Other combustible and non-combustible matter will be taken to a waste disposal site designated by the Government authorities on a regular basis.

4.6.4 Sewage and Wastewater Disposal

Since the maximum number of staff permanently working in the project will not exceed 20 and hence the quantity of waste water and sewage would be very low therefore the proposed Sewage will be

disposed via septic tank system. Many inhabited islands in the Maldives still use this system. With proper design the method is safe and can avoid contaminating ground water. For only 15 – 20 people on Vavathi the septic tank system is considered to be effective and safe.

In the septic tank system sewage and waste come into septic tank and solid matters settle down at the bottom of the tank. Anaerobic Bacteria convert the sewage into liquid and gases during the process of digestion. In this way there is appreciable reduction in the volume of waste and it changes into semi solid condition, which is called sludge. It is necessary that septic tank is covered with water tight top roof slab. Following general guideline lines should be used for the use of septic tank system.

- Sufficient water is required for proper functioning of septic tank.
- The waste containing detergent should be avoided in septic tank as it had adverse effect on anaerobic bacteria.
- Septic tank should have minimum width of 0.75 meter and minimum depth of 1 meter below water level of the septic tank.
- Length of the tank should be 2 to 4 times the width.
- Every septic tank should be provided with ventilation pipe of at least 50 mm diameter.
- Minimum free board above water level should be of 30 cm.
- The floor of the tank should be of cement concrete 1:1.5:3 and has a minimum slope 1 in 10 provided towards the sludge outlet to facilitate de-sludging.
- The inner surface of septic tank should be plastered with rich cement.
- For efficient working of septic tank the sludge should be cleaned half yearly or yearly

4.6.5 Power Generation and Water Production

Power generator will be installed early in the development. It is estimated that no more than 4 gen sets of 30 kW will be required even at full operation of the facility. A soundproof, compact diesel power generation units will be installed as indicated in the plan.

Transmission cables will be buried with appropriate protective covering. Mindful of reduction fossil fuel burnt, lead light will be used as much as possible. Lead lights although expensive are known to last much long and consume only a fraction of the regular incandescent bulb.

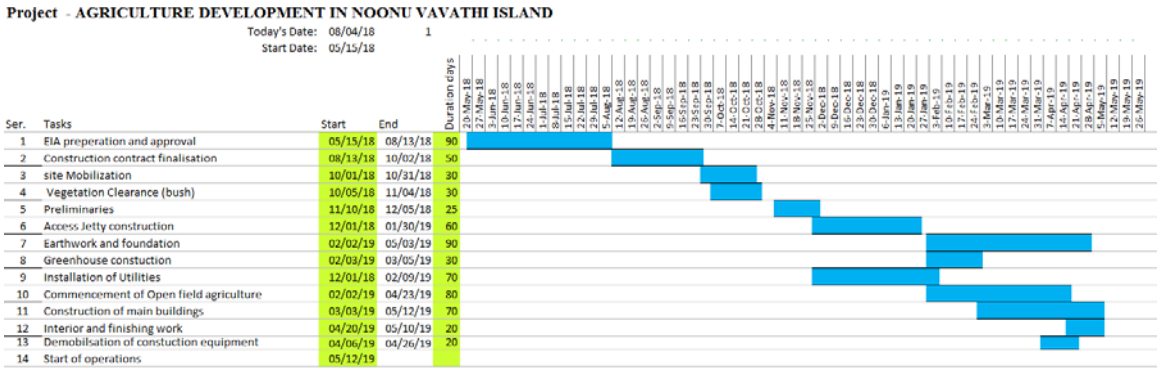
A small diesel storage tank (about 1,000 litres, day tank) will be installed at the power house. Tank will placed insider bunded area to avoid any spill leaking into the ground.

Ground water will not be extracted at any stage. Therefore an RO plant will be installed and commissioned at very early stages of the development works. A 30 tonnes/day capacity RO plant will be installed. It is proposed that intake will be placed in the Western side and outlet on the eastern side. The effect of discharge of brine is unlikely to have a visible impact to the environment. The effects if any would be immediately diluted to insignificant levels by the currents. Water storage capacity of 100,000 litres will be installed. RO product water and rain water will be mixed and stored. Rain water will be harvested from every possible roof available and connected to the storage tanks. Care will be taken for safer harvest and storage of rain water.

4.7 DEVELOPMENT SCHEDULE

The Figure 7 shows the project activities to be carried out from EIA preparation to start of operations in Vavathi Island.

Figure 7: Tentative project development schedule



4.8 INPUTS AND OUTPUTS

Table 4: Matrix of major inputs to the project construction and operational phase

Input resource(s)	Source/Type	How to Obtain Resources
Construction Phase		
20-30 construction Workers	Foreign/ local	Contractor's employees, 1 engineer and a 2 site supervisor Recruited through bidding and announcement in local papers, and recruiting agencies etc.
Construction material	Reinforcement steel bars, river sand, cement, aggregates Timber; greenhouses, 600-800mm steel pipe, electrical cables and wires, DBs, MMCBs and MCBs, PVC pipes, light weight concrete blocks, light weight, telephone cable CAT, PVC conduits, core armoured cables, PP-R pipe, Pump, floor and wall tiles, gypsum boards, calcium silicate boards, zinc coated corrugated metal roof, paint, varnish, lacquer, thinner, dry walls etc.	Imported and locally purchased where available
Heavy machinery (excavators island pickups, concrete machine and operational tools)	Contractor's machinery	Hire locally/ contractors machinery
Maintenance tool and equipment	Maintenance parts and fluids required for the machinery	Import or purchase locally where available
Fuel and lubricant for machinery	Diesel, Petrol, Lubricants	Local suppliers/contractor
Fresh water	Rain /desalinated water collection	Drinking water purchased from nearby inhabited islands

Electricity/ energy during construction	Diesel generator	2 Genset 30 kW diesel generator
Electrical appliances/machinery	Energy efficient machinery and appliances	Local suppliers if available if not import
Fire fighting equipment	Fire pumps, Fire protection system, and Foam fire extinguishers.	Local suppliers if available if not import
Operational Phase		
10-15 operational staff	Mostly locals and few expatriate	Recruited through bidding and announcement in local papers, and recruiting agencies etc. priority will be given to locals from nearby islands
Water supply	Rainwater/desalinated water management system	Rain water collection form the roofs of accommodation buildings
Drinking water	Bottled water	Locally purchased empty bottles will be sent back to the company for recycling
Electricity/energy	Diesel Generators	Diesel Generators
Maintenance material	Timber, electrical cables, electrical appliances, paint, thinner etc.	Locally purchased
Telecommunications	PABX system, email and internet facilities	Local telecom companies
Transport	by sea	Launches and Dhoni
Food	Locally produced sources. Preference will be given to locally grown agricultural items and produced food items.	Import and purchase locally (fruits, fish and vegetables).
Laundry chemical	Detergent, all-purpose cleaners, glass cleaners, bathroom cleaners, destainer, softener, alkali neutralizer, detergent, detergent plus, stain spots remover, etc. preference will be given to bio-degradable compounds	Imported and locally purchased
Paper products	tissue roll, tissue boxes, hand tissues, office use paper products	Local supply if available if not import. Recycle products and fabric material tissues will be preferred
Fire fighting equipment	Fire Pumps, Fire Protection System, Smoke Detectors, Carbon Dioxide and Foam Fire Extinguishers, etc.	Local suppliers

Fuel, Kerosene and LPG	Light Diesel, LPG Gas, Petrol, Lubricants	Local suppliers

Table 5: Matrix of major outputs construction and operational phase

Outputs (s)	Anticipated quantities	Disposal method
Construction phase		
Green waste from site clearance	Large quantities	mulched on site and used composting
Construction Waste	Small quantities	combustibles burnt/ incinerated others sent to Thilafushi
Fuel and lubricant for machinery	Minor quantities	Gathered in a barrel and sent to Thilafushi
Waste water from workers	Minor quantities	Managed through the stand alone sewage treatment units
Operational Phase		
Non portable water	100-200 liters/day	Rainwater/desalinated water mix
Portable water	10-20 plastic bottles/ day	Plastic Bottles – crushed and sent to the bottling company
Sewage and wastewater	20-50 liters/person/day grey water laundry waste water	Septic tanks
General Domestic waste	Over 20 kg/day	Managed through waste management system
Kitchen and organic waste	Over 10kg/day	Managed through waste management system
Waste oil and grease	Over 5 liters/ month	Nearest waste management center/ Thilafushi
Scrap metal/cans/plastics	10-20 kg/month	sent to Thilafushi
Paper and Plastics, packaging waste	5-7 kg/month	sent to Thilafushi
Glass and glass bottles	50-100 bottles/month	sent to Thilafushi
Hazardous waste	Minor quantities	Properly sealed in containers and sent to Thilafushi

5. REGULATORY CONSIDERATIONS

5.1 LEGAL ADMINISTRATIVE FRAMEWORK

As part of the EIA process, consideration of regulatory framework pertains to the project needs to be addressed. Therefore, this chapter would identify the relevant regulations, standards and environmental policy relevant and applicable to the Project being proposed. This would also include identifying roles and responsibilities of different government institutions and line Ministries describing their possible roles in the regulating the proposed work on Vavathi leased by the Ministry of Fisheries and Agriculture. The chapter would also identify regional and international obligations the Maldives must meet in terms of sustainable environmental development.

The proposed project will be subjected to the Law 20/98 – the Law on Uninhabited islands and the Leasing requirements of the uninhabited islands being administered by the Ministry of Fisheries and Agriculture (MoFA) and the also the Environmental Protection and Preservation Act of the Maldives (Law No. 04/93). The EIA process should satisfy the Laws and Regulations requiring Environmental Protection Agency (EPA) to issue the environmental decision Statement.

5.2 POLICY FRAMEWORK

The following are key policy frameworks of the Maldives that governs environmental management of the country

National Biodiversity Strategy Action Plan 2016-2025[1]. This is a policy document that has been recently revised and updated which gives guidance on the sustainable management of the biodiversity consistent with objectives of the Convention on Biological Diversity which Maldives is party to. Under the NBSAP the following targets has been endorsed by the government. Under each target suggested actions, indicators identified with its baseline, including lead agency (ies), stakeholders and the time line during which the target is aimed to achieve.

1. By 2020 governance of biodiversity conservation is strengthened at local and national level.
2. By 2020 enforcement of the laws and regulations on biodiversity are strengthened
3. By 2025 mainstream biodiversity into island, atoll, sectoral and national plans
4. By 2025 government, businesses and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.

National Waste Management Policy 2014: This is an important area for a country like the Maldives, with limited land and surrounded by the coral reefs that sustains livelihoods of its inhabitant. The National Waste Management Policy was a culmination of series of activities starting from a Barriers Report developed in 2005. The first National Waste Management Policy document was issued in 2008 with broad policy objectives formulated in line with major international principles. The key strategic principles outlined in the document include; establishing polluter pay principle, integrated solid waste management, best practice environmental option, best available technology not entailing excessive costs and proximity principles.

[1] http://www.environment.gov.mv/v2/en/download/4318, accessed August 2018

The most recent waste management policy was released in 2015 which also endorses similar principles. The purpose of this policy is to protect the Maldivian seas and the coastal zone from the negative impacts of waste. Furthermore, the Policy explicitly states that it is based on international waste management principles such as the European Union (EU) waste hierarchy pyramid of prevention, reduction, reuse, recycle, waste to energy and disposal. The policy is comprised s 16 strategies. Of those the most relevant are those that endorse international principles for waste management that include utilization of the 3R concept (reduce, reuse and recycle) in the overall development of waste management policies and management. Readers are encouraged to refer to the document[2]

As identified in this policy document, it is the priority of government of the Maldives to set up regional waste management facilities, island waste management centres, in order to decentralize waste management administration. In fact, the first Waste Management Centre in the country has started operating since September 2016 in Raa Vandhoo. The Waste Management Centre is operated by Waste Management Corporation which is charged with transporting waste (except food and organic waste) from all the inhabited islands.

5.3 REGULATORY BODIES

5.3.1 Ministry of Fisheries and Agriculture:

Ministry of Fisheries and Agriculture administers the mandate on managing uninhabited islands in the Maldives. The Ministry maintains records of all the islands (location, area, major features of the island, and its lease category) in an online database called the Atolls of the Maldives (http://www.atollsofmaldives.gov.mv/[4]). Islands ear-marked for tourism development and identified for the work of state-owned enterprises are excluded from Ministry's purview.

For the purposes of this project the Ministry leased the island of Vavathi on commercial lone term lease as per Regulation on Lease of Uninhabited Islands.

5.3.2 Ministry of Environment and Energy

In the Maldives the Ministry of Environment and Energy (MoEE) is mandated with formulating policies and strategies, laws and regulation relating to environmental management, protection and conservation and sustainable development. The Minister of Environment or a designate (currently the Environmental Protection Agency- EPA) givens the environmental approval or clearance to EIA through and Environmental Decision Statement. MoEE is responsible for formulating relevant laws and regulations, policies and strategies concerning environment, energy, water and sanitation.

5.3.3 Environmental Protection Agency (EPA)

EPA is the main regulatory body on environmental issues under the MoEE. It is mandated to implement EIA process in the Maldives including the regulation on water and sanitation, biodiversity, conservation and waste management.

[2] http://www.environment.gov.mv/v2/en/download/4584, accessed August 2018
[3] Accessed 03 August 2018
[4] Accessed 03 August 2018

Under the EIA Regulation, development projects in fisheries and agriculture require to conduct a full EIA and a valid decision statement is to submitted to MoFA as part of the due process long term commercial lease of the uninhabited island.

5.3.4 Atoll and Island Councils

Under the Maldives' Decentralization law, elected atoll councils and island councils have been formed as regulatory bodies dealing directly with atolls, cities, and island issues. In this regard, some of the development projects subject to approval by these councils through a public consultations process. For the proposed project, EPA requires that a copy of the draft final of the EIA report be submitted to Noonu Atoll Council.

5.4 LAWS AND REGULATION

5.4.1 Law on Uninhabited Islands

Managing uninhabited islands in the Maldives is under purview of the Ministry of Fisheries and Agriculture (MoFA) mandated under Law No. 20/985−Law on Uninhabited Islands of the Maldives which repealed Law No. 20/78. The Law deals with Varuvaa – a scheme of leasing an uninhabited island or section of an island for the purposes of maintaining in its natural state – and commercial leasing, rehabilitation of islands, including cutting down and planting of trees. The Law explicitly excludes island leased for tourism development which is under the purview of the Ministry of Tourism.

Under the Law MoFA has the mandate to draw regulation of activities it sanctions. The Law states when leasing such islands, there should be public call to submitting application for lease or close-bidding as may be required by the MoFA. The Law encourages MoFA to give due considerations for proposal with highest rent, including consideration on nature and social and economic merit of the proposed activities.

Under the Law MoFA may lease islands for a period not more than 21 years. However, should the starting investment be more than USD 10 million MOFA has the discretion to increase period of lease up to 35 years.

The Law excludes the islands ear-marked or taken by state-owned enterprises such as MIFCO and MPL.

Following passing of the Law 20/98 MoFA published a comprehensive 11-page "Regulation on Uninhabited Islands6" which details leasing of the uninhabited islands, including administering of the Varuaa scheme. The regulation also details the process in which requests for Varuvaa or for commercial leasing may administered.

Ministry of Fisheries and Agriculture brought number of the amendments on Regulation to deal with emerging issues. These are:

[5] http://www.fishagri.gov.mv/images/download/20-98Uninhabitad_island_law.pdf, accessed August 2018

[6] http://www.fishagri.gov.mv/images/download/falhurah%20rashaa%20behey%20gavaidhu.pdf, accessed August 2018

1. Amendment #1: Dated 19 August 2015. Provides comprehensive application form to request leasing of islands. The amendment also states special consideration may be given to parties who requests to lease uninhabited islands close to an existing island owned and operated by the requesting party.

2. Amendment #2: Dated 19 October 2016. Sates lease agreement may be made to a Maldivian above the age of 18 or for registered companies or partnership under the Ministry of Economic Development. The second clause of the amendment states that MoFA has the right to terminate agreements made prior the Regulation for the purpose of harmonizing agreements with the new Regulatory framework.

3. Amendment #3: Dated 19 December 2016: The amendments were brought to Clause 14. These include giving discretion to MoFA on deciding lease of an island under Varuvaa even if a single party has submitted the application, provided that Ministry considers the proposal is sound. It also gives clarity to MoFA to making decision in situations where two or more requests state equal rent. Finally, it states that if no one submitted application for a call for proposal, MoFA had the right to make decision on who to assign the island for Varuvaa. These all make sense as the objective would be islands are assigned to a party taking responsibility managing and that government gets a nominal amount for its rent. In the past some islands have been assigned to island/atoll councils on a temporary basis.

4. Amendment #4: 22 February 2018; The amendment is on the application form, requiring additional information of the nature of the investment being proposed including details of the projects the proponent will supporting and total value of the 5 activities being proposed.

Once an uninhabited island is leased for commercial purposes, the lease agreement would take precedence over the Regulation

5.4.2 Environmental Protection and Preservation Act.

The environmental Law 04/09 is the single most important legal instrument with regards to environment management and it gives very high prominence towards safeguarding the environment with regards to all the development activities. Under the Act the Ministry of Environment has developed regulations and guidelines concerning the environmental protection through implementation of EIA process.

Clause 2 of the EPPA mandates the Ministry of Environment and Energy to formulate policies, rules and regulations regarding the environment.

Clause 5 of this Act specifically provides for environmental impact assessment which is encouraged be used as a tool to integrate environmental issues into development decision. It states the environmental impact assessment is a mandatory requirement for all economic development.

Clause 6 of the EPPA gives the Ministry of Environment the authority to terminate any project that has an undesirable impact to the environment.

Clause 7 of the EPPA refers to the disposal of oil, waste and poisonous substances into the Maldivian territory. According to this clause, any type of waste, oil, toxic gas, or any substances that may have

harmful effects to the environment should not be disposed within the Maldivian territory. If, however, the disposals of substances become necessary, the clause states that they should be disposed only within the areas designated for that purposes and if incinerated, appropriate precautions should be taken to avoid harm to the health of the population.

5.4.3 Environmental Impact Assessment Regulation

The EIA Regulation, stemming from EPAA, which came into force in 2007, has been recently revised and the revised EIA Regulation 2012 is currently in force since May 2012.

This EIA is subjected to the EIA Regulations 2012. The EIA Regulation 2012 is currently only in Dhivehi and an official translation is being prepared. The Regulation sets out the criteria to determine whether a development proposal is likely to significantly affect the environment and is therefore subject to an EIA. Schedule D of the EIA Regulations defines the type of projects that would be subject to Environmental Impact Assessment. Agriculture development projects are also subject to environmental impact assessments.

The main purpose of this Regulation is to provide step-by-step guidance for proponents, consultants, government agencies and public on how to obtain approval in the form of an Environmental Decision Statement.

5.4.4 Regulation on Uprooting, Cutting and Transportation of Palms and Trees

This Regulation was implemented on 1 February 2006 by the then Ministry of Environment, Energy and Water. The primary purpose of the Regulation is to control and regulate large-scale uprooting, removal, cutting and transportation of palms and trees from one island to another. According to the regulation, certain types of trees and plants that have unique attributes are prohibited to be removed from its natural environment. Also, uprooting and removal of 50 or more mature trees and palms are subject to Environmental Impact Assessment (EIA), which is required to be submitted to the Environmental Protection Agency, and written approval is required prior to implementation of the project.

5.4.5 Hazardous Substance Act

Under the Hazardous Substances Act, prior written consent is required from the Ministry of Defense and National Security for import of chemicals to the country. The following information must be submitted to the Ministry for approval of the chemical to be imported to the country:

- Name of the chemical (in English),
- Common name and principal trade name of the chemical,
- Use (as insecticide/fungicide/rodenticide),
- Country where it is being imported from,
- Amount that needs to be imported,
- Reason for the import, and
- If the chemical is retailed, name of the retailer.

Import of Class A chemicals into the country is banned and are listed in Table 3-1 of the Act. The Proponent shall obtain prior written consent of the Ministry for the import of chemicals, if the proponent decides to use any in future expansions (at present proponent does not plan to use any

imported chemicals under this project). In addition, the Proponent shall not import chemicals listed in Table 3-1 of the Act.

5.4.6 Desalination Regulation

Desalination Regulation (2002) states that all sea water desalination plants installed and intended to supply water to 200 or more people or large-scale agricultural needs or tourism related activity need to be registered prior to the operation of the plant. Therefore, it would be necessary to consider the impacts of desalination plant in this EIA so that registration can be done without further environmental scrutiny. Desalination plant registration is required to be renewed every five years. Therefore, regular monitoring shall be ensured in order to carry out and efficient renewal process. The Borehole Guideline, which came into effect in September 2011 is also of relevance to desalination projects. These guidelines provide the basis for installing boreholes in the Maldives. If boreholes were used for desalination, the borehole guidelines will be adhered to in this project.

5.4.7 Powerhouse Registration Guidelines

Guidelines for the registration of powerhouses have been issued by the Maldives Energy Authority recently. According to these Guidelines, all power plants need to be registered and environmental clearance is required prior to registration. Therefore, this EIA will look at the environmental aspects of power generation proposed for Vavathi to assist the powerhouse registration process

5.4.8 Regulation on Environmental Damage Liabilities

Under the Environmental Protection and Preservation Act (No. 04/93), the Ministry of Environment and Energy formulated the Environmental Damage Liabilities Regulation in February 2011, which encompasses the basis to avoid environmental deterioration, extinction of biological resources, environmental degradation and avoid wastage of natural resources. The main purpose of this regulation is to stop unlawful activities on environment and adequately implement a fining procedure for violations as well as implement a compensation mechanism on environmental damages. Its schedules form the basis for levying fines on various environmental components and activities. Hence, the proposed project will be subject to this Regulation for any activity outside of the EIA scope and Environmental Decision Statement.

5.4.9 Waste Management Regulation

The Waste Management Regulation 2013 (Regulation No: 2013/R-58) lists the guiding principles on how to implement the waste management policy.

5.4.10 Regulation on Important of Plants and Animals

There are regulations on importing plants and animals into the Maldives (administered under Ministry of Agriculture and Fisheries). Any seed or seedling that need to be imported for the Project will have to be quarantined by the Animal and Plant Quarantine Unit of the Ministry of Fisheries and Agriculture in Hulhulhe7. The practice is that importation should accompany a quarantine certificate from the state facility along with prior permission from the Ministry of Fisheries and Agriculture.

[7] http://www.fishagri.gov.mv/images/download/Guidelines%20for%20Quarantine%20detained%20items%20in%20Maldives%20%20%20Dhivehi%20%201.pdf, accessed August 2018

Importation that violates these rules are confiscated and destroyed at the Plant and Animal Quarantine Unit.

5.5 INTERNATIONAL AND REGIONAL CONTEXT

The major global issue facing the Maldives is from global warming, and climate change and its consequent impacts such as sea-level rise and ocean acidification. The small size of the islands and their low elevation above mean sea leave makes the Maldives as one of the most vulnerable states in the world. Consequently, the country plays a prominent role in fore-fronting environmental issues faced by many other Small Islands Developing States (SIDS) including the Maldives in the international arena. The Maldives is a party and signatory to various international conventions and declarations. These include;

- UN Convention on the Law of the Sea – UNCLOS (1982)
- International Convention for the Prevention of Pollution of the Sea by Oil (1982)
- Vienna Convention for the Protection of the Ozone Layer (1985)
- Montreal Protocol on Substances that Deplete the Ozone Layer (1987)
- Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal (1989)
- The London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1990)
- Agenda 21 and the Rio Declaration of the United Nations Conference on Environment and Development (1992)
- Convention on Biological Diversity (1992)
- United Nations Framework Convention on Climate Change (1992)
- The Copenhagen Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1992)
- The Montreal Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1997)
- The Beijing Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1999)
- Washington Declaration on Protection of the Marine Environment from Land-Based Activities
- Kyoto Protocol to the United Nations Framework Convention on Climate Change
- (1998)
- Cartagena Protocol on Biosafety (Maldives acceded on 2 September 2002)
- United Nation Convention to Combat Desertification (2002)

The Maldives is also a key player in formulating and adopting various regional plans and programmes to protect the environment by continuously participating in various activities organized by regional bodies such as SACEP, ESCAP and SAARC. As a result, the Maldives is committed to the following;

- SAARC Environment Action Plan adopted in 1997 in Malé.
- SAARC Study and its findings on Greenhouse Effect and its Impact on the Region
- South Asian Regional Seas Action Plan and Resolutions concerning its implementation (1994)

- SAARC Study on Causes and Consequences of Natural Disasters, and South Asian Seas Programme initiated by SACEP
- Malé Declaration on Control and Prevention of Air Pollution and its likely Transboundary Effects for South Asia (1998)

6. EXISTING ENVIRONMENTAL CONDITIONS

6.1 GEOLOGY AND GEOGRAPHY

Vavathi is situated on the Central western part of Noonu Atoll, at approximately 7 73°13'39.64"E and 5°47'43.02"N. Vavathi island was formed on an isolated oval shape NE-SW oriented reef platform measuring a length of 900m and the width is 540m, Nearest inhabited island to Vavathi are Holhudhoo 5.2 km south east and Fodhdhoo 5.8km South west and Manadhoo, the capital of Noonu Atoll is located 20 km North east of Vavathi island. Velaa resort in Noonu Atoll is located 4.3km north of Vavathi Island. Agricultural island Felivaru island is 10km east of Vavathi. Number of resort development work is underway at Noonu Atoll.

Vavathi is a vegetated island situated inside the western part of Noonu Atoll. Vavathi reef is over 900m long and 500 wide and NE- SW oriented. Approximate area of the vegetated part is 17 hectares and the area from the beach end is estimated to be 19 hectares and the total area of the reef from the outer edge is 42.4 hectares. The island occupies approximately 40% of the reef, which makes the reef a largely saturated reef.

6.2 OBJECTIVES

The purpose of this was to assess the existing environmental conditions of the island, including marine and land environment. Further, study of existing environment also involved undertaking review of available literature to understand long term trends in climatological regime and natural hazard incidents. These assessments would not only enable avoiding impacts to the environment as a result of the project but also would contribute to better planning recommendations for the proposed project. This is critical in assessing potential impacts and to determine the actual extent of damage should an unforeseen impact occur during the implementation phase.

A series of rapid survey techniques were used to assess the beach, terrestrial and marine environment. These techniques are consistent methods and procedures recommended by the EPA.

Main objectives of the assessment were:

1. To determine the type and density of flora present on Vavathi Island
2. To determine the general soil characteristics.
3. To determine the quality of groundwater
4. To obtain beach high/low tide, and beach lines of Vavathi
5. To establish the general description and conditions of Vavathi reef.

6.3 STUDY AREA AND SURVEY LOCATIONS

Figure 5 below shows the vegetation, ground and sea water sampling locations, with their respective GPS co-ordinates of water samples is given in respective sections of the report.

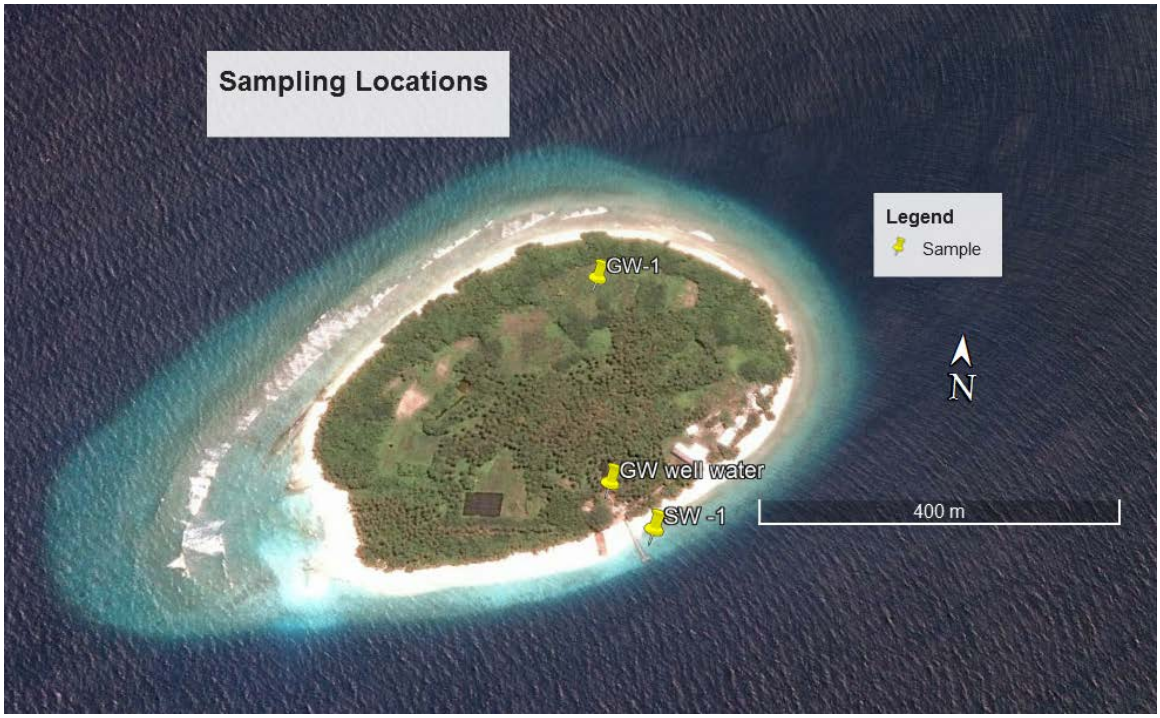


Figure 8: Study area, Water sampling locations

6.4 METHODOLOGIES

Both qualitative and quantitative methods have been used to collect data. Terrestrial environment was assessed and type of vegetation in the island was determined. Ground water and soil of the island was assessed by digging a well and taking the soil profile of the island. Ground water was analysed from the laboratory in Male Water and Sewerage Company.

6.4.1 Flora and Fauna Assessment

Both qualitative and quantitative methods have been used to gather site-specific information on flora and fauna of the island. Qualitative methods included visual assessments, observations and aerial photography. The assessments undertaken on fauna of the island were mainly qualitative including field observations, calls, and encounters during the visits to the island.

6.4.2 Soil and Groundwater Assessments

A water sample was collected from the central part of the island, from well dug for the purpose and another existing well near the abandoned mosque, in clean 1.5 L PET bottles after washing them with water to be sampled. Parameters tested for ground water quality assessments were physical appearance, temperature, pH, electrical conductivity, total suspended solids. Necessary parameters to assess the overall quality of the ground water were analyzed at the laboratory in (MWSC) laboratory. The location of sampling area given in Figure 8 and geographic coordinates are given in Table 6.

Well No	Latitude	Longitude
GW-1	5°47'51.43"N	73°13'39.78"E
GW Well	5°47'42.56"N	73°13'40.61"E

SW-1	5°47'40.84"N	73°13'42.24"E

Table 6: Geographic coordinate of ground water sampling and soil profile location

Soil structure of the island was assessed from the well dug to extract ground water sample. Given the time constraints, during the field studies only the physical aspects of the Island soil were considered. However, due to the similar nature of oceanic island soils throughout the world, certain generalizations with regard to soil chemistry for the Island have been made based on similar studies done for other island soils of the same geomorphologic aspects.

6.4.3 Geology and geomorphology

Aerial photographs and Digital globe, Google earth and island surveys are comparatively evaluated using GIS technology to assess the developments of the island.

6.4.4 Bathymetry

General depth of the lagoon was measured by using echo sounder. Overall the lagoon on the eastern side of the island narrow and has a fairly uniform depth ranging between 0.9-1.5m. Western side of the shallower than eastern side but the lagoon is wider. Water depth on the western side lagoon is within the range of 0.3-1m. Island lagoon will not be used for any type of development other than the access jetty, therefore more details bathymetry survey was not conducted. The jetty will be constructed in the footpath of the existing jetty, therefore no further developmental activities would be carried out in the lagoon and marine environment.

6.4.5 Marine Water Quality

Water sample was obtained from the lagoon from a randomly selected location. Sample was taken in a plastic bottle after washing it with seawater obtained from the same location. The sample was kept in low temperature and was delivered to the MWSC lab within 24 hrs of collection. Analysis was carried out at MWSC laboratory using certified methodology.

6.4.6 Coral Reef Assessment

Qualitative methods have been used to gather site-specific information on marine environment of the island. Qualitative methods included visual assessments, observations and underwater photography. General description the marine environment is provided as the development will be on land only.

6.5 METEOROLOGY AND CLIMATE

6.5.1 Temperature

The daily average temperatures rarely drop below 25°C and rarely go above 32°C. The warm period of the year is from March to May with an average daily high temperature above 31°C. The hottest day of the year is during April, with an average high of 32°C and low of 28°C.

The cool periods lasts from October/November to January with an average daily high temperature below 30ºC. The coldest day of the year is around mid-December, with an average low of 26°C and high of 30ºC. The sea surface temperature in the Indian Ocean in July 2014 is recorded to be around 29-30ºC.

The annual average rainfall is approximately 1,950mm. As Maldives lies on the equator, Maldives receives plenty of sunshine throughout the year. Significant variation is observed in the climate between the northern and the southern atolls. The annual average rainfall in the southern atolls is higher than the northern atolls. In addition, greater extremes of temperature are also recorded in the southern atolls. On average southern atolls receive 2,704 hours of sunshine each year. Table 7 provides a summary of key meteorological findings for Maldives.

Parameter	Data
Average Rainfall	9.1mm/day in May, November 1.1mm/day in February
Maximum Rainfall	184.5mm/day in October 1994
Average air temperature	30.0 C in November 1973 31.7 C in April
Average wind speed	3.7 m/s in March 5.7 m/s in January, June
Maximum wind speed	W 31.9 m/s in November 1978
Average air pressure	1012 mb in December 1010 mb in April

Table 7: Key meteorological features of the Maldives

Seawater surface temperatures (SST) are usually 28-29oC, but can reach 30 or more in shallow near shore areas. The Maldives are reported to experience a mixed layer of relatively saline water (36 ‰) from Arabian Sea which mixes with occasional intrusion of 34 ‰ waters from Bay of Bengal.

6.5.2 Monsoons

The climate of Maldives is characterised by the monsoons of Indian Ocean. Monsoon wind reversal significantly affects weather patterns. Two monsoon seasons are observed in Maldives: the Northeast (*Iruvai*) and the Southwest (*Hulhangu*) monsoon. The parameters that best distinguish the two monsoons are wind and rainfall patterns. The southwest monsoon is the rainy season while the northeast monsoon is the dry season. The southwest monsoon occurs from May to September and the northeast monsoon is from December to February. The transition period of southwest monsoon occurs between March and April while that of northeast monsoon occurs from October to November.

6.5.3 Winds

The wind conditions for the island is dominated by monsoons. These winds approach with great constancy, primarily from the northeast and southwest directions. Some seasonal changes occur within this pattern, as a result of the relative position of the sun and the earth's surface. In general, these seasonal changes in the annual wind regime may be described as follows:

Strong winds and gales are infrequent although storms and line squalls can occur, usually in the period May to October. During stormy conditions gusts of up to 60 knots have been recorded at Malé (data from Maldives Meteorological Services).

Wind speed is usually higher in central region of Maldives during both monsoons, with a maximum wind speed recorded at 18 ms-1 for the period 1975 to 2001. Mean wind speed is highest during the

months May and October in the central region. Wind analysis indicates that the monsoon is considerably stronger in central and northern region of Maldives compared to the south (Naseer, 2003). Annual averages show that wind directions are mostly in W (32%) and E (11%) and NW (10%).

Wind data obtained from Hdh. Hanimaadhoo has been compared with the local conditions recorded in Irufushi Island 12km south east of Vavathi to see the wind direction and speed variation that can take place over a considerable distance (Figure 9).

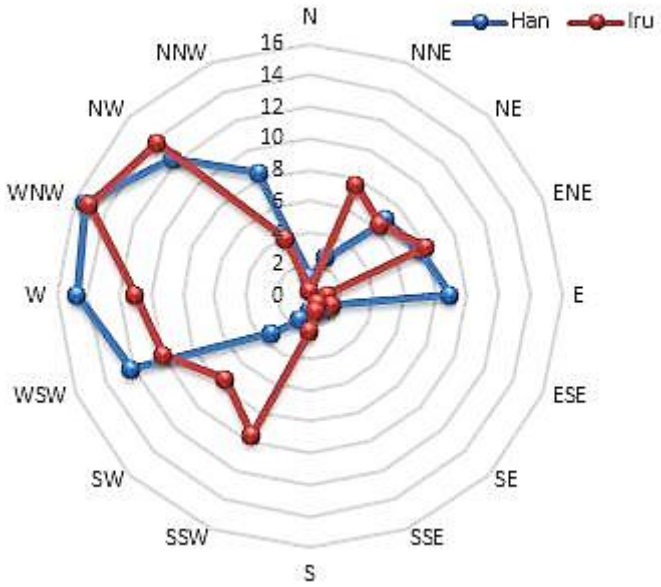


Figure 9: Wind data analysis for N.Irufushi Island and HDh Hanimaadhoo Island; closest islands to N. Vavathi for which weather data is available

The comparison showed significant variation between the wind records from Hanimaadhoo and Irufushi Island in dominant wind direction and speed.

Wind data comparison shows that 73% of the wind is blowing between SSW and NW directions in Irufushi while 69% of the wind direction is concentrated between SWS- NNW directions in Hanimaadhoo Island. Also 15% of the westerly wind has WNW direction in Irufushi while 15-12% of the dominating wind direction in Hanimaadhoo is W and WNW direction. Wind speed recoded from Irusfushi shows that the average wind speed is lower than Hanimaadhoo throughout the year except in June and July, where wind speed is similar or very close between the two islands during this period.

Figure 10 shows monthly local variations in wind characteristics between Hdh. Hanimaadhoo and N. Irufushi which is 14km south east of Vavathi. Considering the distances between N. Vavathi and Hanimadhoo and Irufushi weather conditions in N. Irufushi is more likely to prevail in N. Vavathi.

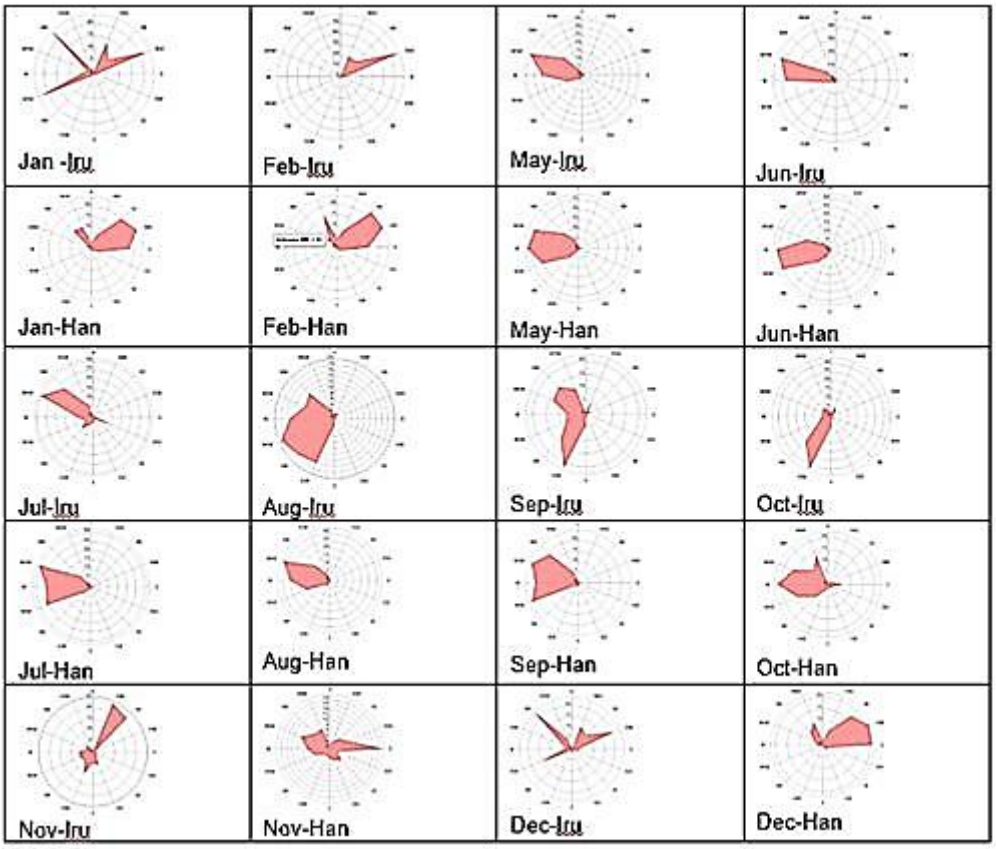


Figure 10: Monthly local variations in wind characteristics between Hdh. Hanimaadhoo and N. Irufushi (Han=Hanimaadhoo, Iru=Irufushi).

Considering the predominant wind directions for both islands studied, the following can be generalised for the expected wind directions prevailing in N. Vavathi.

a) January to July: Winds are primarily from the NW to ENE.
b) August to October: Winds are mainly from the North West to SSW.
c) November to December: Winds are primarily from the NNE to ENE.

6.5.4 Rainfall

Rainfall data for N. Vavathi was obtained from the nearest meteorological station which is at Hanimadhoo Island. Analysis of the rainfall data for the past 20 years (1992-2012) shows high variability from year to year with an average yearly mean of 1778mm as shown in the Figure 8.

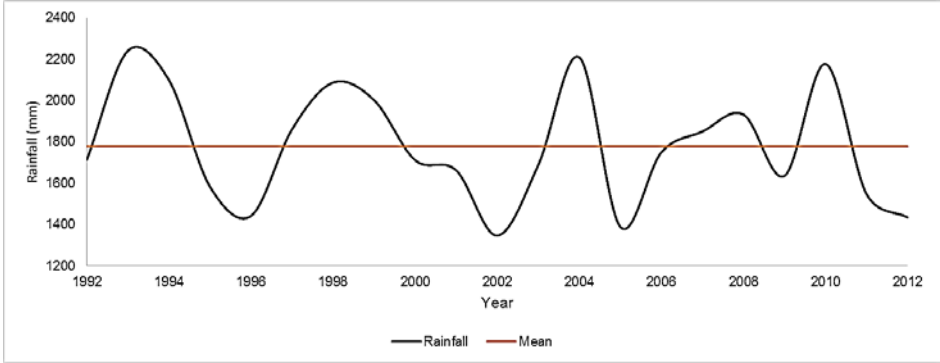


Figure 11: Yearly rainfall for Hanimaadhoo for the period between 2011 and 2012

Month by month analysis of rainfall data for the period 2011 – 2012 shows lowest chances of precipitation for the first quarter of the year. Chances of precipitation being greatest for the period between May – October as shown in Figure 11.

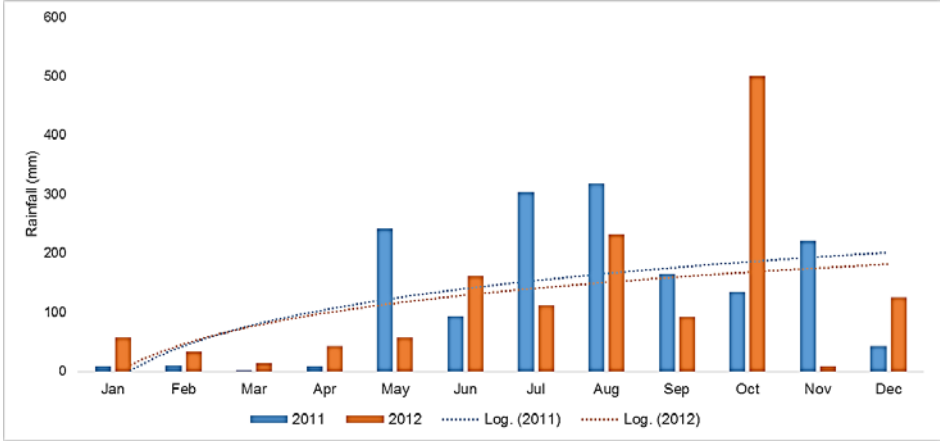


Figure 12: Rainfall for Hanimaadhoo by month 2011 – 2012

Wind and rain fall pattern expected for N. Vavathi show that the higher wind speed during southwest monsoon is coincided with higher precipitation.

6.6 TIDES, CURRENTS AND WAVES

6.6.1 Tides

Tides experienced in Maldives are mixed and semi-diurnal/diurnal. Typical spring and neap tidal ranges are approximately 1.0m and 0.3m, respectively. Maximum spring tidal range in the central atolls is approximately 1.1m. There is also a 0.2m seasonal fluctuation in regional mean sea level, with an increase of about 0.1m during February to April and a decrease of 0.1m during September to November. Like in most other atolls, semidiurnal tides are experienced in Noonu Atoll - that is two high tides and two low tides a day. The tide varies from place to place, depending on the location and on the shape and depth of the basin, channels and reefs and also time of the year. Tidal variations in Maldives are presented in Table 8.

Tide Level	Referred to MSL
Highest Astronomical Tide (HAT)	+0.64

Mean Higher High Water (MHHW)	+0.34
Mean Lower High Water (MLHW)	+0.14
Mean Sea Level (MSL)	0.00
Mean Higher Low Water (MHLW)	-0.16
Mean Lower Low Water (MHLW)	-0.36
Lowest Astronomical Tide (LAT)	-0.56

Table 8: Tidal variation observed at Ibrahim Nasir International Airport (Mean levels reported by the Maldives Meteorological Services).

Astronomical tides are related to the motion of the earth-moon-sun system, and have a range of periodicities. The highest astronomical tide was recorded as 0.64 m above the mean sea level and the lowest astronomical tide was recorded as 0.56 m below the mean sea level. Tidal variation of 1.2m from lowest to the highest tide levels were recorded in the country. Tidal fluctuations (rise and fall of tides) cause changes in current flow pattern around the island and bring subsequent changes in physical aspects of the shoreline. At low tide water movement is very slow, therefore low tide period is considered to be a good time to conduct the jetty construction work.

6.6.2 Currents

Currents which affect the sea area around the Maldives are caused by one or more of the following systems:

a) Oceanic currents
b) Tidal currents
c) Wind-induced currents
d) Wave-induced currents

The oceanic currents flowing across the Maldives are notorious for their strength. The exposure of the Maldives to the vast Indian Ocean ensures that an immense body of water is constantly flowing across the plateau on which the atolls are built. In the Arabian Sea, as one gets closer to the equator, the prevailing winds become more and more indicative of the oceanic surface current. Thus, wind (especially during monsoons) can be a major factor affecting current velocity and direction, and currents can be of great strength (wind-induced currents). For example: currents in the channels near Malé have been recorded at 4 knots or more. Inside an atoll, current speeds are more settled. Oceanographic currents are driven by two monsoonal winds, namely the westerly and easterly wind. The westerly flowing current tend to dominate from January to March while the easterly currents dominate from May to November. The changes in current flow patterns occur in April and December. The current velocities are about 0.5 m/s, only in May values may increase to 0.8 m/s.

The vertical water movements associated with the rise and fall of the tide are accompanied by horizontal water motion termed tidal currents. These tidal currents have the same periodicities as the vertical oscillations, but tend to follow an elliptical path and do not normally involve simple to- and-from motion. Generally the tidal currents are eastward in flood and westward in ebb. Tidal currents, which flow according to the height of the tide, are generally not strong. There is a strong diurnal influence, which governs the tides in the Maldives, but in general the tidal range is less than 1m.

On a more local scale, especially on the reef flats, wave-induced currents (cross-shore and/or long-shore) also form an important factor affecting the current regime.

6.6.3 Waves

The swell and wind waves experienced on the Maldives are governed mainly by the two monsoon periods. Swell caused by cyclonic storms in the area west of Australia may also reach the southern atolls of the Maldives on occasion.

The swells and wind waves experienced by the Maldives are conditioned by the prevailing biannual monsoon wind directions, and are typically strongest during April – July in the south-west monsoon period. During this season, swells generated north of the equator with heights of 2-3m with periods of 18-20 seconds have been reported in the region.

The Maldives also experiences swells originating from cyclones and storm events occurring well south of the equator. It is reported that the swell waves from southeast to south-south-east occur due to strong storms in the southern hemisphere in the area west of Australia with direction towards the Maldives.

Local wave periods are generally in the range 2-4 seconds and are easily distinguished from the swell waves. Due to the shallow depths on the reef flat, significant wave breaking (energy dissipation) will take place at the reef's edge, reducing the wave height of waves, which pass over the reef flat. A general swell forecast and swell periods are available from various weather related websites. These forecasts are very general and it does not reflect local variations in wave period and wave height (Figure 13).

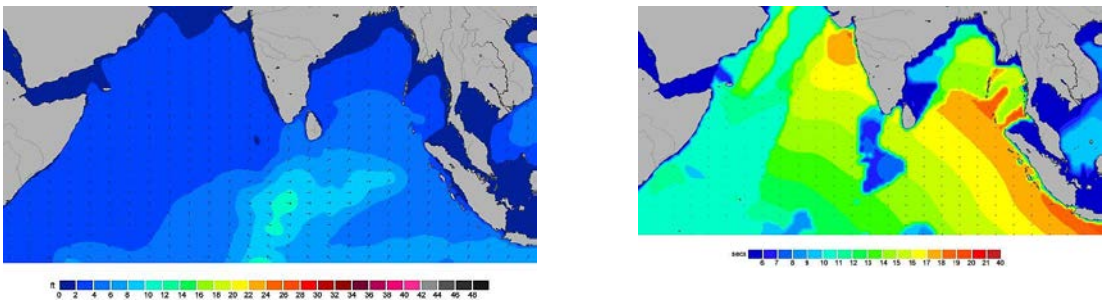


Figure 13: Generalised wave height (left) and wave period (right) prediction for the Indian Ocean on 23rd November 2014 (http://magicseaweed.com/, accessed 4th December 2014)

As per the wind record observations Vavthi Island is subjected to average wind speed of 4-10 knots. Wind speed of 4-6 knots can generate small wavelets with glassy appearing crest without breaking. Wind speed of 7-10 knots can generate large white-capped fetch waves. Irufushi Island shows that wind speed around Vavathi and Irufushi area could reach 20-40 knots at gale, rain and thunderstorms periods. This means that Vavathi region has potential to generate medium-high waves with long wave lengths. It is also expected to experience residual swell waves throughout the year. The western side experiences wind-induced regenerated waves originating from atoll lagoon during SW monsoon and residual waves approaching the reef from the western side.

General wave and current pattern around Vavathi Falhu was assessed using available information and data. The dominant wave direction during NE monsoon will be from north and north eastern side of the reef while during SW monsoon the dominant wave direction is expected to be from west, south and south western side of the reef. The reef is exposed to swell waves from the eastern side.

6.7 TERRESTRIAL ENVIRONMENT

6.7.1 Assessment of Soil

The top most layer (~15-50 cm) had black humus soil. The soil was soft and loose due high composition of decaying leaves (Figure 14). Humus layer is followed by a coarse coral sandy layer which consists mainly of Helimeda flakes (kashiveli) and other organic debris. This was followed by the slightly less, but whiter sand. Tree roots were extending only to humus layer Water level was estimated at 185cm.

Figure 14: Show the various layers of soil observed in the sample pit (left). Humus laden soil on the top layer is contributed by the vegetation – Vavathi July 2018.

6.7.2 Groundwater Assessments

The water table is approximately 185 cm below ground level at MSL, and is subject to vary with tidal fluctuations. Two samples were tested one from the water well near the mosque (sample GW-Well) and the other from water dug well in the farm land in the past (GW-1) Table 9 below shows the parameters tested and the results.

Table 9: Ground water quality test results.

Parameter	GW-Well	GW-1
Physical Appearance	Opaque and cloudy	Pale yellow with white particles
Conductivity (µS/cm)	453	8000
pH	7.38	7.51
Salinity	0.22	4.43
Total Dissolved Solids	226	4000
Nitrate (mg/L)	0.042	0.022
Phosphate (mg/L)	0.15	0.20

6.7.3 Vegetation Cover

Large part of the vegetation cover has already been cleared for agriculture 3.5 hectares and for temporary accommodation of employees during Vela Resort construction 1.4 hectares. Cleared areas are now covered by hip-length bush. Total of the vegetation cleared area is 4.9 hectare. This is about 28% of total vegetation cover of the island. Terrestrial flora surveys of the island revealed typical vegetation comprising of a coastal strip of Magoo (Scaevola taccada), Kuredhi, Boashi and Velan'buli

(Cassyth afiliformis) with an inland community dominated by Ruh (Cocos nucifera) particularly on the central and eastern part of the island. Areas of domination certain types of trees such as Magoo, Kuredhi Boashi were observed on the outer vegetation line. Figure 15 shows examples of vegetation cover on the island.

Figure 15: Snapshots of vegetation cover in Vavathi island

The flora of the Island is presented in Table 10, and these flora have widespread distribution throughout Vavathi Island and is commonly found on other islands of the Maldives. Most commonly occurring coastal plant is Guettarda speciosa (uni), Pemphis acidula (kuredhi), Cordia subcordata (kaani), hirundhu, Scaevola taccada (magoo) and Hibiscus tiliaceus (dhiggaa). Changes in the vegetation of the island is shown in Figure 16.

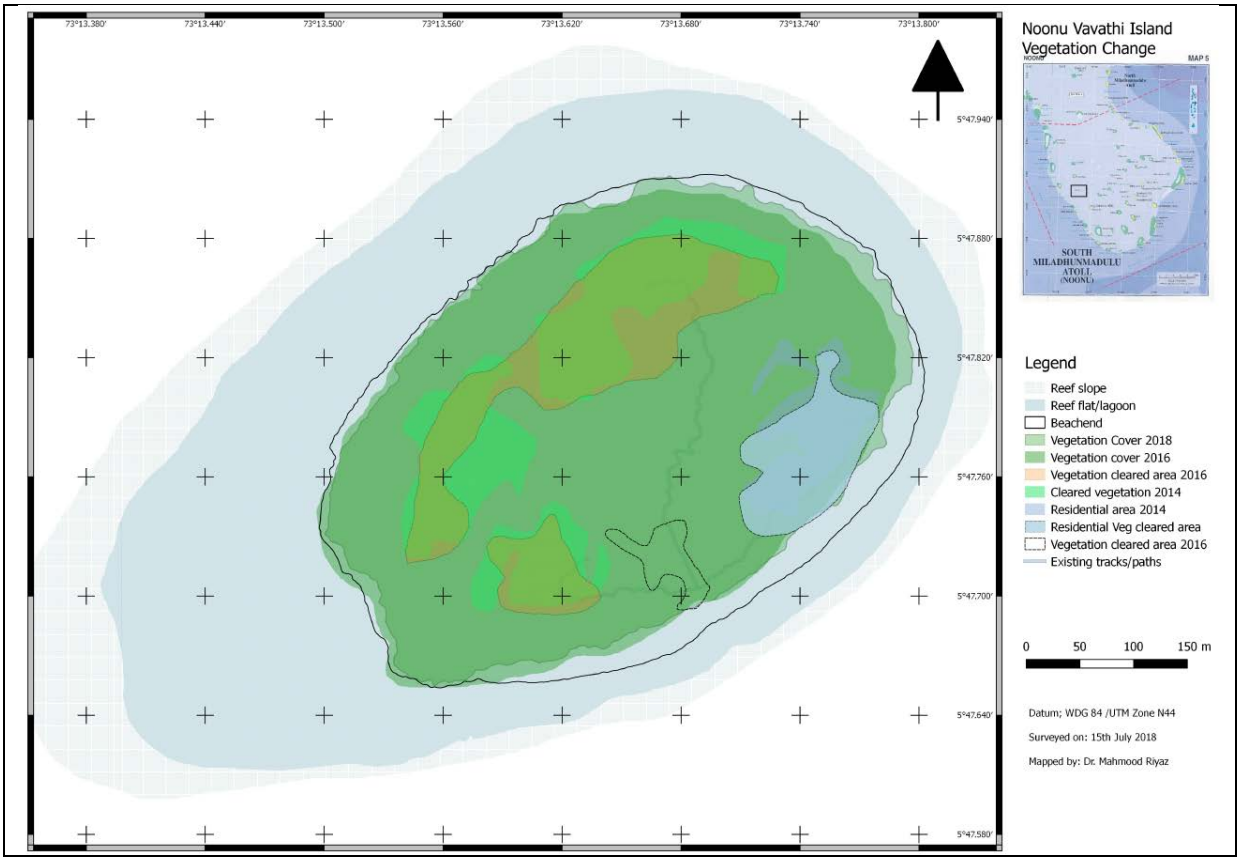


Figure 16: Vavathi Island change in vegetation cover 2014-2018

Table 10: Coastal vegetation occurrence at the project site showing the abundance and growth form [(D) Dominant, (A) Abundant, (F) Frequent, (O) Occasional, (R) Rare]

Scientific Name	Common Name	Occurrence (DAFOR Ranking)	Growth Form
Cocos nucifera	Coconut	A	tree
Hibiscus tiliaceus	Beach hibiscus	A	
Pandanus odoratissimus	Wild screw pine	F	
Banyan tree	Ficus benghalensis	R	
Terminalia cattapa	Tropical almond	R	
Cordia subcordata	Cordia	F	
Scaevola taccada	Scaevola	F	
Tournefortia argentea	Tree heliotrope	F	
Pemphis acidula	Pemphis	F	
Ipomoea pes-caprae	Beach morning glory	R	vine

A network of Narrow paths connecting with the agriculture areas exists in the island. Large excavated areas ground water wells exist in various parts of the island. These excavated wells have freshwater fish in it. It seems that these wells were used for extraction of water for irrigation for agricultural farm land in the past. Plants from the previous farming practice such as papaya, guava etc., are still remaining on some parts of the island.

6.7.4 Ruins, buildings and debris

As mentioned earlier, the island was used for agriculture and later on it was used as an accommodation camp for construction workers during the Velaa resort construction period. Various types of building ruins and wares were found in various parts of the island. As such building ruins and abandoned buildings, a reefer container kitchen and toilet wares, wood and steel wares and structures are concentrated on the north eastern part of the island. There is also an abandoned steel barge on the eastern beach near the jetty. The barge is not usable and it is acting as a groyn to accumulate and trap sand which is affecting the coastal dynamics of the island. The barge has to be removed and the beach has to be cleared. A ruin of an access jetty which is no longer usable exists on the eastern side. It is suggested to construct the new jetty on the footprints of the ruined jetty. Figure x shows the building ruins and abandoned wares, debris found on the island.


Abandoned Barge


House built of coral rock


Small Mosque usable


Frames of equipment Debris


Agriculture field


20 foot container


Accommodation blocks


Debris


Accommodation blocks


Debris


Debris


Accommodation blocks

Figure 17: Ruins debris and abandoned buildings in the island

6.7.5 Coastal dynamics

Coastal dynamics of the island was studied by using historical aerial photographs google earth images and comparison with the recent survey of the island. The study shows that there is a very dynamic beach on the island which forms a sand spit (Thundi) on the south western side during the easterly monsoon mainly January and February. In the westerly Monsoon most of the sand around the island distributed fairly evenly on eastern side creating a wide beach on the eastern side and exposing beach

rock on the western and south western side of the island (Figure 18). The presence of abandoned barge is disturbing the natural sand shifting process and interrupting the movement, creating an imbalance in distribution of sand on either side of the barge. Figure 19 shows coastal dynamic around island.

Figure 18: Beach around the Vavathi Island

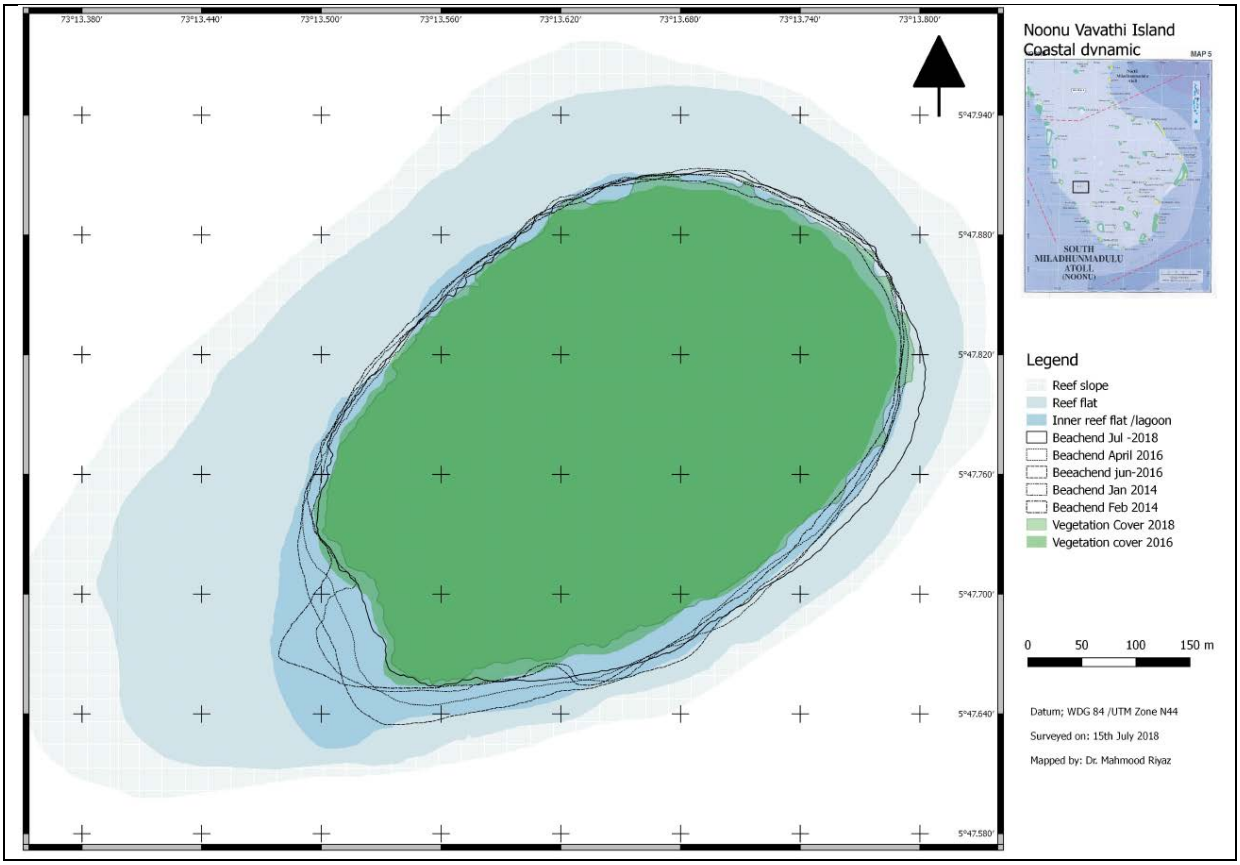


Figure 19: coastal dynamics around Vavathi island showing the seasonal changes

6.7.6 Habitats and species of concern

The island does not have any particular or unique habitat, neither it has any flora or fauna that needs to be given special attention such as those that needs to be given status of protection, conservation or special management under Environmental Protection Act of Maldives. It is typical of a number of islands found in the Maldives. However the large Banyan tree in the island can be considered as an old tree that need to be protected.

6.8 MARINE ENVIRONMENT

Noonu Vavathi is oval shape, with NE-SW orientation and its narrowing tip pointing towards the SE. At present Vavathi reef is approximately over 900m long and 500 wide, and has an area of approximately 43.4 ha. The island occupies 40% of the total reef area, which makes the reef a largely saturated reef. Overall the lagoon on the eastern side of the island narrow and has a fairly uniform depth ranging between 0.9-1.5m. Western side of the shallower than eastern side but the lagoon is wider. Water depth on the western side lagoon is within the range of 0.3-1m.

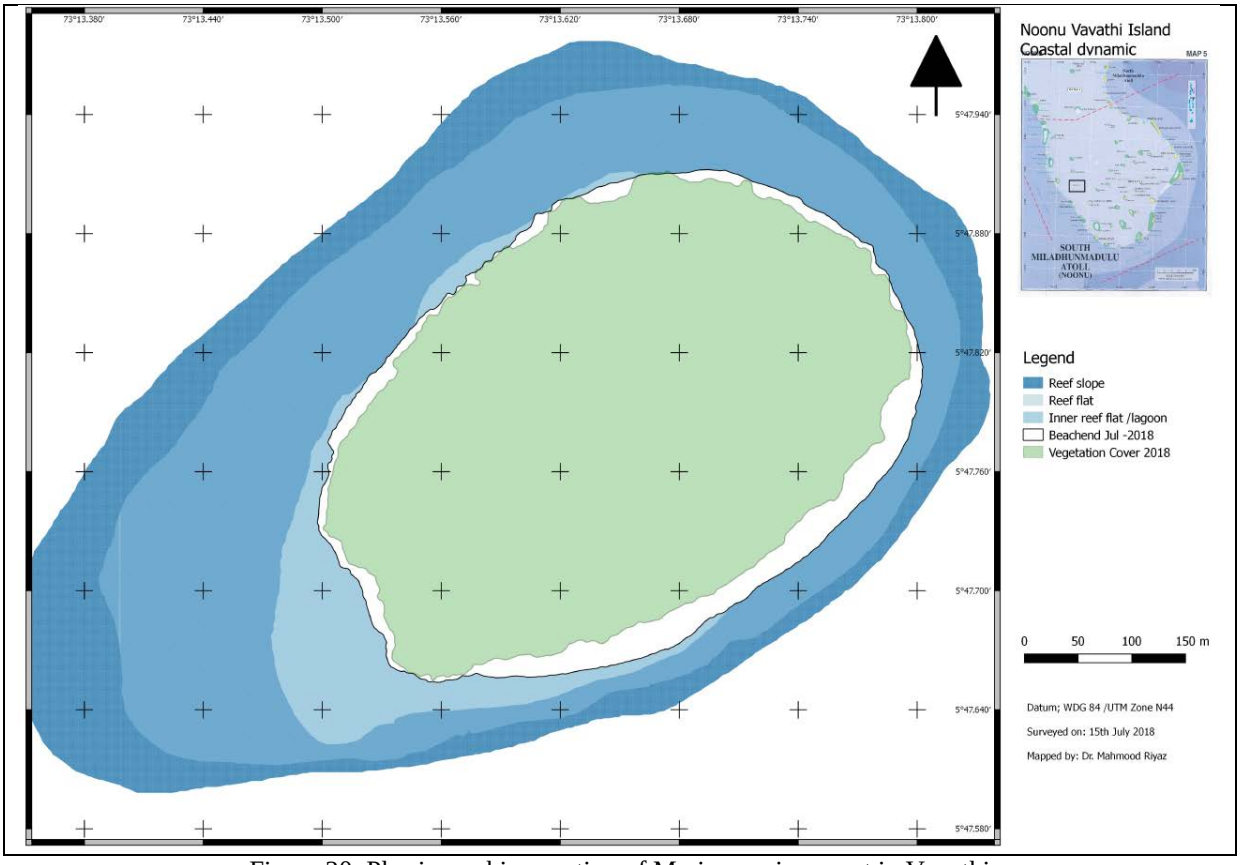


Figure 20: Physiographic zonation of Marine environment in Vavathi

The above Figure 20 summarizes the physiographic zonation of the marine environment including shallow lagoon areas, reef flats and slopes around, coral patches within the lagoon as well as presence of beach rock on the southern side of the island.

6.8.1 Beach Rock

Beach rocks are observed to be present on the entire North, East and Western, sides of the island. A 2-4m wide shore adjacent beach rock that runs continuously from the eastern tip of the island to the western tip was observed. Beach rock series sloping on opposite directions was observed on the north western tip of the island (Figure 21). Shore perpendicular beach rock series were observed on the western side between NW and SW tip of the island. The length of these beach rock series are over 50m and the width is between1- 2.5m. Beach rock formations are believed to be acting as a barrier for seasonal sand movement around the island. Also, areas where beach rock was observed, beach erosion were quite prominent (Figure 22).


Figure 21: Beach rock on the NW tip of the island, sloping opposite directions

Figure 22: Severe erosion beach rock covering larger part of the western side of the island

6.8.2 Sea Grass

No sea grasses have been observed to be currently present within the lagoon of Vavathi Island.

6.9 PROTECTED AREAS AND PROTECTED SPECIES

Under the Environmental Protection and Preservation Act of Maldives (Law No. 4/93) several Marine Protected Areas (MPAs) have been established in the Maldives. Currently there are 35 MPAs established throughout the central atolls of the Maldives. These MPAs have been established for various reasons including protection of rich biological diversity, protection of rare and threatened species, protection of flagship species, protection of seascapes as well as protection of popular dive spots amongst tourists.

Currently there is no Marine Protected Area in Noonu Atoll, the nearest Marine Protected are to Vavathi is Villingili Thila situated on the southern periphery of Raa atoll.

A number of marine species currently protected, exploration, fishing and export banned under the Fisheries Law of Maldives (Law No. 5/87) have been found from the reef of Vavathi. These include giant clams, parrotfish, chromis, nurse shark and lobsters.

Turtle nesting areas were observed during the field trip on the eastern beach of Vavathi. Photographs of the observed turtle tracks and their locations are given below. According to locals Vavathi island is a turtle nesting site.

Figure 23 Fresh turtle nests were observed in two location on the eastern side

Marine Water Quality Tests

Marine water samples were collected from lagoon; The results of seawater laboratory analysis are shown in in Table 11 and the original is provided in Annex .

Table 11: results of Seawater analysis

Parameter	**SW-1**
Physical Appearance	Cloudy with particles
Conductivity (µS/cm)	51500
pH	8.11
Salinity (%)	33.77
Total Dissolved Solids mg/L	25700
Turbidity (NTU	1.33

6.10 SOCIO-ECONOMIC ENVIRONMENT

6.10.1 Geographic Context

Bodu Thiladhumathi Atoll is the second largest natural atoll of the Maldives. Administratively it is divided into four; Haa Alif (HA) Haa Dhaal (Hdh), Shaviyani (Sh) and Noonu (N) atolls. A total of the thirteen islands are inhabited and 54 islands are uninhabited in Noonu Atoll. Five resorts are operational and more than 10 islands are ear-marked for tourism development.

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6.10.2 Population and Housing

Summary data for the most recent censuses are shown in Table 7. The population of the Noonu atoll was stable around 11242 in 2014 and 10015 in 2006. The total population of the Atoll is 11,242 which is 3.08% of the total population of the country. Average annual population growth rate of the Atoll is 0.57. Manadhoo with a population of 1408 is the capital of Noon Atoll, but Holhudhoo Island has the highest population 1682.

South Miladhunmadulu (N)

Locality	Population 2014									Maldivian Population 2006			Maldivian Population 2014			
	Total			Maldivians			Foreigners									
	Both Sexes	Male	Female	Both Sexes	Male	Female	Both Sexes	Male	Female	Both Sexes	Male	Female	SEX RATIO Males per 100 Female	INTER-CENSAL AVERAGE ANNUAL GROWTH RATE 2006 -2014	SHARE OF POPULATION IN LOCALITY %	
Total	12,837	6,942	5,895	11,100	5,391	5,709	1,737	1,551	186	10,015	4,589	5,426	94	1.21	100.00	
Administrative Islands	11,242	5,429	5,813	10,513	4,818	5,695	729	611	118	10,015	4,589	5,426	85	0.57	94.71	
Henbadhoo	497	192	305	483	187	296	14	5	9	396	160	236	63	2.34	4.35	
Kedhikolhudhoo	1,331	606	725	1,293	578	715	38	28	10	1,204	565	639	81	0.84	11.65	
Maalhendhoo	667	327	340	634	308	326	33	19	14	561	278	283	94	1.44	5.71	
Kudafari	480	239	241	439	210	229	41	29	12	373	166	207	92	1.92	3.95	
Landhoo	668	295	373	655	287	368	13	8	5	582	258	324	78	1.39	5.90	
Maafaru	616	300	316	603	294	309	13	6	7	710	305	405	95	-1.92	5.43	
Lhohi	611	302	309	567	265	302	44	37	7	552	272	280	88	0.32	5.11	
Miladhoo	809	350	459	790	335	455	19	15	4	784	336	448	74	0.09	7.12	
Magoodhoo	258	128	130	255	126	129	3	2	1	209	92	117	98	2.34	2.30	
Manadhoo	1,408	714	694	1,307	630	677	101	84	17	1,201	565	636	93	1.00	11.77	
Holhudhoo	1,682	771	911	1,556	657	899	126	114	12	1,527	680	847	73	0.22	14.02	
Fodhdhoo	228	110	118	215	100	115	13	10	3	200	90	110	87	0.85	1.94	
Velidhoo	1,987	1,095	892	1,716	841	875	271	254	17	1,716	822	894	96	0.00	15.46	
Resorts	1120	1039	81	493	480	13	627	559	68	0	0	0	NA	NA	4.44	
Industrial Islands and Others	475	474	1	94	93	1	381	381	0	0	0	0	NA	NA	0.85	

7

Figure 24: Population distribution in Noonu Atoll (Source: Census 2014)

The total number of households found in the atoll is 1810, hence, the average household size is 5.5 persons. Majority of the households (47%) have a land plot area greater than 1,000ft2 having 3 or more rooms (Greentech, Riyan and CDE, 2010).

6.10.3 Health and Education

Noonu Manadhoo hospital located in at the capital of Atoll is the largest health care facility Noonu atoll. The nearest regional hospital is in Raa Atoll. All other islands are served with either a health center or a health post. Overall access to health is available for approximately 94.5% of the population, however, only 24.3% reported that access to health services in the atoll is easy (Greentech, Riyan and CDE, 2010).

Generally the literacy rate is high in Noonu Atoll approximately 96%. There are over 20 schools in Noonu Atoll, which includes 20 Pre-primary, 13 primary, 12 lower secondary and 2 higher secondary schools. Currently only 2 schools in the atoll located in Holhudhoo and Manadhoo are up to GCE A' Level (Isles website). The majority of the school goers are studying in the secondary level having 32.2% from Grades 6 – 12 followed by primary school goers are studying in the primary level having 29.2% from Grades 1 – 5 (Greentech, Riyan and CDE, 2010).

6.10.4 Water, Sanitation and Energy

92% of the population of Noonu Atoll have access to safe drinking water of which the majority of water that is used daily come rainwater having 98.5%. Rainwater is mostly collected from the house and public building roofs and stored locally. About 1.1% of the population use well water as a drinking water source, while only 0.2% of the population use bottled water or mineral water as a drinking water source.

Although 97% of the population in Noonu Atoll have access to sanitation services, the majority of the population use septic tanks having 96%. About 2% use pit toilets and 2% do not have access to sanitation.

6.10.5 Electricity

In 1997, about two thirds of the islands electricity is available for only 6 hours a day, however, now all islands have access to 24 hours electricity.

6.10.6 Waste Management

Due to the rapid population and changing life styles in the islands, waste generation is getting increased annually. Due to the absence of proper collection and disposal facilities segregation of waste is very low. There is very little waste segregation undertaken even at household level in Noonu Atoll. Most of the waste generated in the atoll are managed by open burning having 99.6%, while 0.4% dispose waste to landfill sites. Most islands in Noonu Atoll have Island Waste Management Centers (IWMCs) for waste collection purposes.

6.10.7 Local Economy

The main economic activities in the islands of Noonu Atoll are fisheries and agriculture. Almost all islands are involved in fishing activities. Agriculture is also practised in many islands, however, mostly done at a household level. Activities of trading is also an integral part of the local economy where goods brought from Male' are traded in the islands.

According to the Census 2014 there are about 7000 people above the age 15 and 4070 people which can be considered as the labour force. 3900 people out of 4070 are employed and 170 (only 4%) are categorised as seeking employment or unemployed.
The people of Noonu Atoll are employed in various types of industries. Types of industries and number of people from Noonu atoll employed in each inductial activity is given below

Table 12: Number of employed resident Noonu Atoll population 15 years of age and over by industry

	Total employed	Agriculture Forestry and Fishing	Mining and Quarrying	Manufacturing	Electricity Gas Steam and Air conditioning supply	Water supply; Sewerage Waste management and remediation activities	Construction	Whole sale and retail trade, Repair of motor vehicles and motorcycles	Transportation and Storage	Accommodation and Food Service activities	Information and Communication	Financial and Insurance activities	Real estate activities	Professional scientific and technical activities	Administrative and Support service activities	Public Administration and Defense, Compulsory Social Security	Education	Human Health and Social Work activities	Arts Entertainment and Recreation	Other service activities	Activities of households as employers, undifferentated service producing activities of households for own use	Activities of Extra-territorial organizations and bodies
South Miladhunmadulu (N)	3,900	465	22	1024	116	4	166	291	119	347	10	9	0	4	92	379	547	175	5	67	23	1

Tourism has been growing in Noonu Atoll. Most luxurious high end resort exists in this atoll. Currently there are 5 tourist resorts and 4 guest houses in operation in the Atoll. The total of 878 tourist beds is in the Atoll, this is about 2.5% of the total tourist beds in the country. A total of the 10 islands have been ear-marked for resort development. However, today only 5 resorts are in operation.

Most of the employed labour force is engaged in salaried jobs covering 25% while self-employed percentages reach 18% and fisheries related employments are over 10% (Greentech, Riyan and CDE, 2010). Over 53% of the households in the atoll receive an income between 100,000 –m 200,000 annually and 30% receive an income less than 75,000MVR.

7 STAKEHOLDER CONSULTATION

The EIA scoping meeting of the project was held on 10th June 2018 at the meeting room of Environmental Protection Agency, Green building During the scoping meeting held at EPA on 10th June consultation relating to the project took place and officials representing Ministry of Fisheries and Agriculture, Environmental Protection Agency, Ministry of Environment and and Mr. Mohamed Rasheed as the representative of the proponent – of Vavathi island were present at the meeting. Apart from the scoping meeting consultation with the following stakeholder groups were separately held.

1- Holhudhoo Council
2- Noonu Atoll Council (Telephone communication)

7.1 METHODOLOGY.

First the introductions of everyone were made. It was followed by the introduction of the consultants and brief explanation of what the EIA is all about. Following the proposed development project was explained including the key development features. After the briefing the floor was opened for general remarks and issues they may have on any aspect of the project. Points of concerns from the various discussions are presented below.

7.2 SCOPING MEETING -EPA

The consultant presented an over-view of the proposed agriculture development project in Noonu Vavathi island. The consultant gave a background and explained the sustainable and environmentally friendly nature of this project and how it is going to introduce vertical hydroponics systems also other activities proposed to undertake in the island such as open filed farming, free range poultry farming and fish packing facility proposed in the island. He also gave noted that the island seems to have used for agriculture in the past as large area has already been cleared. Furthermore the consultant explained that the existing footprints in the island will be used for the proposed development and vegetation clearance (removal of mature trees) will be minimized as much as possible.

7.3 NOONU ATOLL COUNCIL

As part of the consultation process the consultant has discussed the development with Noonu Atoll council president Ali Zafir and Council Member Rausham in two spate telephone communication on 4th July 2018. The consultant gave an over-view of the proposed agriculture development project in the Vavathi island and a background on the type of farming that is proposed to conduct. Also explained how it is going to be sustainable and environmentally friendly. He also informed the council member how the proponent got the island through the bidding process. Also he inquired if they are aware about agriculture that has been conducted in the island in the past and if the island has still being used by anyone.

In General the atoll council is very much in favor of the project and they want the practical work of the project to start as soon as possible. The Atoll council is hoping that the nearby island will greatly benefit from the development directly and indirectly through creation of employment opportunities during construction and operational phase of the project, increased income, improved services and flow of much needed foreign currency into the economy. They also somehow expressed their grievances about some of the ongoing project which do not contribute and assist the island community

needs. The consultant had expressed his hopes that this project will have some important CSR component within the proposal hence, the community will be benefiting from the project. They are on the opinion that the project will contribute to improvement of public facilities and infrastructure, general improvement of social conditions and service industry activities, in addition to the increased agriculture and economic infrastructure.

7.4 HOLHUDHOO COUNCIL

N. Holhudhoo council was invited for the consultative meeting during the field trip that took place 15-16 July 2018. The consultation was held with the president of Holhudhoo Council Mr. Mohamed Naseer in Digi Coffee shop. The consultant gave an over-view of the proposed agriculture development project in Vavathi Island and a background on the type of farming and other activities that is proposed to conduct on the island. Also explained how it is going to be sustainable and environmentally friendly and how it is going to introduce fairly advanced type of vertical hydroponic farming that will be very useful for grow plants in confined spaces.

The consultant opens the discussed the development with the council and requested to raise any concern if they have and/or to express their expectations from the project and overall benefits expecting for the livelihood of the community particularly for improvement in their agricultural practices.

The council is very much in favor of the project and they want the practical work of the project to start as soon as possible. The council believes that the island will greatly benefit from the development directly and indirectly through creation of employment opportunities during construction and operational phase of the project, increased income, improved services and flow of much needed foreign currency into the economy. They also believe that the island community can learn good farming practices from this project which will be an important indirect benefit from the project. The council also requested as part of CSR to conduct information and awareness workshops on farming practices and technologies as well as marketing and management of agricultural produce. They also expect from the project to contribute to the developmental activities and community activities in the future. The council is at the opinion that there will be no conflict of interest in terms of the competition for marketing agricultural products as the scale and types of the produce from the proposed activities will be very different from the on-going agriculture practiced in the Atoll.

In response to public requests regarding information and awareness activities the consultant said that the matter will be brought to the proponent of the project and it is very likely that naturally similar activities will be conducted for the farmer of nearby islands.

At the end the council reaffirmed that they will give their full support and cooperation for the project and expressed that they are eagerly looking forward to see the practical implementation of the project activities in the island. They strongly believe the people of the Atoll particularly Holhudhoo island will directly and indirectly benefit from the project.

7.5 CONSULTATION WITH MFDA

Stakeholder consultation with Maldives Food and Drug Authority (MEA) was held at 11.30am with Shathish Mousa. MFDA confirmed reiterated that their responsibility lie in health and safety issues of the products. MFDA's primary role is to ensure the process of production follows internationally accepted norms of HACCP (Hazard Analysis and Critical Control Points). As such their role at this stage of the proposed project will come after the construction and before the start of operations. But

he indicated that MFDA is working on adoption of GAP (Good Agriculture Practice) certification by FAO in agriculture sector. The consultant reaffirmed that they will look into the matter very seriously and will probably try obtain either prior to commencement of firm operation or at an early stage of the operations.

7.6 CONCLUSIONS OF STAKEHOLDER CONSULTATION

Following conclusion can be drawn from the various consultations held with stakeholder. The Atoll council is in favour of the project and they want the practical work of the project to start as soon as possible. They also hope that the project will contribute and assist the island community needs through CSR component.

Holhudhoo council is very much in favour of the project and believes that the island will greatly benefit from the development directly and indirectly through creation of employment opportunities during construction and operational phase of the project, increased income, improved services, learning good farming practices and flow of much needed foreign currency into the economy. Holhudhoo Council requested to conduct information and awareness as part of project CSR and expect from the project to contribute to the developmental activities and community activities in the future.

MFDA's role at this stage of the proposed project will come after the construction and before the start of operations. MFDA is working on adoption of GAP (Good Agriculture Practice) certification by FAO in agriculture sector. MFDA recommended that the Vavathi firm to consider obtaining GAP certification for their produces.

MoFA is looking forward for successful implementation and start of project work and the ministry's policy is to ensure that the proposed development in the island to go ahead as planned.

Table 13: List of participant their contact details list of people attended public consultation is given in Annex 9.

Name	Office/Designation	Contact
Rifath Naeem	EPA/Director	Rifaath.naeem@epa.gov.mv
Ali Mishal	EPA	7766659
Mohamed Naseem	ADG/ MoFA	7953545
Mohamed Rasheed	Proponent's Representative	7784117
Dr. Mahmood Riyaz	Consultant	7890307
Mohamed Naseer	Holhudhoo Council President	
Ali Zafir	Atoll Council President	779736
Rausham	Atoll Council Member	7779864

8 POTENTIAL IMPACTS AND MITIGATION MEASURES

8.1 INTRODUCTION

Various methods are available to identify the extent, magnitude and significance development impacts of the project. Some of these include simple checklists, matrices, expert opinion, modeling etc. Impacts from the proposed activities, both during the construction and operational phases have been identified through consultation with the project management team, assessment during field surveys, observations and expert judgment based on previous work of similar projects (eg. Dhandhoo)[8]

Other sources of information have been used wherever possible. Data collected during field surveys can be used to predict outcomes of various operational and construction activities on the various related environmental components. Data presented in this report can also be used as a baseline for environmental monitoring of the project activities for future reference for environmental change relative to the baseline.

Possible impacts arising from the construction and operation works are categorized into reversible and irreversible impacts. Reversible and irreversible impacts are further categorized by intensity of impacts (negligible, minor, moderate and major) for identifying best possible remedial (mitigation measures) action to be taken. Below are the impact categories

- Negligible: the impact is too small to be of any significance (Reversible)
- Minor: the impact is undesirable but accepted (Reversible)
- Moderate: the impact give rise to some concern but is likely to be tolerable in short-term, or will require value judgment as to its acceptability (Reversible)
- Major: the impact is large scale giving rise to great concern; it should be considered unacceptable and requires significant change or halting of the project (Irreversible)

Leopold Matrix have been used to classify the magnitude and importance of possible impacts which may arise during the constructional and operational phase of the of the proposed Project on . Leopold Matrix is the most widely used methodology for identifying the impact of a project on the environment. It is a two-dimensional matrix which cross references between the activities which are foreseen to have potential impacts on the environment and the existing conditions (environmental and social) which could be affected. Leopold Matrix for the proposed development activities on is provided Annex 4.

8.2 IMPACTS AND MITIGATION MEASURES

8.2.1 Construction phase

Impacts from Mobilization of Equipment and Workforce: Clearing of vegetation would be necessary to setup the small workforce about 10-20 workers on site. If proper attention is not paid workers in the island could easily disturb the island fauna. Inappropriate land disposal of domestic and sewage waste has the potential to degrade and pollute the local aquifer. The plastic wastes generated would have to be stockpiled away from the construction site until the Island's waste management system become fully functional. The food wastes will be composted even during the

[8] Adam, M. S. and M. Riyaz (200x). Environmental Impact Assessment of Dhandhoo ---

construction phase Disposal of hazardous waste and sewage may be a concern if not appropriately dealt with.
Given the scale of the proposed activities it is not expected work will be limited to what is absolutely required as prescribed in the Project Description.
Mitigation Measures:

- Areas should be clearly marked for construction activities.
- A specific area should be designated in the coastal area for landing and material loading/unloading. This should be beside the existing jetty.
- Vegetation that needs to be retained must be clearly marked and communicated to the construction workers.
- Signs should guide workers to proper environmental care.
- A portable desalination plant should be installed for potable water. Alternatively one-time use of plastic bottles may be brought, but should be disposed appropriately.
- The supervisor should check compliance of the workers to the environmental guidelines set for the project including avoidance of removal of unmarked vegetation, proper waste management, marine water pollution and ground water pollution.

Mitigation cost: included in the project

Clearing of vegetation: Clearing of some vegetation would be required for three major activities identified in the proposal i) vertical farming ii) open-field agriculture iii) fish-packing. In addition to this civil works for (accommodation, office, kitchen, dining, powerhouse, desalination plant, mosque and fish packing building) will alter the existing landform characteristics. It will inevitably result in the loss of about 10% of the island's vegetation. The existing flora is not considered unique or particularly unusual. Main negative effects of clearing of vegetation will include reduced number of resident birds and bird visits to the island, reduced open space qualities, reduced scenic views and vistas, alteration of the local climate and exposure of island soil for erosion.

Mitigation measures for loss of species:

- Any large tree or shrub that fall within the allocated area for various infrastructure developments will be made available for replanting elsewhere in the island.
- Vegetation clearing will be conducted in stages so that clearing will take place only when required;
- Introduction of plants from abroad will be avoided instead plants in the infrastructure development plots will be relocated to appropriate areas;
- An appropriate education program among workers to refrain from damaging vegetation unnecessarily;
- Avoiding use of imported cow dung manure or inorganic fertilizers for landscaping purposes; and
- Prohibiting catch and keeping birds (except poultry) and exploitation of turtle nests on the Island by the workers;
- Most of the large and mature trees removed will be made available for replanting elsewhere in the island.
- Strict guidelines and construction monitoring is required during the vegetation removal stage to ensure that every single large tree could be replanted.

- All clearing works will be carried out during day time to minimise disturbances caused to nocturnal fauna such as birds and fruit bats that uses auditory communication.

Mitigation cost: Included in the project

Coastal development Works: Jetty: The existing jetty needs to be refurbished. This would involve removal and repositioning of stilts and redoing of the cross-planks for strengthening. This development will have negligible impact on the coastal processes of the island and might make minor alterations to the current and sediment regime.

Vertical Hydroponics System: The activity involves assembling of series of the PVC pipes placed horizontal and vertical where the nutrient-laden water would run along the pipe system. Construction would release PVC shaving and chipping from sawing of pipes. These would have to be collected and disposed adequately. The area will be covered with shading nets or with polyethene material, for the latter case to provide greenhouse effect. This would require a metal frame which will be welded on site.

Mitigation Measures:

- Cut or saw the PVC pipes in a single area so as to avoid dispersing of the shavings and dust.
- Remove all empty PVC adhesive containers.
- Vegetation clearings should be treated as stated earlier.

Mitigation cost: Included in the project

Fish packing area: The development is essentially a civil work. General principles standards of good practice should be followed. Site clearance has been addressed earlier. The facility is not large and so is limited to construction of the building and installing machinery (fish cutting and for packing). Construction waste would be an issue if not properly removed and disposed after the work is completed. These should be properly disposed including packing material from machinery.
Mitigation cost: Included in the project

Open-field agriculture / poultry area: The activity has been described in the Project Description. During the construction phase it is unlikely to have any impact. It is proposed to have the area fenced so that animals (chicken and turkey) would be limited to roam with the confines of the area. It is expected the area demarcated for this activity would be in the less dense open space on the island as shown in the Figure 2.
Mitigation cost: Included in the project

Noise, Vibrations and Air Pollution: The types of noise generated from the operational activities on is unlikely to affect fauna in adjacent habitat. During mobilisation of equipment and operation of machinery for vegetation removal, it is anticipated that significant noise will be generated. These would be only for a short period and would not affect bird population.

Mitigation measures:

- All construction works will be carried out during day time to minimise disturbances caused to nocturnal fauna such as birds and fruit bats that uses auditory communication.
- All vehicles and machinery will be tuned and well maintained to minimise air pollution

- To minimize dust from construction works ground/soil will be kept damp.

Mitigation cost: Included in the project

Greenhouse Gas Emissions:

Vegetated areas are known to act as carbon sinks for greenhouse gases particularly carbon-dioxide. The proposed project involves clearing of vegetation during site preparation. However, any large trees that are removed will be replanted on other areas.

On-site diesel engine generators will be the main source of energy for operating machinery such as desalination, pumping, cooling, drying and lighting at the island. This would contribute to air pollution and greenhouse gas emissions.

Savings on electricity will be achieved through energy saving lights installations, use of energy efficient appliances and by placing awareness rising messages at the appropriate locations of the island.

Mitigation Measures:

- All mature trees will be re planted where possible.
- Only vegetation that is absolutely necessary to be removed will be cleared.
- Waste will be properly stockpiled temporarily on site and disposed at a designated disposal site.

Mitigation cost: Included in the project

8.2.2 Operational phase

Operation of desalination unit: Dilution of small volume of brine produced by the RO units and discharged into the outer back-reef area will instantly mix and its effects would be negligible. The discharge point will about 5-10m away from the reef flat where mixing of the discharge with the seawater will be greatest It is recommended to have the outfall 3-5 m below for instant mixing.

Wastewater: Disposal of untreated wastewater on land or marine environment has the potential to produce detrimental impacts. Disposal on land can contaminate the groundwater while disposal into nearshore may cause eutrophication leading to development of seagrass meadows or algae. It is recommended to that wastewater from toilet flushing will be collected via a system of gravity lines, junctions and pumping stations to a central septic system for treatment and disposal.

It is recommended to use to septic tank system for treating toilet effluents. The septic system, when performing properly, safely treats and disposes of sewage without creating any danger to human health or to the environment.

To lengthen the “retention time” of the wastewater in the septic tank for enhancing purification, possible measures will be taken to reduce unnecessary discharge and too a large a volume of water at once into the septic tank. The amount of water entering the septic system will be controlled through the following practice. The laundry and kitchen wastewater will not be allowed into the tank instead it will directly pass into drainage well. If allowed into the septic tank the laundry wastewater is believed to slow down the microbial processes in the tank.

Hydroponics System: The operation of hydroponics system to grow micro green require nutrient rich medium to for the plants in the system. Rarely does it need to be cleaned. But in such cases, the waste water may be diluted and dispersed in the open area. Packing of the products would be produce organic waste which can be used as fertilizer of feed for the animals. Old PVC material that gets replaced should be disposed adequately.

Mitigation cost: Included in the project

Open Field Agriculture / Poultry: Agriculture plots may require applying organic fertilizers and pesticides. This is quite common, although often indiscriminate application is becoming an issue. The proponent is aware of these issues. Fertilizers if absolutely required should be applied sparingly for both animal waste (cow-dung) and chemical fertilizers and both have the potential for environmental pollution. Organic manures contain Nitrogen-rich material, high extractable nutrients, e.g., Phosphorous, Potassium, Calcium, Magnesium, Copper and Zinc. These can significantly raise soil fertility in the medium to long term. Continued application of organic manure will increase levels of soil nutrients, and cause a buildup of some nutrients, but at the same time loss of nutrients to environments. In the context of Maldives this may not be an issue since there are no rivers for them be carried to the sea. However, during heavy tropical down pours flooding may occur resulting, in some cases, run-off to the sea. Excessive application over long periods of time may also contaminate the fresh water layer. Local knowledge about indicates such an event would be relatively rare.

In general application of fertilizers should be kept minimal and fertilizer used should be approved by the Ministry of Fisheries and Agriculture. It would be helpful to have written instruction (dos and don'ts) posted somewhere visible and provide instructions for the farm workers on the best practices.

Mitigation cost: Included in the project

Fish packing Facility: During the operational phase most important would be the fish waste (offal) and blood water. Since the facility is small (processing <1MT of fish per day), one should not expect production of significant volume of waste. Blood water may be drained in to the septic tank system. But if proponent were to process large volumes alternative means to disposal should be considered. Fish waste (scale, gut and skin, head, bones, fins) should be collected and disposed over the edge of the reef. It may be useful not to dump the waste on to one site. Use of few sites would help to mitigate any negative impacts from regular aggregation of predatory fish which may also attract sharks.

Mitigation cost: Included in the project

Potential Spills of Fuel, Lubricants and Oily Wastes: The fuel tank will be contained in a bunded area to prevent diesel from entering the island's aquifer in the event of refueling mishaps and leaks. The need for regular fuel transfer from visiting inter-island tanker will provide a small but significant spill risks from the tanker itself and from the refueling operations. The risk can be considered significant owing to the sensitivity and high economic value of potentially affected habitats in the immediate area such as coral reefs and beaches.

The risks of major oil spills following accidental collision or grounding in the project area is low owing to:

- the sheltered intra-lagoon waters which form the approach route to the project area;
- the use of daylight arrival and departures times to maximize navigational safety;

In the unlikely event of a large spill of diesel fuel, any use of dispersants would be highly unadvisable owing to the proximity of shallow coral reefs and total absence of mangroves in the project area. Diesel fuel has a high evaporation rate, and very fast weathering process in well oxygenated, warm and sunlit tropical waters are well known. Therefore main effect would be short-term, such as oiling to local seabirds and beaching of the heavy residues on the local beaches.

In addition, careless or inappropriate handling of lubricants, grease and solvents in the work areas or from speed boats or dhonis engines maintenance has the potential to pollute the local aquifer and deposit tarry products on local beaches respectively. All lubricants and oily wastes will be taken to the waste processing unit for incineration.

Mitigation cost: Included in the project

8.2.3 Potential Positive Impacts

Hydroponics is a versatile technology perfect for growth of agricultural crops in controlled environment (polythene greenhouses). This is a very appropriate technology for the Maldives as the country lacks suitable land for agriculture, the soil is poor in moisture and nutrient retention and the ground water is very salty not suitable for hydroponics. The technology has already been tested and used by the “Seagull Group” in the Maldives. Hydroponics system has the following positive impacts on the environment:

- Water Efficiency. Every drop of water that goes via the Smart valve to the growing container is available to the plant. The single minimal wastage of water is through evaporation from the surface of the container. There is no run-off and no recycling of water.
- Watering According To Demand. The system dictates that the amount and frequency of water provided is exactly as the plants require
- Vertical hydroponic system proposed for will use overhead water tank gravity fed system.
- Self-scheduling irrigation cycle caters exactly for the plant’s ever changing needs throughout the year creating seasonal cycles akin to monsoon season.
- No potential significant contamination issues

8.2.4 The cumulative beneficial impact Hydroponics / Vertical Farming

Production of food in the Maldives would positively contribute food security and self sufficiency of the country. The proponent plans to employ locals early on. This would create knowledge and information about the hydroponics and encouraging locals for small set up in home-yard.

The isolated location, size and habitat of agriculture project contribute favorably to the environment. The project causes no distraction to social life, no disruption of protected areas or heritage and the

benefits of the agriculture project will substantially outweigh its negative impacts on the environment. The estimated impact footprint from the project is shown in Figure x.

Figure 25: Estimated impact footprint of the project.

8.3 LIMITATION OR UNCERTAINTY OF IMPACT PREDICTION

Environmental impact prediction involves a certain degree of uncertainty particularly when applying new technologies in agriculture. Impacts can vary from place to place due to even slight differences in ecological or social conditions in a particular place. Uncertainties of impact prediction are mainly due to the lack of long term experimental data, inherent complexity of ecosystem and availability of similar case studies from elsewhere. There is also limited data and information regarding hydroponics particularly about the impacts of nutrients and chemicals that are used in this technology, which makes it difficult to predict impacts. Available literature and case studies elsewhere clearly indicates that this is one of the best technologies available, and perfectly suitable for the environmental conditions of the Maldives. Therefore, the level of uncertainty, in the case of Vavathi as per the available literature on this issue indicates that this is a very positive and very beneficial technology for the Maldives.

The other impacts are predicted by reviewing the survey data collected during the field visits and based on the experience of similar project activities in the country. Therefore, there is very little uncertainty involved in this project with regard to the use of Hydroponic agriculture technology and there is a high degree of accuracy in prediction of the remaining impacts of the project

9 ALTERNATIVES

9.1 NO DEVELOPMENT OPTION

It is believed that a number of environmental impacts will be generated from the proposed agriculture development project in Vavathi Island, Noonu Atoll. Although no impacts on the environment will be associated if the proposed development does not go ahead, the development of the island will bring numerous socio-economic impacts to the livelihood of the local community. Commercial agricultural development is a priority in the Sixth National Development Plan which aims at import substitution of crops that can be grown successfully and competitively in the Maldives, as well as to increase food security of its people. The Government's agriculture policy is to increase production and income through more efficient use of the limited land resources, improve the quality and quantity of production, and promote a balanced development in the rural areas through strengthening agriculture. In terms of socio-economic benefits, the proposed agriculture development will bring socio-economic development, introduce advanced farming practices and introduce environmentally friendly technologies in the field and will create jobs and improve living standard and livelihood of the Maldivians.

Given the range of benefits that the proposed development will bring to the local economy and people, the proposed development project has been considered important. Development can take place only within the limits of the environment and the society. Hence, the aim is to ensure that all project activities are undertaken without any adverse long term irreversible environmental damages that cannot be mitigated. Preferred alternatives discussed below has been selected based on the above broad development concept

9.2 DEVELOPMENT OPTION

Having decided and followed the development option of the proposed project one has to consider the alternative options in Vavathi Island that would have least environment impact. Most of the elements of the proposed development concept are environmentally conscious therefore not much alternatives that would bring significant change to the project is difficult to find. But some alternatives for some components of the project are suggested below.

9.3 ALTERNATIVES FOR ENERGY GENERATION

The proposed method of generating energy from diesel generators is the most reliable means at present. However, given the unstable nature of the world economy, and the scale of the proposed development it is important to consider sustainable energy sources such as photovoltaic, or energy mix (photovoltaic and diesel generated) energy systems. Large open area is required for photovoltaic systems; however, the proponent may incorporate photovoltaic system as a hybrid to the proposed diesel generators to reduce CO_2 emission. It is better to avoid diesel-based systems given their negative impact on the global environment. Diesel generators produce carbon dioxide, sulphur dioxide and nitrogen oxides which are believed to contribute to global climate change. However, it should be noted that the contribution to global emissions from any diesel generators used for the proposed project will be minute and miniscule in relative terms. Yet, the cumulative impact needs to be taken into consideration when choosing the best option.

9.4 ALTERNATIVE WATER PRODUCTION

Most of the, if not all, industrial developments in the Maldives produce desalinated water for production and processes. Groundwater is required to be conserved. Therefore, desalination has been proposed for this project as the hydroponic systems consume large amount of water. An alternative to fuel-based desalination is a solar desalination plant. There are currently small-scale plants available for solar desalination, which could be perfect for the proposed agricultural development in Vavathi Island. The diesel or fuel-based systems have negative environmental impacts while the solar desalination systems have very low environmental impacts. Solar desalination technology may also have high setup costs compared with fuel-based systems.

9.5 ALTERNATIVE USE OF FISH WASTE

A large quantity of fish waste generated from the fish packing (deheading, removal of gill, bone, gut, and scale etc.) will be disposed-off at the deep sea. Therefore as an alternative it is suggested that if the facility could make the useful parts of the fish waste available for the interested local people to make other uses of the fish instead of throwing away into the deep sea. Similar arrangements by other companies in some islands (eg: Huraa) have brought reasonable income to local people and benefitted economically. Other potential alternatives would be to establish a fishmeal plant to make use of the fish waste and recover high level of protein and oil that goes into the wastewater effluent line.

10 MONITORING

Environmental monitoring is essential to ensure that operational impacts identified in this report can be eliminated in a timely manner. Monitoring will help to continuously evaluate the result of mitigation measures suggested and to adjust the measures to reflect and react to the changes in environmental condition of the area.

10.1 OBJECTIVE OF MONITORING

The main objectives of the monitoring plan are:

- To verify effectiveness and the accuracy of the mitigation measures and adjust the response accordingly
- To identify observe and response to unforeseen impacts in a timely and appropriate manner at the earliest
- To eliminate or reduce environmental costs

10.2 MONITORING PARAMETERS

The parameters that are most relevant for monitoring the impacts that may arise from the proposed project are included in the monitoring plan. These include, shoreline and coastal processes, coral reef, ground water (pH, dissolved oxygen, electrical conductivity, and faecal coliforms), seawater quality (turbidity, dissolved oxygen, phosphates, nitrates COD and BOD), of the lagoon harbour area.

Table 14: Environmental Monitoring Program for Vavathi Agricultural Development Shoreline, and Coastal Process:

Parameter	Indicators	Baseline / Reference Values	Method / Technique	Frequency	Cost US$
Shorelines (high / low tides)	Sediment distribution	Baseline to be re-established immediately after construction is complete	Differential GPS	Bi-annually in the first two year and yearly thereafter	500/trip
Beach profiles	Rates of accretion / erosion	Requires to re-establish the baseline following the construction	Beach profile surveys	Bi-annually in the first two year and yearly thereafter	200/trip
Currents	Nearshore currents	Baseline to be collected immediately constructions are over, especially on western side	Drogue survey	Bi-annually in the first two year and yearly thereafter	200/trip

Table 15: Environmental Monitoring Program for Vavathi Agricultural Development Reef Surveys

Parameter / Method	Frequency of Monitoring	Purpose	Cost US$
Benthic cover by major life forms (live, dead, rock rubble and sand)	Annually	Indicative of the changes in the live coral cover	300/ trip

Fish population / visual census	Annually	To assess broad scale change in the ecological status of the coral reefs (increase / decrease of herbivores, etc)	300/trip

Table 16: Environmental Monitoring Program for Vavathi Agricultural Development Water Quality

Indicators	Measuring parameter	Survey Technique	Frequency	Baseline/References	Cost (USD)
Ground water Quality	Salinity, pH, Nitrate (ug/l), Ammonia, Chloride, Phosphate, COD, colliform and faecal colliforms	Sampling and Laboratory Analysis	Once a month	Baseline data available.	300.00
Sea water Quality outfall	turbidity, dissolved oxygen, phosphates, nitrates COD and BOD	Sampling and laboratory analysis	Once every three months 10-samples	Baseline data available	300.00

10.3 MONITORING REPORT

Based on the data collected, a detailed monitoring report will be compiled annually and submitted to the relevant government authorities for compliance. The report will include methodologies and protocols followed for data collection and analysis, quality control measures and indicate the uncertainties.

Table 17: A tentative schedule for submission of EIA monitoring report to EPA

	2018				2019				2020			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Monitoring report, Operational Phase												

10.4 MONITORING COSTS

It is understood that costs of monitoring be borne by the developer. It is also understood the mitigation measures would be accommodated in the contract costs. A commitment from the proponent is given Appendix 7.

11 CONCLUSIONS

The environmental impact assessment study for agriculture development Project on Noonu Vavathi Island shows the only activity that would cause significant negative environmental impacts is associated with vegetation clearance.

Clearance of vegetation is significant in terms of loss of ecological habitat and it is an irreversible loss as the area has to be left cleared for the rest of the farming period. However, the positive economic impacts from the development outweigh the loss of habitat and this can be mitigated if the existing footprint of already cleared land is used for farming and infrastructure development.

Jetty construction, staff accommodation, water, energy and other infra-structure development would have localised impact on the terrestrial and marine environment of the island. Based on the scale of infrastructure development that is taking place in Maldives, impacts associated with the proposed project would be insignificant and minor. Close monitoring and strict implementation of the mitigation measures suggested is the report is very important.

The study has evaluated alternative options for the project activities and has suggested alternative energy generation water production and alternative use of fish waste. The report has come-up with an extensive monitoring programme that will keep on monitoring the environmental changes associated with the development and make necessary adjustment to the activities of the project based on the findings of various measured environmental parameters suggested in the monitoring plan.

The study has identified the following beneficial effects form the proposed agricultural development project in Vavathi Island:

- Creation of competitive agriculture market for locally grown fruits and vegetables;
- Availability of locally grown high quality agricultural produce that can cater for the high-end tourist resort and local demands
- Employment: Temporary (10-30 job opportunities during construction period) permanent (over 10-20 jobs during operational phase);
- Development of business opportunities in supply and services; and
- Capacity building and technology transfer opportunities in modern farming practices.
- Improvement of public facilities and infrastructure, general improvement of social conditions and service industry activities, in addition to the increased national agriculture and economic infrastructure.
- Better guardianship of the terrestrial and marine resources of the island;
- Improvements in environmental quality of the island;
- Stimulation of local economy, cultivation and small business opportunities within the nearby island communities; and
- Increased government revenue and increased GDP.

The study found no evidence that the project requires or involves:

- loss of unique habitat or wilderness areas;
- resettling of local communities;
- removing or destroying cultural properties;
- contravening national government of the Republic of Maldives, or island community policies, regulations, criteria, customs or aspirations concerning environment, economy, employment, cultural traditions or life styles.

On the basis of this environmental impact assessment study and the impact mitigation measures proposed in the report will be duly implemented and recommendations are given due consideration, it is concluded that the benefits of the proposed agriculture development project in Noonu Vavathi Island will substantially outweigh an unwelcomed demand of burden on the environment.

12 REFERENCES

Bureau of Statistics, Maldives (2014) Preliminary Results, Maldives Census 2014

DHI 1999, Physical modelling on wave disturbance and breakwater stability. Fuvahmulah Port Project, Port Consult, Denmark

DNP (2012) Household income and expenditure report findings 2009/2010

Energy Consultancy Pvt. Ltd (2013) EIA for playground reclamation project for Ga Dhaandhoo by Energy Consultancy Pvt. Ltd, February 2013

English, S., Wilkinson, C. and Baker, V. (1997). Survey Manual for Tropical Marine Resources (2nd edition), Australian Institute of Marine Science

EPA (2013) Dredging and Reclamation Regulation, 2013,

Fourth Tourism Master Plan (2013-2017), Ministry of Tourism, Arts and Culture.

Goda, Y. (1988), Causes of high waves at Male' in April 1987, Dept. of Public Works and Labour, Male, Maldives,

Goda, Y (1988), Report on environmental conditions and related problems at Male Port, Male Port Development Project, Maldives, ADB

Kench, P.S. (2009). Coastal Erosion Monitoring Program - Inception Report. Ministry of Housing, Transport and Environment, Maldives.

Leopold, L. B., F. E. Clarke, B. B. Hanshaw, and J. E. Balsley. 1971. A procedure for evaluating environmental impact. U.S. Geological Survey Circular 645, Washington, D.C

MEEW (2006), Handbook on Compilation of Laws and Regulations on Protecting the Environment of Maldives, Maldives

MEE (2012), Environmental Impact Assessment Regulations 2012, Maldives

Naseer A (2003) The integrated growth response of coral reef to environmental forcing: morphometric analysis of coral reefs of the Maldives. PhD Dissertation, Department of Biology, Dalhousie University, Halifax, NS.Canda.

Ministry of Housing, Transport and Environment (2009), Maldives National Sustainable Development Strategy, Maldives

Ministry of Housing, Transport and Environment (2009), Third National Environment Action Plan - 2009-2013, Maldives

Ministry of Environment, Energy and Water (2007), National Waste Management Policy Maldives

Ministry of Tourism (2016)Tourism yearbook 2015

Riyaz M., Shiham A. (2016) Environmental Impact Assessment For Agriculture Development In Gdh. Hudhuvaarulaa, Menthanhoo Golhaalaa And Dhoonirehaa, Gaaf Dhaalu Atoll, , prepared for Hummingboy Farms PVT. LTD.

Adam, M.S., Riyaz M. (2012) Environmental Impact Assessment for the proposed Autopot Hydroponics Agriculture project on Dhandhoo, Baa. Atoll, prepared for Mr. Mohamed Shareeef, G. Sunnycoast Male.

Woodroffe C (1992) Mangrove sediments and geomorphology. In: Robertson A1 & Alongi DM (Eds) Tropical Mangrove Ecosystems (pp 7-41). AGU, Washington, DC

Young, I.R. (1999). Seasonal variability of the global ocean wind and wave climate. International Journal of Climatology, 19, 931 – 950.

ANNEXES

Annex 1: EIA Terms of Reference (ToR) Approved by EPA

Annex 2: Letter of award from MoFA

Annex 3: Land use plan and concept design

Annex 4: Leopold matrix of Vavathi agriculture development project

Annex 5: Ground and sea water laboratory test results

Annex 6: Environmental monitoring and mitigation commitment letter from the proponent

Annex 7: Letter from Council indicating that they have received the EIA report

Annex 8: Stakeholder consultation, scoping meeting and public consultation attendance

Annex 9: Details of consultant's contribution to the report

Environmental Protection Agency EPA

No: 203-EIARES/PRIV/2018/422

Terms of Reference for Environmental Impact Assessment for agricultural project at N. Vavathi

The following is the Terms of Reference (ToR) following the scoping meeting held on **10th June 2018** for undertaking the **EIA of the proposed agricultural project at Vavathi, N. Atoll. The proponent of the project is Mr. Abdul Latheef (A045007).**

While every attempt has been made to ensure that this TOR addresses all of the major issues associated with development proposal, they are not necessarily exhaustive. They should not be interpreted as excluding from consideration matters deemed to be significant but not incorporated in them, or matters currently unforeseen, that emerge as important or significant from environmental studies, or otherwise, during the course of preparation of the EIA report.

1. Introduction to the project – Describe the purpose of the project and, if applicable, the background information of the project/activity and the tasks already completed. Objectives of the development activities should be specific and if possible quantified. Define the arrangements required for the environmental assessment including how work carried out under this contract is linked to other activities that are carried out or that is being carried out within the project boundary. Identify the donors and the institutional arrangements relevant to this project .

2. Study area – Submit a minimumA3 size scaled plan with indications of all the proposed infrastructures. Specify the agreed boundaries of the study area for the environmental impact assessment highlighting the proposed development location and size. The study area should include adjacent or remote areas, such as relevant developments and nearby environmentally sensitive sites (e.g. coral reef, sea grass, mangroves, marine protected areas, special birds site, sensitive species nursery and feeding grounds). Relevant developments in the areas must also be addressed including residential areas, all economic ventures and cultural sites.

3. Scope of work – Identify and number tasks of the project including site preparation, construction and decommissioning phases.

Task 1. Description of the proposed project – Provide a full description and justification of the relevant parts of the project, using maps at appropriate scales where necessary. Describe the type of crops cultured. The following should be provided (all inputs and outputs related to the proposed activities shall be justified). The main activities of the project are:

- Land clearance/preparation;
- Water supply plan for irrigation including irrigation infrastructure;
- Renovation of the existing access jetty;

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- Operational plan including transport, pest control, water quality monitoring;
- Project management: Include communication of construction details, progress, target dates and duration of works, construction/operation/closure of labor camps, access to site, safety, equipment and material storage, water supply, waste management from construction operations, power and fuel supply and transport of fuel

Land preparation and storage facility construction

- Irrigation infrastructure;
- Storage and packaging facilities;
- Equipment required for operational phase;
- Access to facility via land.

Agricultural fields and products

- Site map showing planned agricultural fields and facilities;
- Type of crops
- Planned agricultural products

Poultry farming

- Site map showing locations of all poultry farm/s
- Type of birds farmed
- Planned products
- Disease control plan
- Quarantine process in case of a disease outbreak
- Worker safety measures

Jetty construction

- Size of channel, location
- Justification for the selection of this location;
- Jetty construction methodology and materials to be used

Water supply plan

- Location, desalination capacity, technology and water quality monitoring system;
- Location, justification for the location of the water intake and brine outfall pipelines;
- Details of groundwater usage (if any)
- Emergency water supply plan.

Power supply plant and oil storage

- Location and size of generators and facility; and
- Fuel storage and transport

Waste management plan

- Management of both construction and operational waste

Task 2. Description of the environment – Assemble, evaluate and present the environmental baseline study/data regarding the study area and timing of the project (e.g. monsoon season). Identify baseline data gaps

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and identify studies and the level of detail to be carried out by consultant. Consideration of likely monitoring requirements should be borne in mind during survey planning, so that data collected is suitable for use as a baseline. As such all baseline data must be presented in such a way that they will be usefully applied to future monitoring. The report should outline detailed methodology of data collection utilized .

The baseline data will be collected before construction and from at least two benchmarks. All survey locations shall be referenced with Geographic Positioning System (GPS) including water sampling points, reef transects, vegetation transects and manta tows sites for posterior data comparison. Information should be divided into the categories shown below :

Climate

- Temperature, rainfall, wind, waves (including extreme conditions(
- Risk of storm events;

Physical parameters (use maps where appropriate(

- Tidal ranges and tidal currents;
- Wave climate and wave induced currents;
- Wind induced (seasonal) currents;
- Shoreline (high tide/ low tide) and Vegetation line;
- Depth profiles of any areas are that are planned to be dredged; and
- Ground water quality assessment parameters from 1 location for parameters; Temperature, pH, salinity, ammonia, phosphate, sulphate, total coliforms and faecal coliforms.
- Sea water quality at intake and outfall locations measuring these parameters: Temperature, pH, salinity, turbidity and Total Suspended and Solids.

Biological parameters: Land-water run-off could affect the marine environment:

- Identify marine protected areas (MPAs) and sensitive sites such as breeding or nursery grounds for protected or endangered species (e.g. coral reefs, spawning fish sites, nurseries for crustaceans or specific sites for marine mammals, sharks and turtles). Include description of commercial species, species with potential to become nuisances or vector.

Socio-economic environment

- Accessibility for commuting workers from neighbouring islands;
- Demography: total population, sex ratio, density, growth and pressure on land and marine resources for Noonu atoll based on census data.

Hazard vulnerability:

- Vulnerability of area to flooding and storm surge.

Task 3. Legislative and regulatory considerations – Identify the pertinent legislation, regulations and standards, and environmental policies that are relevant and applicable to the proposed project, and identify the appropriate authority jurisdictions that will specifically apply to the project. Legal requirements:

1. Approval from Ministry of Fisheries and Agriculture;

Task 4. Potential impacts (environmental and socio-cultural) of proposed project, incl. all stages - The EIA report should identify all the impacts, direct and indirect, during and after construction, and evaluate

the magnitude and significance of each. Particular attention shall be given to impacts associated with the following :

Impacts on the natural environment

- Water run-off impacts from pesticides and fertilizers on marine environment: include changes in seawater quality assessments especially water turbidity and sedimentation and changes in benthic and fish community structures
- Impacts on ground water quality;
- Impacts on unique or threatened habitats or species (if any); and

Impacts on the socio-economic environment

- Impacts on food prices and availability;
- Impacts on island employment, income and economy diversification;
- Impacts of increased demands on natural resources and services especially waste management

Construction related hazards and risks

- Pollution of the natural environment (e.g. oil spills, discharge of untreated waste water and solid waste, including construction waste)
- Risk of accidents and pollution on workers and local population, and
- Impacts on social values, norms and belief due to presence of workers of dredging company on local population

The methods used to identify the significance of the impacts shall be outlined

Task 5. Mitigation and management of negative impacts – Identify possible measures to prevent or reduce significant negative impacts to acceptable levels. These will include both environmental and socio-economic mitigation measures. Measures for both construction and operation phase shall be identified. Cost the mitigation measures, equipment and resources required to implement these measures shall be provided. The confirmation of commitment of the developer to implement the proposed mitigation measures shall also be included.

Task 6. Alternatives to proposed project – Describe alternatives including the "*no action option*" should be presented. Determine the best practical environmental options. Alternatives examined for the proposed project that would achieve the same objective including the "no action alternative". This should include alternative irrigation options, alternatives access locations alternative options for access to the island, alternative farming options taking into account environmental, social and economic factors. All alternatives must be compared according to international standards and commonly accepted standards as much as possible. The comparison should yield the preferred alternative for implementation.

Task 7. Development of monitoring plan – Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management. The report should provide a monitoring report submission schedule. The baseline study described in task 2 of section 2 of this document is required for

data comparison. Detail of the monitoring program including the physical and biological parameters for monitoring, cost commitment from responsible person to conduct monitoring in the form of a commitment letter, detailed reporting scheduling, costs and methods of undertaking the monitoring program must be provided

Task 8. Stakeholder consultation, Inter-Agency coordination and public/NGO participation – Identify appropriate mechanisms for providing information on the development proposal and its progress to all relevant stakeholders such as;

- Ministry of Fisheries and Agriculture
- Health Protection Agency
- Atoll Council

Presentation- The environmental impact assessment report, to be presented in digital format, will be concise and focus on significant environmental issues. It will contain the findings, conclusions and recommended actions supported by summaries of the data collected and citations f or any references used in interpreting those data. The environmental assessment report will be organized according to, but not necessarily limited by, the outline given in the Environmental Impact Assessment Regulations 2012 and the relevant amendment.

Timeframe for submitting the EIA report – The developer must submit the completed EIA report within 6 months from the date of this Term of Reference.

12th June 2018

ENVIRONMENTAL PROTECTION AGENCY
Male', Rep of Maldives

Annex 2: Letter of award from MoFA

بسم الله الرحمن الرحيم

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ނަންބަރު: 30-E/INDIV/2018/563

އަލްފާޟިލް އަބްދުއްލަޠީފަށް،

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29 ޝަޢުބާން 1439
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ޑރ. އާމިނަތު ޝައުނާ
ޑިރެކްޓަރ ޖެނެރަލް

އަލްފާޟިލް އަބްދުއްލަޠީފް
ދިލްދާރުގެ، ސ. މަރަދޫފޭދޫ

ކޮޕީ: މޯލްޑިވްސް އިންލަންޑް ރެވެނިއު އޮތޯރިޓީ
މިނިސްޓްރީ އޮފް ފިނޭންސް އެންޑް ޓްރެޜަރީ

Velaanaage, 7th Floor,
Ameeru Ahmed Magu, Male', 20096, Republic of Maldives
ވެލާނާގެ، 7 ވަނަ ފަންގިފިލާ،
އަމީރު އަޙްމަދު މަގު، މާލެ، 20096، ދިވެހިރާއްޖެ
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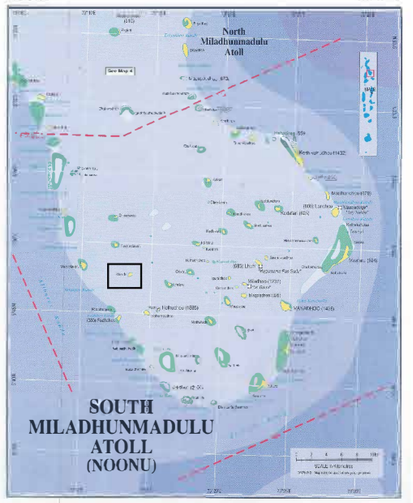
Annex 3: Land use plan and concept design

Noonu Vavathi Island Agriculture Development

NOONU MAP 5



73°13.380′ 73°13.440′ 73°13.500′ 73°13.560′ 73°13.620′ 73°13.680′ 73°13.740′ 73°13.800′

5°47.940′
5°47.880′
5°47.820′
5°47.760′
5°47.700′
5°47.640′
5°47.580′

Legend

- greenhouse
- Free range poultry
- Staff accomdation
- Senior staff Accomdation
- Fish processing
- Fuel storage
- Gensets Disselination
- Massroom Kitchen
- open field farming
- Openfield farming
- Water storage
- Cold storage
- Warehouse
- Jetty
- Banana
- Brinjal
- Nursery
- Papaya
- Pumpkin
- Watermelon
- Cleared vegetation
- Beachend
- Vegetation
- Reef flat/lagoon
- Reef slope
- Existing tracks/paths

0 50 100 150 m

Annex 4: Leopold matrix of Vavathi agriculture development project

		Key: Negligible (N) Minor (Mi) Moderate (Mo) Major (Ma)	Construction Phase														Operational phase									
			Building foundation	Building sourcing and building Materail	Building material stockpilling and storage	Concret mixer operation	Concrete waste storage and disposal	Dusting- air quality degredation	Construciton work noise	Heavy vehicle operation, noise, air quality dust	Sewage and litter management	Construction work water demand	Vegetation clearance	Employment	Visual intrusion on seascape	Coastal excavation and construction work	Employment	fertilizer, Fuel and chemical storage	solid waste management	Equipment vehicle maintanace	Staff trainign	water demand	Electricity demand	Hyroponic and greenhouse operations	Sewage collection and disposal	Fish packing operation
I- Physical and Chemical Chracteristics	1.Land	a.Soil	Mo	N	Mo	Mi	Mo	N	N	Mi	Ma	Ma	Ma	Mi	N	Mo	Mi	Mo	Ma	Mo	N	Mo	N	N	Mi	N
		b. landscape	Mi	N	N	N	N	N	N	Mi	N	N	Mo	Mi	N	N	Mi	Mi	Mi	Mi	N	Mi	N	Mi	Mi	N
		c. soil erosion	Mo	N	Mi	Mi	Mi	N	N	Mi	Mi	Mi	Ma	Mi	N	Mi	Mi	Mi	Mo	N	N	Mo	N	N	Mi	N
	2. Water	a. Ground water	Mo	Mo	Mo	Mo	Mo	N	N	N	Mo	Mo	Ma	Mi	N	N	Mo	Mo	Mo	Mi	N	Ma	N	Mo	Mo	Mo
		b. water table contamination	Mo	N	Mi	N	Mo	N	N	N	Mo	Mo	Ma	Mo	N	Mi	Ma	Ma	Ma	Mi	N	Ma	N	Mo	Ma	Mo
		c. interaction with surface driniage	Ma	N	Mi	Mi	Mi	N	N	N	Mo	N	Mo	Mi	N	N	Mo	Mo	Mo	N	N	N	N	Mi	Mi	Mi
		d. change in water quality	Ma	N	Mi	N	Mo	N	N	N	Ma	Ma	Ma	Ma	N	N	Ma	Ma	Ma	Mi	N	Ma	N	Mo	Ma	N
	3. Amosphare	a. air quality (gases, aerosol)	Mo	N	Mi	Mi	Mi	Ma	Mi	Ma	Mi	N	Mo	Mo	N	Mi	Mo	Mi	Ma	Mi	N	N	Mi	Mi	Mi	N
		b. Climate	N	N	N	N	N	Ma	Mi	N	Mi	N	N	N	N	Mi	Mi	Mi	Ma	N	N	N	N	Mi	Mi	N
II-Biological Conditions	1. Coastal and Marine Resources	a.current sediment dynamics	N	N	N	N	N	N	N	N	N	N	N	Mi	N	Mo	N	N	N	N	N	N	N	N	N	N
		b.lagoon water quality (turbidity)	N	Mi	Mi	N	Mi	N	N	N	Mo	N	Mi	Mi	N	Mo	Mi	Mi	Mo	N	N	N	N	N	Mi	N
		c. coral	N	Mi	Mi	N	Mi	N	N	N	Mo	N	Mi	Mi	N	Mo	Mi	Mi	Mo	N	N	N	N	N	Mi	Ni
		d.sandy bottom creatures	Mi	N	N	N	N	N	Mi	N	Mi	N	N	Mi	N	Ma	N	N	Mi	N	N	N	N	N	N	N
		e. beaches	Ma	N	Mi	N	N	N	N	M	N	N	N	Mo	N	Mo	Mi	N	N	N	N	N	N	N	N	N
		f. fish and fisheries	N	N	N	N	M	N	Mi	N	N	N	N	Mo	N	Mo	N	N	Mi	N	N	N	N	N	Mi	Ni
		g. Endangered species	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Mi	N	N	N	N	N	N	N	N	Ni
	2. Flora	a.trees, shrubs, grass	Mo	Mi	Mi	N	Mi	N	N	Mo	Mo	N	Ma	Mo	N	Mo	Mo	Mo	Mi	N	N	Mi	N	N	Mi	Ni
		b. endangered species	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Mi	N	N	N	N	N	N	N	N	Ni
	3.Fauna	a. birds land animals, reptiles	Mi	Mi	Mi	Mi	Mi	Mo	Mo	Mo	Mo	Mi	Ma	Mo	N	Mo	Mo	Mi	Mi	Mi	N	Mi	Mi	Mi	Mi	Ni
		b. insects	Mi	Mi	Mi	Mi	Mi	Mo	Ma	Ma	Mo	Mi	Ma	Ma	N	Mo	Ma	Mo	Mo	Mi	N	Mi	Mi	Mi	Mi	Ni
		c. Endangered species	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Ni
III- Cultural & socio-economic Condition	1.Cultural Status	a. cultural patterns lifestyles	N	N	N	N	Mi	Mi	Mi	N	Mi	Mi	N	Ma	N	N	Ma	Mi	Mo	N	N	Mi	Mo	Mi	Mi	N
		b. health and safety	Mo	Mi	Mi	Mi	Mo	Mi	Mo	Mo	Mo	Mi	Mi	Ma	N	N	Mi	Mo	Ma	Mo	N	Mi	Mo	Mi	Mi	Ni
		c. Employment	Mo	Mo	Mo	Mi	Mo	Mi	Mo	Mo	Mo	Mo	Mi	Ma	N	Mi		Mi	Mo	Mo	N	Mo	Mo	Mi	Mi	Mo
	economic	bussiness oppertunities	Mo	Mo	Mo	N	Mo	N	N	Mo	Mo	Mi	Mi	Ma	N	N	Mo	Mo	Mo	Mo	N	Mo	Mo	Mi	Mi	Ni

Note:

☐ Negligible (N): the impact is too small to be of any significance (Reversible)
☐ Minor (Mi): the impact is undesirable but accepted (Reversible)
☐ Moderate (Mo): the impact give rise to some concern but is likely to be tolerable in short-term, or will require value judgment as to its acceptability (Reversible)
☐ Major (Ma): the impact is large scale giving rise to great concern; it should be considered unacceptable and requires significant change or halting of the project (Irreversible)

Male' Water & Sewerage Company Pvt Ltd
Water Quality Assurance Laboratory
FEN Building 5th Floor, Machangoalhi, Ameenee Magu, Male', Maldives
Tel: +9603323209, Fax: +9603324306, Email: wqa@mwsc.com.mv

WATER QUALITY TEST REPORT
Report No: 500180414

Customer Information:
Mahmood Riyaz
H.Hithifaiy

Report date: **07/08/2018**
Test Requisition Form No: **900184880**
Sample(s) Recieved Date: **06/08/2018**
Date of Analysis: **06/08/2018 - 06/08/2018**

Sample Description	N.Vavathi GW 1	N.Vavathi GW 2	**TEST METHOD**	**UNIT**
Sample Type	Ground Water	Ground Water		
Sample No	83199665	83199666		
Sampled Date	04/08/2018	04/08/2018		
PARAMETER	**ANALYSIS RESULT**			
Physical Appearance	Opaque and cloudy	Pale yellow with particles		
Conductivity	453	8000	Method 2510 B. (adapted from Standard methods for the examintation of water and waste water, 21st edition)	µS/cm
pH	7.38	7.51	Method 4500-H+ B. (adapted from Standard methods for the examintation of water and waste water, 21st edition)	-
Salinity	0.22	4.43	Method 2520 B. (adapted from Standard methods for the examintation of water and waste water, 21st edition)	‰
Total Dissolved Solids	226	4000	Electrometry	mg/L
Nitrite	0.042	0.022	Method 8507 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Phosphate	0.15	0.20	Method 8048 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L

Keys: µS/cm : Micro Seimen per Centimeter, **‰** : Parts Per Thousand, **mg/L** : Milligram Per Liter

Checked by

Aminath Sofa
Assistant Laboratory Executive

Approved by

Mohamed Eyman
Assistant Manager, Quality

Notes: Sampling Authority: Sampling was not done by MWSC Laboratory

This test report is ONLY FOR THE SAMPLES TESTED.
~ Information provided by the customer

********** END OF REPORT **********

Male' Water & Sewerage Company Pvt Ltd
Water Quality Assurance Laboratory
FEN Building 5th Floor, Machangoalhi, Ameenee Magu, Male', Maldives
Tel: +9603323209, Fax: +9603324306, Email: wqa@mwsc.com.mv

WATER QUALITY TEST REPORT

Report No: 500180415

Customer Information:
Mahmood Riyaz
H.Hithifaiy

Report date: **07/08/2018**
Test Requisition Form No: **900184880**
Sample(s) Recieved Date: **06/08/2018**
Date of Analysis: **06/08/2018 - 06/08/2018**

Sample Description	N.Vavathi Lagoon Water	**TEST METHOD**	**UNIT**
Sample Type	Sea Water		
Sample No	83199667		
Sampled Date	04/08/2018		
PARAMETER	**ANALYSIS RESULT**		
Physical Appearance	Cloudy with particles		
Conductivity	51500	Method 2510 B. (adapted from Standard methods for the examintation of water and waste water, 21st edition)	µS/cm
pH	8.11	Method 4500-H+ B. (adapted from Standard methods for the examintation of water and waste water, 21st edition)	-
Salinity	33.77	Method 2520 B. (adapted from Standard methods for the examintation of water and waste water, 21st edition)	‰
Total Dissolved Solids	25700	Electrometry	mg/L
Turbidity	1.33	HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)	NTU

Keys: µS/cm : Micro Seimen per Centimeter, **‰** : Parts Per Thousand, **mg/L** : Milligram Per Liter, **NTU** : Nephelometric Turbidity Unit

Checked by

Aminath Sofa
Assistant Laboratory Executive

Approved by

Mohamed Eyman
Assistant Manager, Quality

Notes: Sampling Authority: Sampling was not done by MWSC Laboratory
This report shall not be reproduced except in full, without written approval of MWSC
This test report is ONLY FOR THE SAMPLES TESTED.
~ Information provided by the customer

********** END OF REPORT **********

Annex 6: Environmental monitoring and mitigation commitment letter from the proponent and proponent declaration

Platinum Residence
Flat A2-5/2
Hulhumale', Maldive

Our Ref: LL/18/002

12th July, 2018

Mr. Thoriq Ibrahim
The Minister
Ministry of Environment and Energy
Ameenee Magu, Maafannu,
Malé-20392 , Republic of Maldives

Dear Mr. Ibrahim,

Re: PROPOSED AGRICULTURE DEVELOPMENT IN VAVATHI ISLAND, NOONU ATOLL

As the proponent responsible for environmental compliance for the above project, I hereby give our financial commitment to implement the monitoring plan, undertake the mitigation measures recommended and to comply with the issues identified in the Environmental Impact Assessment Report submitted to your agency.

Yours sincerely,

Abdul Latheef

Declaration of the Proponent:

As the proponent of the proposed agriculture development project in Noonu Vavathi Island, I guarantee that I have read the Environmental Impact Assessment report thoroughly and that to the best of my knowledge all information provided here is accurate and complete.

For 

Mr. Abdul Latheef,
Dhildhaaruge S. Maradhoofeydhoo

Annex 7: Evidence that EIA report has been sent to the council and request ed confirmation of the receipts

Mahmood Riyaz <mahmood.riyaz@gmail.com>
to admnhr.noon, ali.zafir

8:06 AM (1 hour ago)

Dear Ali Zafir

Attached please find the draft EIA Report of Noonu Vavathi Agriculture development.
Please confirm that you have received the report in a return mail and filling out the form below:

Thank you and looking forward to your prompt response

Best regards

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED AGRICULTURAL PROJECT ON VAVATHI, NOONU. ATOLL

2018

Annex 8: Stakeholder consultation, scoping meeting and public consultation attendance

Environmental Protection Agency

Male', Rep of Maldives

بسم الله الرحمن الرحيم

Meeting : Scoping of EIA for the proposed agriculture project at N. Maradhi'
Date: 10th June 2018
Time: 11:00 am

ATTENDANCE FORM

	Name	Designation	Office	Email	Phone No.	Signature
01	Rifath Naeem	Director	EPA	rifath.naeem@epa.gov.mv	3355949	
02	ALI MISHAL	EPA Engineer	EPA	ali.mishal@epa.gov.mv	7766659	
03	MOHAMED NASEEM	ADC	MOFA	mohamed.naseem@fisheries.gov.mv	7953544	
04	Mahmood Riy	Consult	Freelance	Mahmood.riyaz@gmail	789 0307	
05	MOHAMED RASHEED		Silver Sands Pvt Ltd	rasheed@silversands.com.mv	7784117	
06						
07						
08						
09						
10						

Annex 9: Details of consultant's contribution to the report

Details of consultant's contribution to the report

Chapter	**Name of Consultant**	**Registration No.**	**Signature**
Introduction	Dr. Mahmood Riyaz	(EIA P03/2007)	
Project Description	Dr. Mahmood Riyaz	(EIA P03/2007)	
Administrative and regulatory framework	Dr. Mahmood Riyaz	(EIA P03/2007)	
Methodology	Dr. Mahmood Riyaz	(EIA P03/2007)	
Existing Environment	Dr. Mahmood Riyaz	(EIA P03/2007)	
Stakeholder consultation	Dr. Mahmood Riyaz	(EIA P03/2007)	
Potential impacts and mitigation measures	Dr. Mahmood Riyaz	(EIA P03/2007)	
Alternatives	Dr. Mahmood Riyaz	(EIA P03/2007)	
Environmental Monitoring plan	Dr. Mahmood Riyaz	(EIA P03/2007)	
Conclusions	Dr. Mahmood Riyaz	(EIA P03/2007)	