# ENVIRONMENTAL IMPACT ASSESSMENT

# FISH PROCESSING AND PACKING FACILITY - FISH WORLD MALDIVES PVT LTD MAALHOS, ALIFU ALIFU ATOLL

PREPARED FOR
Fish World Maldives Pvt Ltd

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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.

M. Shiham Adam (EIA01/07)
12 December 2013

## Acronyms used in the text

| | |
|---|---|
| BOD | Biological Oxygen Demand |
| EPA | Environmental Protection Agency |
| EU | European Union |
| FRG | Frigate tuna |
| GMP | Good Manufacturing Practice |
| HACCP | Hazard Analysis Critical Control Points |
| ISO | International Standards Organization |
| KAW | Kawakawa |
| MEA | Maldives Energy Authority |
| MoEE | Ministry of Environment& Energy |
| MoFA | Ministry of Fisheries and Agriculture |
| MRC | Marine Research Centre |
| MSC | Marine Stewardship Council |
| NPC | National Planning Council |
| REEF | Reef fish |
| SKJ | Skipjack tuna |
| YFT | Yellowfin tuna |

# 1 NON TECHNICAL SUMMARY [DIVEHI]

1. ފިޝްވޯލްޑް މޯލްޑިވްސް ޕްރައިވެޓް ލިމިޓެޑުން ހުށަހަޅުއްވާފައިވާ ތަރައްޤީ މަޝްރޫޢު އަކީ މަސް ތައްޔާރުކުރުން، ޕްރޮސެސްކުރުން ބަންދުކުރާ ކާރުހާނާއެއް ޤާއިމުކުރުމެވެ. މިމަޝްރޫޢުގެ އަސްލު މުހިއްމު ބަޔަކީ ތާޒާ މަސް އެކްސްޕޯޓްކުރުން ސަޕްލައިކޮށްދިނުން ކަމަށްވާތީ މިކަމުގައި ނަގަން ޖެހޭ ރަސްމީހުއްދަތައް އެޕްރޫވަލް އަދި ސެޓްފިކެޓް ބަލައިގަތުން މިކަމަށް ބޭނުންވާނީ މޯލްޑިވްސް ފުޑް އެންޑް ޑްރަގް އޮތޯރިޓީ (އެމްއެފްޑީއޭ) އާއި ގުޅުމުން ތަރައްޤީކުރާ ޤަވާޢިދާއި އެއްގޮތަށް މިކަމަށް އެކުލެވޭ މަހާއި މަހުގެ އުފެއްދުން ތަކާއި އެކްސްޕޯޓްކުރުމަށް ކުރެވޭ އިންތިޒާމުތަކާއި އެއްގޮތަށް ހުއްދަ ދޫކުރާ ފަރާތުން ބަލާނެ ކަމެއް ކަމުގައިވާތީ، ސްޓޭންޑަރޑް ބޭނުންކުރުމަށް ނުވަތަ އަމިއްލަ ދިރާސާކުރުމުގެ ފުރުޞަތު ވަނީ ލިބިދީފައެވެ. ކުއްތާ އޮޕަރޭޝަނާއި ހިނގާ ދަތުރުތަކާއި ބެހޭ ބަޔަކީ މިކަމަށް އޮތް ހިދުމަތްތަކެވެ. ނަމަވެސް، ފަހުން އެމްއެފްޑީއޭއިން ފިލާޓް ފެސިލިޓީގެ އަދި ހަރުކުރާ ފެސިލިޓީ އެޕްރޫވަލް ކުރަނީ ފައިލްގެ ބޭނުމަށް. ކުއްލިއެއް އިން ހަދައިދެނީ ބެލުމަށް ކޮންމެ ބައެއްގެ ހިދުމަތް ހޯދުމާއި ކުރާނެ ކަންތަކާއި ގުޅޭ މިނިސްޓްރީ އަދި ފިޝަރީޒް އެންމެ އެޕްރޫވަލަށް ދިން ދަތުރުކުރާ ގަވާއިދު ހުށަހަޅަން ބޭނުންވާ ފަރާތްތަކުގެ ތަފާސް ހިސާބު ލިބިދޭ ޓެކްނިކަލް ޤަވާޢިދު ދަތުރުކުރާ ޕާރޓީ ބޭނުންކުރާ ބަޔަކަށް އެދިގެން ފެށުމުގައި ބިނާކުރަން ބޭނުންވާ ކަންތައް ދިރާސާކޮށް މިނިސްޓްރީ އަދި ފިޝަރީޒް އެކުލަވާލައި ފާސްކުރާ ސްޓާފުން ވަނީ ބެލެހެއްޓިފައެވެ.

2. މަތީގައި ދެންނެވުނު ސަބަބުތަކަށް ޓަކައި މިހާރު ސަރަހައްދު އަރިހުން މަޝްރޫޢުގެ ތަފްޞީލީ ދިރާސާއެއް ބަލާން ކުރި ރިޕޯޓް (އީއައިއޭ) ވަނީ ތައްޔާރުކުރެވިފައެވެ. ނަމަވެސް، އެދިގެންވާ ދިރާސާކޮށްފައި ގޮތުގައި މިކަމަށް ބޭނުންވާ އެކްސްޕާރޓް ކުރަމުންދާ ސަރަހައްދުގެ ފިޒިކަލް އަދި ބަޔޮލޮޖިކަލް ސަރަހައްދުތަކާއި، އީއައިއޭ ހެދި ރިޕޯޓް ސަރަހައްދު ދެކޮޅު ހުރި ފަރާތްތަކާ އަދި ފިޝަރީޒް މިނިސްޓްރީ މާލިއްޔަތު ނިންމާފައިވެއެވެ.

3. ފިޝްވޯލްޑް މޯލްޑިވްސް ޕްރައިވެޓް ލިމިޓެޑްގެ މަސް ޕްރޮސެސިންގ ބަންދުކުރާ ކާރުހާނާ ޤާއިމުކުރެވިފައިވަނީ މއ. މާލޭގައެވެ. މަޝްރޫޢުގެ ސައިޓް ވާގެ ނިމި މާލެ ރަށް ފުޅާކުރުމުގެ ބަޔަކަށްކޮށްފައެވެ. މިތަރައްޤީ މަޝްރޫޢުގެ އިސްވެ ކަމެއް ބިލްޑިންގ ސިސްޓަމް ރީސައިކަލްކުރާ ސޮލިޑް ވޭސްޓްގެ ކުނި މެނޭޖްމަންޓާއި ބަނދަރާއި ޕޯލިސީގެ ފަސޭހަ އިންޓަރނެޓް ރައްކާތެރިކަން ރީސައިކަލް ފެސިލިޓީ ބިނާކޮށް ބޭނުންކުރާނެ ކުނި ސަރަހައްދު ހިމާޔަތްކުރުމެވެ. ރީސައިކަލް ހުރިހާ މަސްވެރިކަމާ ބެހޭ ދިރާސާއިން ފެނިފައި ރީސައިކަލް ބޭނުންކުރާ ސަރަހައްދު ކާނާތައް ފުރިހަމަކޮށްފައި ބެހެއްޓިފައިވާ ސަރަހައްދުގައި ދުވަހަކު ފެނުން އުފައްދާ ސިސްޓަމްތަކެވެ. ރީސައިކަލް ބޭނުންކުރާ ވިއުގަ އެކުލެވޭ ބަރާޅް ޑިޒައިން މަސްޓަރ ޕްލޭން ހަދާފައިވާ ބިލްޑިންގތަކުގެ ބޭނުމަށް ބޭނުންވާނެ. މިފަދަ އުފެއްދުންތައް ވިއްކުމުގެ ހިދުމަތް ދޭނެ ރީޖަން ފޮރުވާލާނެ ލާމަރުކަޒީ ފެސިލިޓީތަކެވެ.

4. އެފަދަ ހައްދަވާފައިވާ މާރުކެޓް ސްޓާފުންނާއި އުސޫލުތަކުގައި ރީސައިކަލް ކުރިއަށްގެންދާނެ މިންވަރަކީ ގިނަ އަދަދެކެވެ. ގޯތިގެކަން 700 މެޓްރިކްޓަނުގެ ރީސައިކަލް ހަމައެކަނި ކުއްލިއަކަށް ދެމިއޮތްނަމަ ދުވާލަކު 150 ޓަނު މަސް ބަލަހައްޓަން ވެއެވެ. އަދި 2006 ވަނައަހަރު ހިނގާފައިވާ ސުނާމީއާއި ހެދުމަށް ދިރުމެއް ބެލެހެއްޓުމަށް ކުރެވުނު ކަންމަތި ޖަހަރު ހުރިހާކަން 1.29 ޓަނު މާބޮޑު މަސްބަލަހައްޓަވެއެވެ. މިއީ ރީސައިކަލް ކުރެވޭ މަސް ސަރަހައްދު ކުރުކުރި ދުވާލެއްގައި އަދި ވަރަށް މާލޭގެ ޖަމާއަތް ދެވަނަ ތަނެއްގައި އެހެނިހެން ދިރިއުޅުންތަކެވެ.

5. މއ. މާލޭގައި އެރި ފަރުބަދަ ހިސާބުގެ ބަނދަރުގެ ދުވަސް ކޮޅުގައި އޮތް ހިއްލާ ސަރަހައްދުގައެވެ. މިސަރަހައްދަކީ ބަނދަރު ހުރިހާ ކަންތައް ނިމުނު ވަގުތު ހިސާބުގައިވާ ސަރަހައްދެވެ. މިސަރަހައްދުގެ ދޮށުގައި ބިޓުމަން ފިކްސް ކަން ހިމާލަނީ ހައްދަވާފައިވެއެވެ. 1200 އަކަފޫޓުގެ 14 ބައިން ބަޔާލައިވާ ސަރަހައްދުގައި ވާރޭގެ މަސައްކަތް ކުރުމަކީ ކުއްލިން

ދިނުމަށް ވަނީ ނިންމާފައެވެ. މިގޮތުން މިހާރުވެސް އެނގޭ އިރުމަތީފަރާތުގެ ބޮޑުކަނޑާއި އަދި ދެކުނުގައިވާ ބޮޑުކަނޑު ކުދްއަހަރު ދޫކަން ވަނީ އިމާރާތްތަކުވެސް ކޮށްފައެވެ. ފިޝްފާމްގެ ކޯލްޑްސްޓޯރ ޕްރޮސެސިންގ ހިމެނޭ ކުރިއަށްދާ ކުއްޔަށް ދޫކުރުމަށް ހަރުމަތީގައި ވާ 4 ބޮޑުކޮށެވެ. މީގެ އިތުރުން ދެކުނުގައި އިމާރާތްކުރެވިފައިވާ ގުދަން ވަނީ ފިޝްފާމްގެ ކޯލްޑްސްޓޯރ މިހާރު ކުއްޔަށް ހިފާފައެވެ.

6. ފްރޯޒަންގައި ތަފާތު ބާވަތްތަކުގެ އުފެއްދުމަށް ފިޝްފާމްގެ ކޯލްޑްސްޓޯރ ޕްރޮސެސިންގ ޖަރީޖެހުން ހަރަކާތްތެރިވެއެވެ. މިގޮތުންގައި ބޮލާއި ގޮނޑު ނަގާފައި ބޮޑު މަސް، ކަރުގަނޑާއި ގޮނޑު ނަގާފައި ބޮޑު މަސް، ބޮޑު ޓޫނާސް، ބޮޑު ފިލޭޓްސް އަދި ދިރުއްސި މަސް، ހިކިމަސް، އަދި އެހެނިހެން ޕްރޮޑަކްޓްސް ބާވަތް ހިމެނެއެވެ. މިގޮތުން ފްރޯޒަންގައި ޕްރޮސެސްކުރާ މަހުން ބާކީވާ މަހުގެ ބައިތަކެއް ފިޝްމީލް ތައްޔާރުކުރުމަށް ފިޝްމީލް ޕްރޮޑަކްޝަން ޕްލާންޓެއްގައި ބޭނުންކުރެވޭނެއެވެ. ޕްރޮސެސްވާ ބާވަތްތަކާއި ފިޝްމީލް ޕްލާންޓްގެ މަސައްކަތްތަކާ ކުރިއަށްގެންދިއުމަށް ހަމަޖެހިފައިވާ ދުވަހުގެ ހިންގުމަށް ބޭނުންވާ. މިގޮތުން އުފައްދާ ފިޝްމީލާއި ފިޝްއޮއިލް ބޭރުގެ ބާޒާރުތަކުގައި ހުރިހާ ވިއްކުމަށާއި އަދި ފަރުމަސްތަކުގެ ފީޑު ބޮޑުވެ ފެރިކަތޯރު ސިނާއަތްތަކުގައި ބޭނުންކުރެވޭނެ އެއްޗެކެވެ. ނަމަވެސް، ރަށްޓެހި ބާޒާރު ނުލިބުނަމަ އެކްސްޕޯޓް މާރކެޓުން ވިއްކުމަށްވެސް ކުރިއަށްދާނެ ކަމެއްކަމުގައި އެކިފަހަރު ފާހަގަކުރައްވައެވެ.

7. މިހެން އުޅޭ ރަށްރަށުގައި ސިނާއީ މަސައްކަތް ކުރާ އެހެން ފަރާތްތަކާއި އެއްގޮތަށް ފިޝް ވާރލްޑްގެ ކޯލްޑްސްޓޯރ ޕްރޮސެސިންގ ޖެޓީޖެހޭނެ ފްލޯޓް އަދި ބޭނުންވާ ފެނާއި ކަރަންޓް އުފެއްދުމަށް ވަނީ ހަމަޖެހިފައެވެ. ހިދުމަތުގެ އިންތިޒާމު ދިނުން ހަމަޖެހިފައިވާނީ ފްލޯޓިންގ ޖެޓީގެ ގޮޅިތަކުގައި މެޝިނަރީ ބަހައްޓައިގެންނެވެ. ކަރަންޓް އުފެއްދުމަށްޓަކައި 125 ކޭވީއޭ ގެ 2 ޖެނަރޭޓަރ ބަހައްޓާނެއެވެ. މިއީ ސަލާމަތީ ފުރުސަތު ޖެނަރޭޓަރެވެ. މެދު ނުކެނޑި ކަރަންޓް ދިނުމަށްޓަކައި 2 ޖެނަރޭޓަރ ސިންކްރޮނައިޒްކޮށް ދޭ އަދި ކޮންޓްރޯލް ކުރެވޭ އޮޓޯމެޓިކް (އޮޓޮމެޓިކް)ގެ ޗޭންޖްއޯވަރ ސްވިޗެއް ބޭނުންކޮށްގެން ބޮޑު ހަރަކާތް ފުރިހަމަކުރެވޭނެއެވެ. އަދި ޗޭންޖްއޯވަރ ފަންކްޝަން އޮޓޮމެޓިކްގައި ރަނިންކުރާނެއެވެ. ފްލޯޓަށް ސަރުކިޓްގައި ކަރަންޓް އުފެއްދި ކަރަންޓުގައިވެސް ވަކިވަކި ގޮތުގައި ބޭނުންކުރާނެ އިންސިއުލޭޓް ކޭބަލް ކަރަންޓް ގެނައުމަށް ހަމަޖެހިފައެވެ. ފެން އުފެއްދުމަށް ހަމަޖެހިފައިވާ ދުވާލަކު 10 ޓަނުގެ އުފެއްދޭ ޕްލާންޓެއް ބަހައްޓާނެއެވެ. ފެންޕްލާންޓް ރިވަރސް އޮސްމޯސިސް ކުރުމުގެ ގޮތާއި ދިމާވާ ބޭނުމަށް ރިވަރސް އޮސްމޯސިސް ކުރިއަށް ގެންދާ ދުވާލަކު 10 ޓަނަށްވުރެ އިތުރުން ފެން އުފައްދާ ޕްލާންޓެކެވެ. ފެންޕްލާންޓުން އުފައްދާ ފެން ސްޓެރިލައިޒްކޮށް ރައްކާކުރާ ޓޭންކްތަކުގެ ދިރާސާ ވާރކްސްޓޭޝަނުން ވަނީ ހަމަޖެހިފައެވެ. އަދި ފެނާއި ނުނާ ފެނުން ފެނާއި އެއްކަރަ ރައްކާކުރުމަށް ބަހައްޓައިގެން ޖަގައި 2500 ލީޓަރުގެ 4 ޓޭންކީ ބަހައްޓައިގެން ވަނީ ހަމަޖެހިފައެވެ.

8. ސާފު ފެން އުފެއްދުމަށް ރިވަރސް އޮސްމޯސިސް (އާރއޯ) ޕްލާންޓަށް ބޭނުންވާ ފެންނަގާނީ ބޯރހޯލަކުންނެވެ. މިގޮތުން އެންވަޔަރަމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީ އިން އެކަށައަޅާފައިވާ ބޯރހޯލް ޑްރިލިންގ ގައިޑްލައިން އާއި އެއްގޮތަށް ބޯރހޯލްއެއް ފެންޕްލާންޓުގެ ގާތު ތަނެއްގައި ހަދާނެއެވެ. ބޯރހޯލް ހެދުމުގައި ގައިޑްލައިންގައި ވާގޮތަށް ބޭނުންކުރާ ޑްރިލިންގ ފްލުއިޑް ބޭނުންނުކުރާ އަދި ނަތީޖާތަކަށް ރައްކާތެރިކަމާއެކުގައެވެ. ބޯރހޯލްގެ ކޭސިންގ ބަނޑުގޮތުން މަދުވެގެން 30 މީޓަރު އޭރުން ކޮންކްރީޓްކޮށް ހަދާނެއެވެ. އޭގެ ފެންތަކުގެ ފަސްގަނޑާ ޖެހޭގޮތުގައި ޖެހުނު ކަރަރު ކަރަރުވާނެއެވެ. މިސަރަހައްދަށް ރަނގަޅު ހިމާޔަތްކުރާ އަދި މިގޮތުގެ ގެދޮރުކުރާ ފެންވަރަށް ފެނަށްކަމާއި ފެންމިން ކަމުގައި ބެލެވެއެވެ. އާރއޯ ޕްލާންޓްގެ ބްރައިން (ރިޖެކްޓް) ފެން ބޭރުކުރުމަށް ހަމަޖެހިފައިވަނީ ހުޅަނގު ފަރާތުގެ ފަރުބޭރަށެވެ.

9. މަސްވެރިން ބާނާ މަސް ޓްރާންސްޕޯޓް ބަހައްޓައިގެން ބޭނުންވާ މަސްވެރިންނަށް ވިއްކުމުގައި އަދި މަސްވެރިންނަށް ދިނުމަށް ދުވާލަކު 20 ޓަނު އުފެއްދޭވަރުގެ އައިސް ޕްލާންޓެއް ގާއިމުކުރެވޭނެއެވެ. އައިސްޕްލާންޓްގައި ބޭނުންކުރާ ރެފްރިޖަރަންޓަކީ އަމޯނިއާ އާއި ރަސްމީ އަދި ރައްކާތެރި ގޮތަށް ހިމާޔަތްކުރާ ބޯނުގެ ރެފްރިޖަރަންޓެއް ނުކުރާކަމެވެ. ފިޝް ވާރލްޑްގެ ކޯލްޑްސްޓޯރ

ޕްރައިވެޓް ޕްރޮޖެކްޓް ވިއްކާ މަހަކީ ތާޒާމަސްކަމުގައި ހެދުމަށް މަސްބާނުމަށްފަހު ދޭ ހުސްކޮށް ކަނޑައިގެން ނުމުމާއި އައިސް އެޅުމުގެ މުހިއްމުކަމާއި އަދި މަސްބާނުމަށްފަހު ތާޒާކަން މަތީ ބެހެއްޓުމަށް ބޭނުންވާ މައުލޫމާތު މަސްވެރިންނަށް ފޯރުކޮށްދީ މަސްވެރިން މިކަމަށް އަހުލުވެރިކުރުވާނެއެވެ.

10. ފިޝްވޯރލްޑް މޯލްޑިވްސް ޕްރައިވެޓް ލިމިޓެޑް ގެންނަ މަހަކީ ހަމައެކަނި ރާއްޖޭގެ މަސްވެރިން މަސްވެރި އުޅަނދުފަހަރުގައި ގޮސް ބާނާފައިވާ މަސް ކަނޑުގައި ވާނެއެވެ. ފެކްޓަރީ ޤާއިމުކުރެވިފައިވާ ހއ. އަތޮޅަކީ ފަތުރަމަސްވެރިކަމުގެ މަޝްހޫރު ސަރަހައްދެއްކަމުގައި ވުމުން ފުރަތަމަ މަސައްކަތް ފަށައިގަނނަ އިރުވެސް އެކަށީގެންވާ މިންވަރަށް މަސްލިބޭން ކަނޑުގައި ބޮޑުވެއެވެ. ހއ. އަތޮޅުގެ ރަށްތަކަކީ މިއަދުމަސްވެރިކަން ހިލާހުރި ކުރުމުގެ ކުރިން މިއަދު މަސްވެރިކަން ކުރެވުން އެކަށީގެންވާ އާބާދީއެއް ހުރިކަމުން އަދި ބޮޑުކަމެވެ. ނަމަވެސް، މިއަދު މަސްވެރިކަން ކުރުން 2010 ގައި އެއްކޮށް މަދުކޮށް އަދި މަސްވެރިންގެ އަދަދުގައި ހުރި މަސްވެރިކަން ކުޑަ އާބާދީއަކަށް ގެއްލިފައި އެކި އިތުރު މަސްވެރިކަމަށް ދިޔުމަން ބޮޑުވެފައި ތިބިކަމަށް މި ދަރަޖައިގެ މަސްދުނިޔޭ ފަރާތްތަކުން ލިބޭން ފަސޭހަކަމުކަމެވެ.

11. ރަށްތަކުގައި މިހާރު ޤާއިމުވެފައި ހުރި ގިނަ ފެކްޓަރީ އާއި ހިފާފައި ފިޝްވޯރލްޑް މޯލްޑިވްސް ޕްރައިވެޓް ލިމިޓެޑްގެ ފެކްޓަރީގެ ގޮތް ތަފާތުގައި އެކަމަށްބެހޭޝަކުން ބޮޑުކުރާނެ ނުކުންނާނެއެވެ. މިގޮތުން ފެކްޓަރީގެ ޒާތުން ނަޖިސް ބޭރުވާނީ ވަރަށް މަދު ވަރަކަށްކަމެވެ. ފެކްޓަރީ ސާފުކުރުމުގައި ބޭނުންކުރާނީ ބޯފެން ކްލޯރިނާއި، ޒާތުން ނަޖިސް އަލަން ފެނާއި އަދި އާއްމު ޕްރޮސެސް ގެ ބަދަލުން އެޅޭ ފެކްޓަރީގެ ގޮތުގައި ބިލްޑިންގައި ހުންނަ ކެމިކަލް ޖެހުން ނުވާނެއެވެ. ފެކްޓަރީގެ އެރިޔާގައި ސެޕްޓިކް ޓޭންކް ހުސްކުރުމުގެ ހިސާބުން ފަރާތްތަކުގެ ފުރު ބަޔަކަށްވޭ.

12. ފިޝް ވޯރލްޑް މޯލްޑިވްސް ޕްރައިވެޓް ލިމިޓެޑްގެ ތަރައްޤީ މަސްދުނިޔޭގެ ސަރަހައްދުން ފްލެޓުން ކާރުފޭން އަސަރު ދަށްކުރުމަކީ ޖަހައި މިފަދަ މަސައްކަތްތަކާ ކުރުމަށް ކުރާވާ ތަރައްޤީ މަސައްކަތްތަކާއި އަދި މިފަދަ މަސައްކަތްތަކާއި ކުރުމުންދިޔުމުގައި ފްލެޓުން އަސަރު ކުރާނެ ދާއިރާތަކެއް ހިމެނޭ ޖުމްލަ ތަފްސީލާއި އެރިޔާގައި ފްލެޓުން އަސަރުކުރާނެ މިންވަރު ވަޒަން ކުރެވޭނެއެވެ. މިގޮތުން ރާއްޖޭގައި ނުލިބޭ އަސަރާއި އެކިވާ އަސަރުތަކެއް ފާހަގަކޮށް އެއަށް މިންވަރު ކުރިޔަށްއެޅުން ހުށަހަޅާފައިވާނެއެވެ. މަސްދުނިޔޭގެ ސަރަހައްދު ކާރުފޭން ނެގޭ އަސަރުތަކަކީ އެކަށީގެންވާ މިންވަރަކަށް ވަސީލަތްތަކެއް، ގިނަދުވަހުގެ ޕްލާސްޓިކުންތަކާއި ހިލޭ ފަޅު ދަރު، ބީޗް، ހުޅަނގު ސަރަހައްދުތައް ފާހަގަކޮށް މަސްވެރިކަމުގެ ދާއިރާ ޚާއްސަ ފަރާތްތަކުގެ މިންވަރުތައް ދެނެގަތުމަށް ކުރެވޭ އަދި މަސްދުނިޔޭގެ ފުރުސަތު އިތުރުވެގެން ދިޔުމުން، ރަށުގެ އާދައިގެ ފުޅާމިނުގައި ރައްޔިތުންގެ އުޅުން މިންވަރު ބޮޑުކަމާއި އަދި މަސްވެރިންނަށް ދިރިއުޅުން ރައްކާތެރި ފުރުސަތު އާއި ބަދަލު ފަހިކުރުމަށް ފުރުސަތު ލިބޭނެ ހުޅުވިގެންދާނެއެވެ.

13. ފްލެޓުން ކާރުފޭން ނެގޭ އަސަރުތަކަކީ ފްލެޓުން ކާރުފޭން އެދުވާއަސަރާއި އެކުލެވިގެން އަދި އަސަރުދުރުކުރުމަށް އިތުރުވާކަމަށް ފާހަގަކުރެވެނެއެވެ. މިގޮތުގައި މަސްވެރިން ދިރިއުޅުމުގެ ފުރުސަތު (ލައިވްލިހުޑް) ރަނގަޅުވެ އެކިފަރާތްތަކާ އާއްމުދުނިޔޭ އާއި ލިބޭނެ ގޮތުގެ މަސްތަކުރާނެވެގައި، މާލީގޮތުން އިޤްތިޞާދީ ބިނާ ފުރާވެ ތަރައްޤީވުމުގެ ފުރުސަތު ބޮޑުވުމައި، މަސްވެރިކަން ރާވާނެގޮތް ބެލެހެއްޓުން ފަސޭހަވެ މަސް އިސްތިރީ ކުރެވޭ މިންވަރު ހިފެހެއްޓުމައި ހާލަތުގައި ތަފާތު ގޮތުގެތެރި ބަރުކުރުމުގެ ފުރުސަތު ލިބިދޭނެކަން ފާހަގަކުރެވޭނެއެވެ. މިގޮތުގައި ދެންނެވުން ފްލެޓުން ކާރުފޭން ކުރެވެނީ އަސަރު ގެނުވާ ފުރުސަތުތަކާއި ގުޅިގެން ތަކެތި ތަރައްޤީކުރުމާއި ހާލަތުގައި ރަނގަޅުކުރެވޭނެ ގޮތުން މިހާތަނަށް ބޭނުންކޮށްފައިވާ ފާހަގަކުރެވިފައިވާނެއެވެ.

14. ރަށުގެ ކައުންސިލް ދެމެހެއްޓެނިވި މަސްދުނިޔޭ ތަރައްޤީއާއި މަސްވެރިކަމާއި ބެހޭ ޖަވާބުދާރީ ފަރާތްތަކާ ގުޅިގެން މި ރަށްތަކުގެ މަސްދުނިޔޭއަށް ދެރަ އަސަރުތަކާ ކުރިމަތިވާ ކަންކަން ފާހަގަކުރެވޭނެއެވެ. އަދި މިމަސްދުނިޔެގެ ކައުންސިލްގެ ފަރާތުން ދޫކުރާ އެހީތެރިކަމާއި ވަގުތަށް ތަފާސްކުރުމުން ހުށަހަޅާ ފާހަގަކުރެވޭނެއެވެ.

15. ތަރައްޤީ މަޝްރޫޢު ތަންފީޛުވަމުން ދާއިރު މޮނިޓަރކުރުމަށް ހުށަހެޅިފައިވަނީ ހާބަރުގެ ފެނުގެ ކޮލިޓީ ބެލުމަށެވެ. ޖުމަލް ގޮތެއްގައި ދަންނަވާނަމަ މިމަޝްރޫޢު ގެ ސަބަބުން މާޙޯލަށް އިތުރު ތަރައްޤީ ވުމުގެ ފުރުޞަތު ލިބި އަދި ފަތުރުވެރިކަމުގެ ސިނާއަތަށް ތާޒާ މަސް ވިޔާފާރީގެ އުސޫލުން ސަޕްލައި ކޮށްދޭނޭ އިތުރު ސިނާއަތެއް ފެށިގެން ދިއުމަކީ އެކަށީގެންވާކަމެކެވެ.

# 2 NON TECHNICAL SUMMARY

1. The development project of Fish World Maldives Pvt Ltd is a fish processing and packing facility. Located in the west central of Maldives in Maalhos, Alifu Alifu Atoll, the proposal is to process, pack and produce variety fish products targeting local markets, including fresh fish requirements of tourist resorts. Essentially the project is conceived on the observation that the amount of resources allocated by the resorts on sourcing fresh fish to feed their guests and staff is not worthwhile their effort. The quality of the fish is poor and wastage is substantial. Simply because fishing is a different enterprise far from their core tourism business; they would rather have this activity outsourced to professionals.

2. Observations by the proponent have shown that requirements of fresh fish on a resort are substantial. For instance, for a resort with 700 staff (not uncommon in high-end 7+ start resorts in the Maldives) would require about 150 – 200 kg fresh fish per night. This result is not surprising since a survey in 2006 have shown that reef fish consumption in resorts stands around 1.29 kg per tourist night.
3. The proponent’s requests to authorities on recognition of the facility on par with facilities producing for export to EU-territories have met with confusion. The current regulation requirement of Maldives Food and Drug Authority (MFDA) and Ministry of Fisheries and Agriculture requirements on issuing ‘Certificate of (EU) Compliance’ and ‘License for Producing Fish and Fishery Products’ (for export) respectively is only for fish processing facilities targeting only for export. MFDA regulation requires the HACCP plan and factory floor layout is pre-approved before construction begins. Approaching Island Council on the issue decided that outlet falls under the category of facilities selling food and food products and therefore have issued ‘Operating License for Food Establishments’ during August 2013. Fortunately MFDA has now approved the layout for the ice-plant and factory floor layout.
4. The location proponent has chosen to build the facility is the area on the west of the Maalhos harbour. The area was reclaimed of dredged material excavated from the harbour basin some years ago. The Island Council have drawn up a land use plan for commercial leasing. Plots of 1,200 sq feet have been marked and 14 such plots have been identified in the area. Of these 4 plots on the western most sections have been leased to the Fish World Maldives Pvt Ltd. In addition they have acquired a large warehouse just three blocks south of their facility in the same area.
5. The proponent is proposing to produce a variety of products; fresh gill and gutted, fresh head and gutted, fresh loins and fillets targeted for resorts. There are also future plans to produce smoked and dried fish for sale in retail outlets on Malé. In addition the proponent plans to have a fishmeal plant with a capacity of 10-15 MT / day which will essentially leave nothing to throw away from the processing activities. The fish meal is intended for sale as component for producing poultry feed or as making aquaculture feed.
6. The Island Council is not able to provide the utility services and so production of water and electricity will take place on site. Initially the plan it to produce 10 MT of fresh water a day supplemented by rainwater harvests. Source water extraction for RO plant is from a bore-hole drilled on site. The borehole will be done by professional

and following the guidelines provided by EPA. The depth of the borehole is around 25-30 m well below the fresh water lens in the area. Water will be stored at site on large plastic tanks. Two sound proof gensets of 125kVA each is installed. Maldives Energy Authority's Regulation will be followed including registration of the power generation system

7. Ice will be produced at site for sale and distribution to the fishermen along with the ice-boxes. The plan is to educate fishermen on post-harvest handline and improving quality similar to the approach adopted in the successful large yellowfin handline fishery. There are also plans to have reefer vessels with ice to collect fish from atolls away from the central Maldives. For smoked and dried fish processing requirements steaming, smoking and drying chambers are fitted. The former is being ordered off the shelf, but the latter two is being custom-fabricated locally.
8. The purchase of fish will entirely be from local fishermen. Fortunately the area is popular for reef fishing; islands of Maalhos, Himendhoo, Mathiveri, Bodufulahodoo and Ukulhas are all popular reef fishing islands. Maalhos Island is strategically located in the atoll, the channel in the north and south (Maalhohu uthuru Kandu and Himendhoo Kandu) are popular crossing by the fishermen into the ocean and from the ocean side. In this sense the facility is well placed for the fishermen on their route to home ports after fishing. The area used to be popular for shark fishing and many are looking for additional work and so the news of establishing the processing factory is welcomed by the fishermen.
9. Waste from the facility will be minimal. Fish waste (from cutting and cleaning) will be used to produce fish meal. Blood water from the factory floor, grey water from toilets and brine (reject water from RO plant) will be collected in a tank underground and pumped into the western side outside the reef. Release of sewage will be minimal as there are no accommodation facilities on factory block. Lube oil and waste oil will be collected in plastic container and disposed appropriately. Any solid waste other than fish cutting will be disposed at the island waste processing facility.
10. Impact prediction exercise was undertaken in qualitative manner or a pre-defined generic template that included all the possible areas of impact from a related development projects. For the impacts that were positive or negative, scores of impact significance were assigned (negligible, moderate, major, beneficial, none). Only few negative environmental impacts were identified. These include moderate negative impacts from odour, potential over-exploitation of fisheries resources in the event of poor or lack of fisheries management from the authorities, potential damage to vegetation from collecting wood (if the plan for processed products starts), burning of significant amount fossil fuel for production of water and electricity and increased transport traffic and potential oil and other forms of pollution of the Maalhos harbour. All were found to be reversible impacts and appropriate mitigation measures are proposed for each.
11. Significant positive impacts were potential to create additional jobs and sustaining livelihoods of fishermen badly needed following the complete ban of shark fishing, better utilization of fish waste and improved opportunities for resources management by the authorities through monitoring control and surveillance and the large positive socioeconomics impact to Maalhos island creating multiplier effects for improving and expanding economic base of the island community.

12. The unique, innovative and a special aspect of the project is its link with the tourism. The project creates market space (for fishermen) and improved efficiency and health and safety of fishery products. Most importantly it adds value to the catch supporting government's over-arching objective of sustainable utilization of the fishery resources.
13. The island council members are in agreement with this development project and they are happy to endorse the work of the Fish World Maldives Pvt Ltd. An environmental monitoring programme involving monitoring the water quality of the harbour area is proposed.

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# 3 BACKGROUND AND CONTEXT

Tourism in the Maldives is expanding rapidly. Over 100 resorts are in operation, spread out over the entire archipelago, but concentrated in the central area (Figure **1**). A major aspect of the Maldives tourism product is fresh reef fish in the gourmet meals served in dining outlets on the resorts. It is estimated that 1.29 kg[i] of reef fish are consumed per tourist night on resorts which puts and estimate of annual consumption of reef fish during 2006 to over 7,100 MT a year (Sattar et. al 2012).

There are a number of ways of supplying reef fish to resorts. Resorts may employ staff to go reef fishing as required. Alternatively resorts may contract fishermen from neighbouring islands to fish for them as and when required. Often at times fishermen may call to resort if they feel the need to sell the fish to the resort. Alternatively many resorts save the catch from the night fishing trips[1]. Many resorts close to the Malé have agents who buy reef fish from Malé market and transport them to the resorts in their supply vessels.

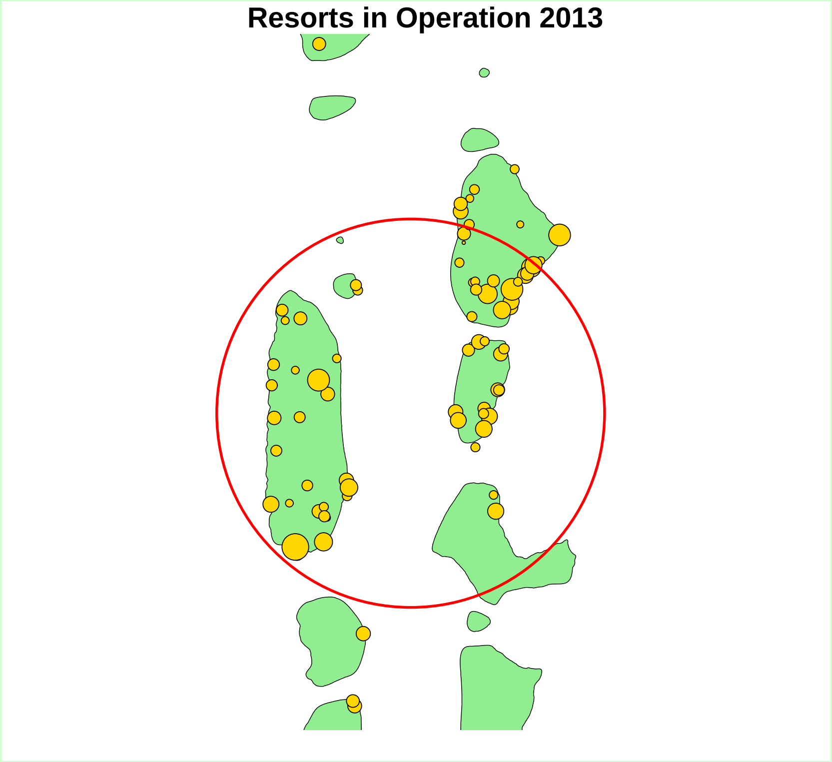

Figure 1: Tourist Resorts in operation in 2013. Area of the circles are scaled to the declared bed capacity during 2013. High concentration of resorts (bed capacity) in the project area is evident Source: MoTAC Tourism Year Book 2013.

Form a management aspect of the resort purchase of fresh fish is the responsibility of food and beverage manager. While most resorts do not have blast freezers[2] most resorts freeze and store the fish in regular deep freezers or in cold storage facilities.

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[1] Night fishing trips are a leisure reef fishing activity undertaken in every resort. It is estimated that more than 70% of the tourists participate on night fishing trips.

[2] Blast freezer) Low-temperature evaporator, which uses a fan to force air rapidly over the evaporator surface.

Staff employed in the kitchen often not made aware of the importance obtaining optimum yield from the fish. As a results considerable quantity of fish are wasted.

During the fact finding missions conducted by the proponent as part of the market survey it was revealed that many resorts are not aware of the poor yield from the reef fish. When asked if they would prefer a private company providing safe, reliable and steady supply of fish may responded favourably. The objective of the proposed development is to provide safe and reliable sourced of cleaned / processed fresh fish products to meet the demands of the resorts.

### 3.1 PROJECT SETTING

The project takes place on Maalhos Island in North Ari Atoll - an inhabited island of about 450 people in residence. The most recent census shows there is a marked decline in the population growth rate (-7.52) indicating net emigration[ii]. According to the manager of the facility based on the island, several families live on Malé – the capital island, for providing education for their children. Most of the working population are employed by the resorts in the area providing regular allotments to families either in the Maalhos or in Malé.

**Figure 2: Maalhos Island to show the location of the Fish World Maldives Pvt Ltd.**

Alifu Atoll has the second largest concentration of resorts in the country and was one of the first atolls that started tourism. The eight islands in the Alifu Alifu Atoll in the northern section of the Ari Atoll proper are popular reef fishing islands – thanks to the large number of resorts and the fish-trade relationships they have established with the resorts over the years. Some of the islands, for examples, Ukulhas, Himandhoo and Mathiveri were also popular shark fishing islands. With the total ban of sharks in the Maldives in 2010 the shark fishermen also have turned to reef fishing.

The context for the project is also of the fresh tuna packing and export business which can now be considered as the most lucrative fish export business in the country fetching about 50% of the total export revenue. The business is entirely based on the tuna, particularly handline caught yellowfin tuna exported to EU and lucrative markets. While many an entrepreneur have thought of the potential of packing fresh reef fish to tourist resorts none have so far ventured in this business area.

The proponent's connection to the high-end resort market and therefore of the confidence are all considered to be context in which the project take place in north Ari Atoll. The model of operation proposed would that be of same as with the large yellowfin fishery where the buyers help and encourage fishermen to increase their catch and also improve on-board handling and storage of the harvests.

The project also is taking the advantage the growing demand of the smoked and dried tuna products for the local consumption and sometime for export. Most the tuna products on sale in the Malé market are of home produce of poor quality and low standards of processing. Fish Maldives will exploit this market segment to produce smoked and dried fish.

## 3.2 OBJECTIVE AND PURPOSE OF THE EIA

Environmental impact assessment is the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made[3]. In doing it ensures that environmental considerations are explicitly addressed and incorporated into the development decision-making process. The process also anticipates and minimizes the adverse significant biophysical, social and other relevant effects of development proposals. The process aims to protect the productivity and capacity of natural systems and the ecological processes which maintain their functions and promote development that is sustainable and optimizes resource use and management opportunities.

The EIA process in the Maldives has shortcomings since it is primary focus always has been an attempt to comply with the environmental regulations **after** key decisions are made. The decision for a development project is always made before the EIA is started. EIA process in effect only identifies the impacts and consequences only in a superficial way. Regardless of findings only in extremely rare cases the project has been suspended or terminated.

The same is true for Fish World Maldives Pvt Ltd's packing facility. The atoll council has already given the permit for the development of the facility. However, realizing the importance of recognition of the facility by the government authorities, the proponent inquired about registration to the Ministry of Fisheries and Agriculture and the Maldives Food and Drug Authority (MFDA), also the EU-competent authority in the Maldives. Because the produce of the factory is not for export, MFDA's view was that the project's activities do not fall under their purview. In the end proponent decided to undertake and EIA of the project before the work is complete.

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[3] www.iaia.org (see publication and resources), accessed July 2013.

### 3.3 METHODOLODY

The EIA process in the Maldives evolved from simple environmental requirements. Following the new EIA Regulation of 2007 and later in 2012 the practice is how of relatively high standards. The EIA Regulation[4] requires screening, scoping, impact analysis and management, review, public comment and post-development monitoring (Figure 3). In order to maintain the standards, draft EIA reports are peer-reviewed by two anonymous reviewers and only registered consultants are allowed to undertake assessments.

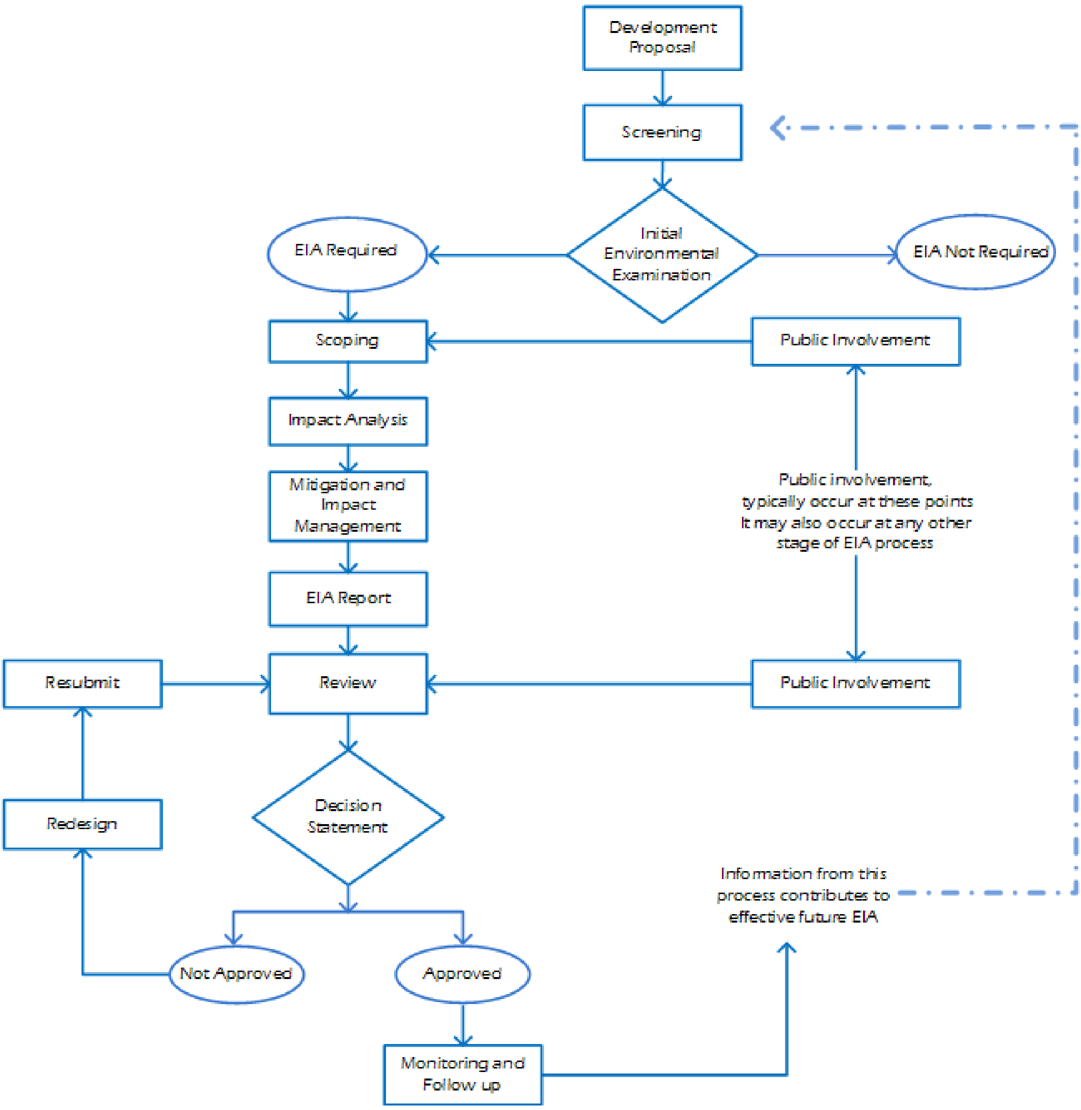

Figure 3: A general flow chart of the EIA process in the Maldives.

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[4] Environment Impact Assessment Regulations, 2007.Ministry of Environment, Energy and Water, Malé, Maldives, 74 pages. + Divehi Version (Regulation No. 20120/R-27), published in Government Gazette on 08 May 2012.

# 4 DESCRIPTION OF THE PROJECT

The basis of the project is the purchase, process, packing, marketing and sale of the variety of fish products. Unlike most of the commercial processing and packing facilities Fish World Maldives Pvt Ltd aims to sell fish locally – the tourist resorts and the retail outlets in Malé and in other larger island communities if required.

The initial concept of the project rests on the idea that resorts would require fresh and hygienically safe products for use on a daily basis to feed their guest and their local staff. Presently resorts supply fish themselves either by fishing by their employees on their vessels or purchase fish through various and ad-hoc arrangement or simply supply from Malé fish market.

It makes economic sense to outsource supplying of fresh fish to resorts so that resorts can expect and demand high quality fresh products. There is also growing demand on Malé for supplying fresh/frozen fish products to retail outlets. Currently the market is catered by the large yellowfin tuna exporters supplying products from reject fish (Adam, 2013 and Adam and Riyaz 2013).

Fish World Maldives Pvt Ltd's Project is about supplying fish products to resorts and local shops in Malé. The project is located on Maalhos Island in Alifu Alifu Atoll.

## 4.1 THE PROPONENT

Fish World Maldives Pvt Ltd is a 100% Maldivian owned company registered for the purpose of executing this Project. The objective of the Company is to purchase, process and sale and fish and fishery products in the Maldives. The company has three shareholders; two individuals and Sandy Crystal Pvt Ltd which is a subsidiary of the Silversands Pvt Ltd. Following the new Law on Decentralization, the paper works of the company have been issued through the Maalhos Island Council.

## 4.2 LOCATION OF THE DEVELOPMETN PROJECT

The development project is located on Maalhos Island on the northern side of the island. The land where the development project takes place is actually reclaimed from the material dredged during creation of the harbour basin located just west of harbour seawall (Figure 2).

According the original land use plan developed by the island council the area will be developed for commercial activities, such as hotels and restaurants[5]. As such the land is allotted to 14 equal plots each having an area of 1,200 sq feet. The allocation is grouped such that two roads cross within the area. The present land lease agreement shows that Fish World Maldives Pvt Ltd has acquired 4 plots in total. Additional two plots of land, besides it have also been leased from the original lessee (Annex 6). See also Figure 4.

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[5] Personal Communication of the Councilors at the stakeholder consultation meeting.

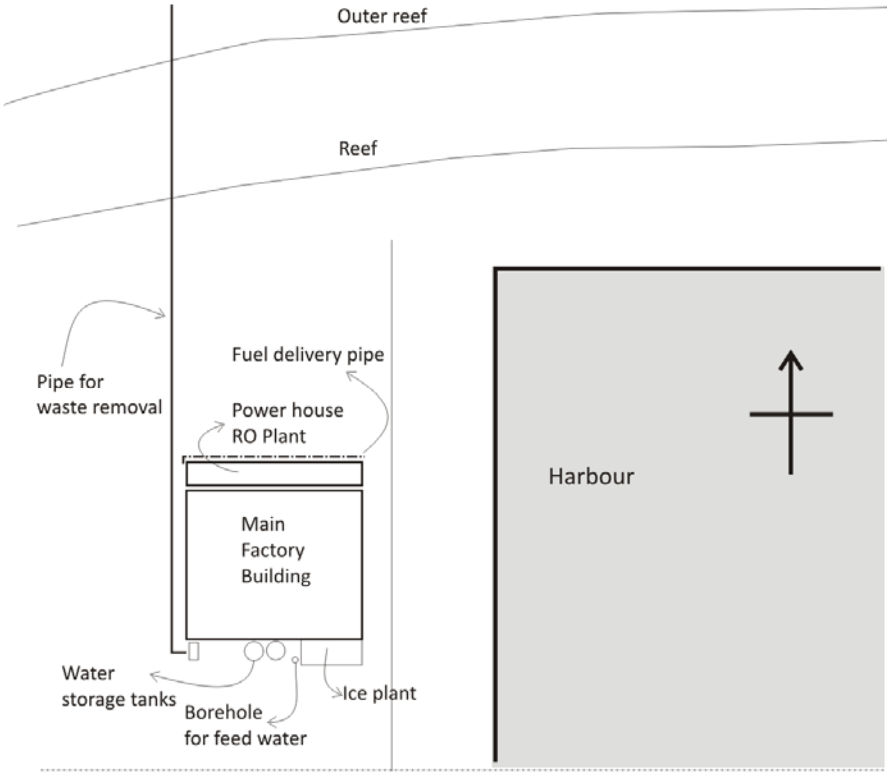

**Figure 4: Sketch of the project area. The factory is located on the east of the harbour basin.**

## 4.3 SOURCING OF FISH

Maldives has relatively large fishing fleet; targeting reef fish varieties on coral reefs and around coastal waters and tuna in the pelagic waters around the atolls. Reported national fish production is around 150,000 MT in the recent years. These include about 120,000 MT of pelagic (tuna) species and 30,000 MT of Reef fish (Figure 5).

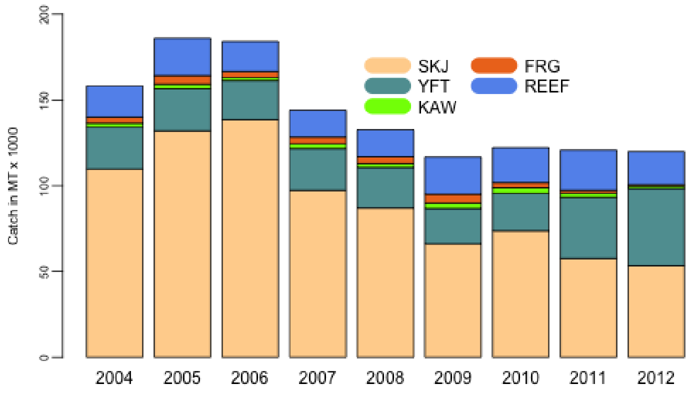

**Figure 5: Fish Production in the Maldives, Source: MoFA Statistics.**

Ari Atoll is a popular reef fishing atoll. Although there are no proper records of number of small crafts targeting reef fish, recent estimates shown there were 25 active reef fishing vessel in 2006 in Alifu Atoll, which can deploy over 525 fishing trips a month (Sattar et al., 2012). Vessels deploy handline and drop line although use of trolling and pole-and-line are also recorded. Average monthly catches of the AA and AD atoll range from 100 MT of Reef fish (Figure 6).

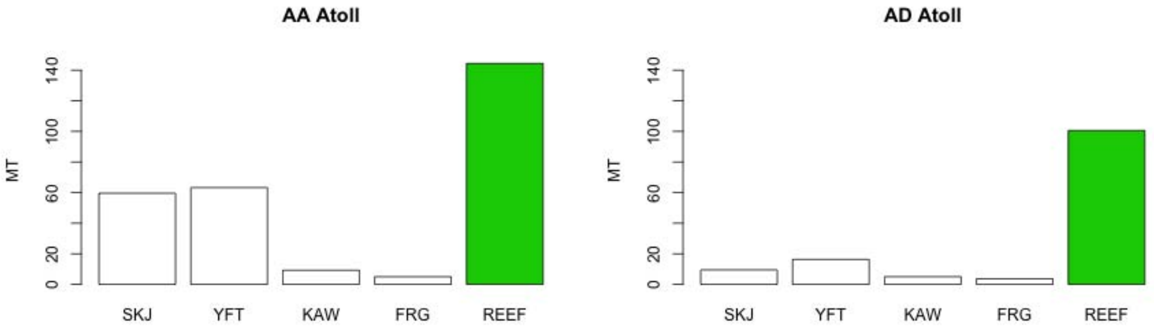

**Figure 6: Mean monthly catch (2004-2012) of fish in AA and AD Atolls. Source. Reef fishing is more popular than the tuna fishing in these atolls: SKJ Skipjack, YFT yellowfin tuna, KAW Kawakawa, FRG Frigate and REEF Reef fish, Source: MoFA**

Fish will be sourced from local fishermen and thus the supply of fish to the factory will depend on fishermen of Maalhos and in neighbouring islands. Quality and freshness of the supply will be ensured by direct engagement with the fishermen and by creating awareness of on board handling.

Similar to the arrangements in large yellowfin tuna fishery[iii,iv,v], the proponent will be supply ice boxes (200 litres – 1,200 litres) capacity. The proponent will also be providing ice and encouraging them to bleed and properly store fish on board. A training programme will be conducted for the fishermen.

The proponent expects the supply of fish from the local fishermen in the area may not meet the expected demand. To accommodate this, collector vessels will be used similar to that used in the tuna fishery. Collector vessel will have ice and capacity to store large volumes accommodating purchase the supply of fish for weeks at a time.

A general product flow diagram is given in Figure 7.

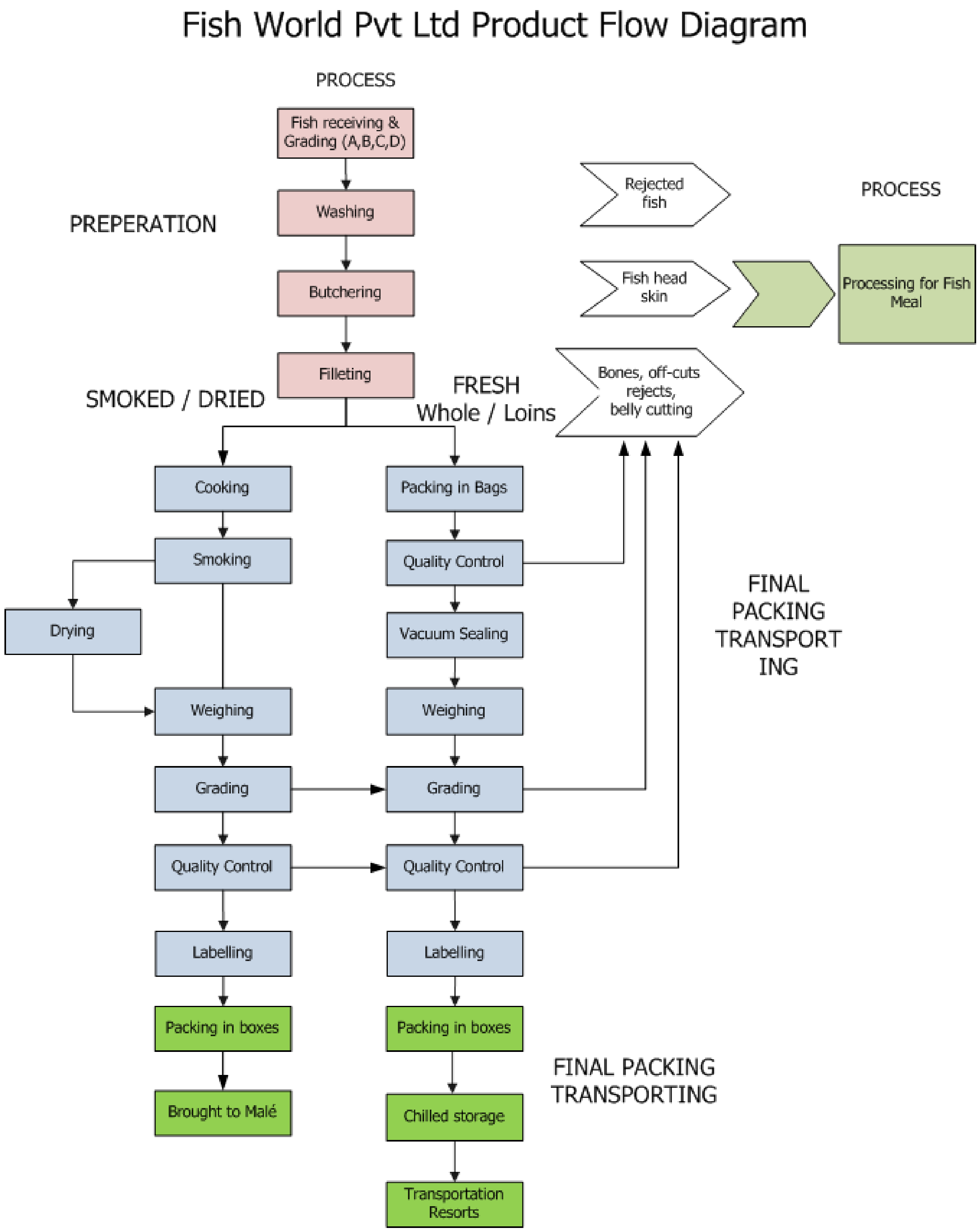

**Figure 7: General product flow diagram.**

## 4.4 SUPPORTING INFRASTRUCTURES

It is very common in Maldives to have proponent-built utility services fully contained within the boundary of the facility area. The electric gird and water supply of the islands are rarely sufficient to provide for commercial outlets. Even if the island grids can supply electricity they are often prohibitively expensive for the business to make economic sense. In other words it makes more economic sense to have power generation, water production and ice production in-built and integrated as part of the project activities.

Following the resort-development model and that other commercial developments, the proponent is proposing to have production of electricity, water, and ice on site. Other infrastructure developments required for the factory are also discussed in the sections below.

### 4.4.1 Power Generation

The powerhouse is located on the northern most section of the area. Two 125kVA units are installed connected to sync panel to be able provide seamless and continuous supply during change over the sources supply. The self-contained soundproof generators have in-built air-cooling and sound attenuating system. Power from island power supply is also connected for use during emergencies.

Maldives Energy Authority[6] requires that powerhouse are registered with the MEA with the following and documentation of the qualified professional certified by MEA. The specific requirements for registration of powerhouses are as follows:

- Information about the generation system - technical drawings to saw the system is laid out
- Generator control panel and distribution panel - singe line diagram of the panel and panel load calculations
- Fuel system – Fuel storage and handline system, include a single line diagram, type of fuel and its speciation, day take and bulk tank capacities.
- Distribution network –single line diagrams of distribution panels above 60A, layout of the distribution network, substations, distribution boxes and service cables on a scaled diagram.
- Electric cables – technical specification of the cables use of transmission, distribution and electrical installation, international conformity certification of the cables (if not approved by MEA)
- Fire fighting system and lightening protection - Certification or reference of approval of fire fighting system for relevant government authority, lightening protection design to be approved by MEA.

The most environmentally sensitive issue in power generation is the fuel system, in particular the practice of topping up day tank(s) and bulk tanks. Ideally both of them have to be in a bunded area to ensure any accidental leak does not get into the ground. It is recommended that to have bunded area where connections for the re-fuelling take place in a bunded area. Any fuel that gets leaked will be in the bunded area can be soaked in a sponge for collecting in to a container for proper disposal.

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[6] www.mea.gov.mv, accessed October 2013.

Lube oil or waste oil should be collected and properly disposed. Instruction and notices should be kept for engineers and power-staff on the sound practices of maintenance of the power generation system.

### 4.4.2 Ice Production

Ice is required to provide for fishermen to store the catch on board the vessels. Similar to the large yellowfin handline fishery and its processing business (Adam, 2013[iii]; Adam, 2013[iv]; Adam Riyaz, 2013[v]) Fish World Maldives Pvt Ltd will provide ice almost free of charge to fishermen. They will also be provided with iceboxes (250 – 1200 litres capacity).

In order provide regular supply of ice, 15MT /day capacity ice plant is being installed. The feed water for the plant is fresh (desalinated) water. Access to ice plant is at a convenient location, next to the waterfront where fishermen can purchase ice after sale of catch.

The proponent is aware of the refrigerants used in the ice-plant has the potential to contribute to global warming issues. The proponent is also aware of the great progress made by the Maldives in The Montreal Protocol on Substances that Deplete the Ozone Layer and is aware of the regulation on import and use of the refrigerants in the ice plant.

### 4.4.3 Water Production

Water will be produced on site using RO plants. Initially the proponent is proposing a 10MT/per day capacity plant. The capacity will be increased if required. The proponent is aware that plants producing more than 10 MT/day required to be registered at EPA. Desalinated water will be supplemented by rainwater harvests. Roofs all buildings will have gutters for collecting rainwater. The total storage capacity on site will be is 4 x 2,500 litres (10,000 litres) at any given time.

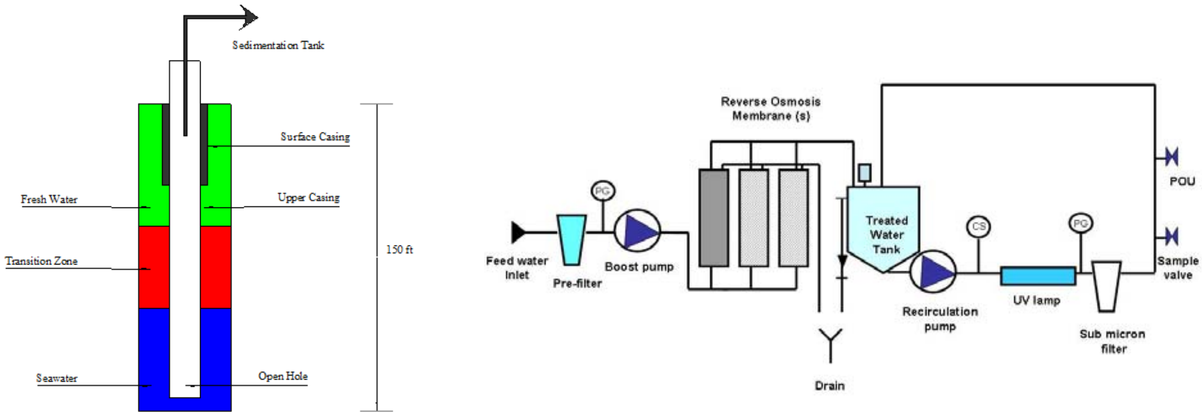

**Figure 8: Schematic diagram to show the arrangement of simple RO Plant installation system, Image from Google Image**

Feed water will be sourced from a borehole. A borehole has been made in the compound. Standard procedures were followed drilling procedure. The borehole was drilled to a depth of around 30m, well below the water table.

The sources water is initially collected tanks. The water is passed over to second tank in a cascade so as to remove any foul odour but also oxygenate in the process. The water is then passed through series of filters (often sand filters) before forcing it over the membrane. The product water is treated with dilute chlorine before pumping to storage tanks (Figure 8).

Water production by reverse osmosis is consumes large quantities of electricity about 6 kWh/m$^3$ (Table 1). It is know that the rate of product water flow is a function of the rate of raw water forced over the membranes among others (Table 1). The total dissolved solids (TDS) in product water should be normally < 150 ppm, which is reasonable. The proponent has purchased an RO Plant taking into consideration product water flow so as to produce around 10MT (or less) during the initial phase.

**Table 1: Table to show relationship of raw water flow, product water flow and power consumption in different models of RO plants (extracted from FEN brochure of MWSC, Oct 2013).**

| Capacity / Model No. | FEN-P50/ FEN-P50-EN | FEN-P100/ FEN-P100-EN | FEN-P150 / FEN-P150-EN | FEN-P200/ FEN=P200-EN | FEN-P250/ FEN-P250-EN |
|---|---|---|---|---|---|
| Raw Water Flow | 6.25 m$^3$/hr | 13 m$^3$/hr | 19 m$^3$/hr | 25 m$^3$/hr | 32 m$^3$/hr |
| Product Water Flow | 2 m$^3$/hr | 4.16 m$^3$/hr | 6.25 m$^3$/hr | 8.33 m$^3$/hr | 10.41 m$^3$/hr |
| Water Recovery | 33% | 33% | 33% | 33% | 33% |
| Power Consumption | 5.7 kWh/m$^3$<br>EN-2.6 kWh/m$^3$ | 5.7 kWh/m$^3$<br>EN-2.6 kWh/m$^3$ | 5.7 kWh/m$^3$<br>EN-2.6 kWh/m$^3$ | 5.7 kWh/m$^3$<br>EN-2.5 kWh/m$^3$ | 5.7 kWh/m$^3$<br>EN-2.6 kWh/m$^3$ |
| Product Water Quality | TDS < 150ppm | TDS < 150ppm | TDS < 150ppm | TDS < 150ppm | TDS < 150ppm |

The reject water or brine is first discharged to the concrete tank underground (Annex **2**). It is then pumped outside the reef on the western side along with the waste water. Wave conditions at the site are such that there will be instant mixing of discharge with the water column diluting brine to background levels almost instantly.

Water plants with production capacities >10MT/day should be registered with the EPA. The main registration requirement would be conduct baseline water quality tests from water samples from the extraction area, the source water, the product water and from the area of brine discharge (see Annex 9). It is recommended that water plant be registered should the proponent decides to increase the production capacity in excess of 10 MT/day.

At the time of this writing, water quality tests of the product water have been undertaken and the tests results fall in the range of the accepted levels in WHO guideline of drinking water (Annex 9).

#### 4.4.4 Fishmeal Plant

Fish processing produces quite large volume of waste. It is know that 30% of wet weight is waste in the fish cutting process in Malé Market (Pers. Obs., 2013). Only about 60% of wet weight is recovered in the loins and fillets product line in the export business of fresh large yellowfin (Waseem, M., Pers. Comms., 2013). While the waste from Malé Market is tipped over to the reef every evening, waste is recovered to produce secondary products from the large yellowfin export business. Elsewhere, in other countries, a fishmeal production activity goes hand in hand with fish processing business.

Following this model, the proponent is proposing to harvest waste from fish cutting and processing lines and make use of them to produce high quality fishmeal. Initially the investment will be of a plant capable to handling 10 MT/day of fish waste. The proponent plans to make this investment a second phase of the development of the project, restricting the current product lines to only fresh fish products.

Fishmeal is made by either cooking, pressing, drying and grinding of fish or fish waste to which no other matter has been added. It is a solid product from which most of the water is removed and some or all of the oil is removed. Four or five tonnes of fish are needed to manufacture one tonne of dry fishmeal[vi]

The stages in the fishmeal production are as follows:

1. Cooking: This is the most important and critical stage in the production of the fishmeal. Incomplete cooking means that liquor from the fish cannot be pressed out satisfactorily and over-cooking makes the material too soft for pressing. No drying occurs in the cooking stage.
2. Pressing: Generally a perforated tube with increasing pressure is used for this process. This stage involves removing some of the oil and water from the material and the solid is known as press cake. The water content in pressing is reduced from 70% to about 50% and oil is reduced roughly 4%.
3. Drying: An important aspect of this stage to get this right. It the fishmeal is under-dried moulds of bacteria may grow. It if is over-dried scorching may occur and this reduced nutritional value of the meal. Two types of drying is used; direct method is pass of very hot air (500 degree C) over the material and is tumbled rapidly in cylindrical drum. This is a quicker method, but heat damage is much more likely if the process is not carefully controlled, indirect method is cylinder with fitted heated discs, which also tumble in the meal.
4. Grinding: The last stage of the production which involves breakdown of any lumps or particles of bone

Normally the process is fully self-contained and assembled as a single unit (Figure 9). The floor worker has to feed the raw material and monitor the processes. The final product is grinded fishmeal produced in every batch.

The location of fishmeal plant is not decided yet. The plan is to request for an additional plot adjacent to the facility (Annex **2**). The fishmeal will be for export, but also to meet the anticipated local requirements for poultry feed and/or aquaculture feed production. According to Ministry of Fisheries and Agriculture, a donor-assisted Mariculture Enterprise Development Project (MEDAP) has already started (www.fishagri.gov.mv, accessed October 2013).

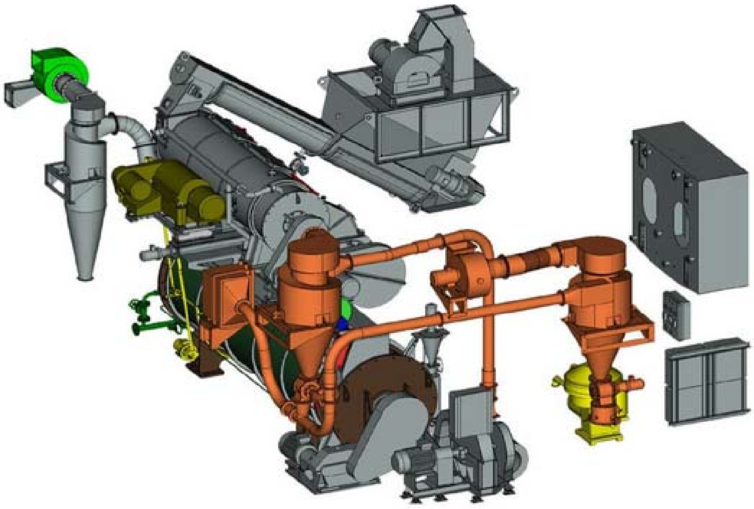

**Figure 9: A diagram of modern fish meal plant (www.alibaba.com/products-free/ Nov 2013)**

### 4.4.5 Steaming Chambers

It is proposed to use steam for cooking the fish. Two electric powered chambers will be acquired from overseas manufactures. The chambers come with steam production units, installed not too far from the chambers.

De-headed, gutted, and cleaned fish will be stacked in series on the trays for steaming. Following steaming the fish would be cleaned before smoking and drying require making dried fish.

### 4.4.6 Smoking / Drying Chambers

Smoking is the process of flavouring, cooking, or preserving food by exposing it to the smoke from burning or smouldering plant materials, most often wood. In traditional preparation of Maldives fish, smoking is done on racks it the kitchen where smoke is produced from coconut husk, palm fronds and firewood collected from woods.

According to the proponent, the design of the smoking and drying chambers will be adopted from what is currently used in the southern atolls by the fish processors. The chamber will be of sheet metal with metal frame where railings are fixed for racks. The wood for the smoke is burnt in a tray underneath. The chimney will rise above the building roof so that the smell and the smoke will be dispersed with the air stream.

Drying chamber is of similar design. But they are separate from smoking chambers and use different types of firewood, which takes more time to burn and therefore maintain heat. In practice the objective is not to heat too much or too rapidly, but keep the heat low and for longer periods.  Coconut and husk and firewood will be collected from the woods for both smoking and drying.

According to the proponent investments for facilities and machinery for the production of processed products and fish meal will be in the second phase of development.

## 4.5 STAFF ACCOMODATION

Unlike some of the fish processing facilities that exit in the Maldives, Fish World Maldives Pvt Ltd will not have accommodation units on site. Instead any accommodation that may be required for the staff will be rented out from the island. Already there is house rented for senior people.

## 4.6 ENGINEERING WORKSHOP, REPAIR YARD AND CARPENTRY

Due to the nature of the activities in the facility (ice production, water production and power generation) access to engineering and repair services will be important for maintaining plants and machinery in working conditions. To address this small engineering workshop will be built at site, alongside the powerhouse. Qualified engineers and mechanics will be hired to work at the engineering workshop. Larger jobs are handled by the engineering workshop in the island or brought to Malé or engineers are hired to do the job.

## 4.7 PRODUCT RANGE AND PROCESSING

The core objective of the project is to buy fresh fish, process and pack in a variety of forms for sale to tourist resorts and for local consumption. The products range from fresh whole, gill and gutted, head and gutted, and fresh loins and fillets. Processed products include smoked, dried fish and fishmeal from the waste generated by fish cutting which will be done in the second phase. A summary of product ranges and processing is given in Table 2.

**Table 2: Summary of product range and processing proposed for Fish World Maldives Pvt Ltd.**

| Raw material | Product(s) | Target Consumer | By products |
|---|---|---|---|
| Fresh Reef Fish (job fish, rainbow runner, snapper, wahoo, dolphin fish, breams, jacks, sailfish, etc.) | Fresh whole and/or fillets<br>Vacuum packed loins | Tourist Resorts and for outlets on Malé | Fish meal,<br>Fish cutting sold as bait for fishermen |
| Tuna (Skipjack, yellowfin, bigeye, Kawakwaka and Frigate tuna) | Fresh whole; loins and fillets | Tourist Resorts and for outlets on Malé | Fish meal<br>Cuttings sold as bait for fishermen |
|  | Smoked Tuna, dried tuna | Local markets and outlets on Malé | Fish Meal |

### 4.7.1 Fish Cutting and Butchering Area

Following the HACCP approved plans and the product flow arrangement; fish will be delivered in baskets from the marked entry point. At delivery fish would gilled and gutted and bled well and so cutting butchering will not be messy.

The cutting area in the factory large, about 30x30 feet, fully air-conditioned area. The cutting takes place on industry standard stainless steel tables with appropriate arrangements for separating collecting the offal. The exact procedure for cutting and butchering may be different for different products.

Following cutting and butchering and depending on product being processed it will go either grading and packing (for fresh products) or steaming in the case of the smoked and or dried products.

The fish waste (skin, fins, vertebrae, read meat, head, tails) collected in bins is discharged from the marked exit door and taken to the fish meal plant. The fishmeal plant is housed in a separate building along with the steaming, smoking and drying facilities (Annex **2**).

### 4.7.2 Grading and Packing

For the fresh packed fish, following cutting and butchering, grading and packing will take place. Packing depends on the order received from the clients (in this case the resorts). It is likely the tourist resort would like to see cleaned whole fish received in good conditions. Normally it is expected the cleaned fish will be vacuum-packed individually and placed in Styrofoam boxes. Gel ice will be placed for long distance transports

### 4.7.3 Steaming

Steaming will take place for the products that requires smoking or drying. Steamers will be placed in a separate building. Steamers are essentially large cupboards where fish are placed on trays. Three such steamers will be used at the start and will increase the capacity depending on demand for processed products.

### 4.7.4 Smoking and Drying

Smoking and drying will take place in locally fabricated smokers and dryers. They are essentially smoke/heat retaining chambers where fish are placed in trays in stacked racks. Wood will be burnt in trays underneath the chambers to produce smoke and infuse the product. Smoking is done by burning wood (coconut husk, dry palm leaves, and fire wood collected from woods locally). Drying is similar except the type of wood used will be slightly hard so that heat is retained longer periods of time.

### 4.7.5 Vacuum Packing

The final stage of the products will be vacuum packing. The packing room is the in main hall, but separated. Products can be passed from the lines for the packing room, where it will be graded and packed.

## 4.8 HACCP

Hazard Analysis, Critical Control Points (HACCP) procedures is a systematic preventive approach to food safety and allergenic, chemical, and biological hazards in production processes that can cause the finished product to be unsafe. It also deals with the design measurements to reduce these risks to a safe. For local production HACCP plans are not strictly required. But for production targeted to export, particularly to Europe, the approval from HACCP plan from the EU-competent authority is required. The EU-competent authority in Maldives is Maldives Food and Drug Authority (MFDA)

Although Fish World Maldives Pvt Ltd does not necessarily target their products for export, they have followed the HACCP plans. The floor plans and product flow lines are now approved by the MDFA (Annex **4**). Once the work starts a series of dry runs are undertaken in the presence of MFDA officials to obtain their approval. The approval would constitute issuing of by-annual Certificate of Compliance. There may alternations or monitoring that may be required even after the authorities have approved the HACCP plans.

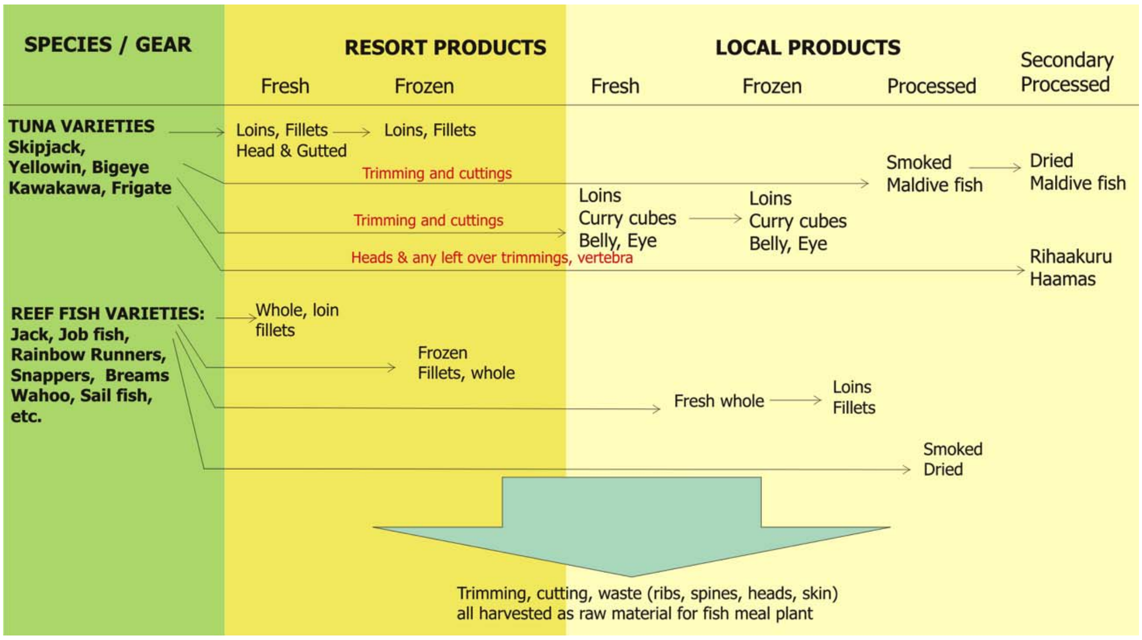

**Figure 10: Possible product lines and their associated secondary products for Fish World Maldives Pvt Ltd – Maalhos Island.**

Fish World Maldives Pvt Ltd intends to fully comply with EU-competent authority on food safety and hygiene. The proponent also plans to obtain ISO22000:500, which the international standards relating to the packing of fresh which also considers the HACCP procedures.

## 4.9 FUEL HANDLING AND FIRE SAFETY

A reasonable amount of fuel, close to 750 litres, is stored in the day-tank for use in power generation. Refilling of the day tank takes place at regular intervals, around three times a week, and will be done means of a pump from the storage tank not far from the day tank. Leakages or drips should be avoided by placing the connection in a bunded area. Any leaks will be caught in the bund, which can be removed for safe disposal. Same procedure should be applied when filling the storage tank. In this case either fuel will be brought in barrels or a fuel-barge will pump into the storage tank.

Lube oil and waste oil will be collected in the plastic drums and will be disposed responsibly. In areas close to the Malé, they are often brought to Thilafushi for proper disposal, but elsewhere it may be used for applying on form works of for concrete. Such re-use of the lube-oil should be explored.

## 4.10 WASTE COLLECTION AND DISPOSAL

Waste generated in the factory will consist of the following

1. Factory floor waste (blood water with mixed with cleaning chemicals)
2. Gray water from toilet flushing and sinks

3. Rejected bring from the RO Plant
4. Waste related to packing material and other sources (solid waste from factory)

All liquid waste from the factory (points 1, 2, and 3) will be drained to the collection tank underground in the compound. The waste water in the tank is flushed into the ocean (outside the reef) where it will instantly mix with turbulent water. It is expected that these releases will have negligible negative environmental impact (cf. Figure 4).

The solid waste will be collected in a bin and disposed appropriately at the island waste management centre.

# 5 LEGISLATIVE AND POLICY CONSIDERATION

The Environmental Protection and Preservation Act (EPPA) (Law No. 4/93) is the main legal instrument that provides statutory power for the Ministry of Environment and Energy on environmental regulation and enforcement. The EPPA states that natural environment and its resources are a national heritage, that needs to be protected and preserved for the benefit of future generations and that the protection and preservation of the country's land and water resources; flora and fauna as well the beaches, reefs, lagoons and all natural habitats are important for the sustainable development.

The main regulation stemming from EPAA for regulating environmental issues of development projects is the Environmental Impact Assessment Regulation of May 2007. The Regulation provides a comprehensive outline of the EIA process including various processes from project screening, scoping, public comment, and appeal and issuing of the decision notes. The EIA Regulation also gives the implementing agency, EPA, the powers of implementation of its provisions. The line ministries require coordinating with MoEE on environmental issues in development projects and ensure regulations relating to development projects are consistent with Environmental Regulation.

With regards to projects relating to fisheries, the line ministry is the Ministry of Fisheries and Agriculture (MoFA). All matters relating to the fishery development, mariculture/ aquaculture, fishery regulation, and management and monitoring are executed and implemented by the MoFA. Development projects on fisheries and mariculture require EIA by law (as indicated in the Appendix II of the EIA Regulation) are expected to complete the EIA and provide the decision notes before issuing required permits for operation.

In the recent years, a number of developments in fishery regulatory framework have taken place with main objective of improving monitoring and enforcement. These developments are related, in part, to the requirement for Maldives to engage and play an active role in the regional fishery management organization, such as the Indian Ocean Tuna Commission (IOTC) and relating to requirements for export of fish and fishery products into EU Territories.

## 5.1 THE FISHERY LAW

The Fishery Law (Law No. 5/87) governs the fishery activities in the country. The Law is based on 14 articles and there are few instances of specific reference to fisheries development and management. Articles 3a and 3b states that MoFA is 'hereby empowered to formulate and administer regulation on matters relating to fisheries" and in article 3b goes on saying that the MoFA 'shall oversee all fisheries activities in the country. It shall be the obligation of the MoFA to explore the possibilities of the development.

Recognising the Fishery Law (5/87) is out-dated the Ministry has been working on a new fisheries bill since 2003. The bill was submitted 2007 and debated in Majlis. However, due to widening differences of opinion on some of the provisions relating to development and enforcement, the Government decided to withdraw the bill for revision. Since then nation-wide consultations have been undertaken and revisions have been incorporated. It is hoped that revised fisheries bill will be submitted to Majlis for debate later in the year.

Lack of regulation and enforcement in fishery issues has been partly hampered by the delays in the new fishery bill. There appears to be a number of requirements of fishery management and monitoring that cannot be enforced with the existing Act (Law No. 5/87). Despite the shortcoming some regulation are being implemented of which most are very recent. Below is a non-exhaustive summary of the fishery and related regulations regarding export of fish and fishery products from the Maldives.

### 5.2 FISHERY REGULATIONS & GUIDLINES

The regulations relevant for fish processing and packing facilities are given below.

1. **Maldives Fishery Regulation:** This is a generic regulation that came into effect in late 1990s. The regulatory power for this regulation is stipulated in Article 3a of the Fishery Law (5/87) that empowers the MoFA to formulate and administer regulation on matters relating to fisheries. The Regulation covers but is not limited to the following:
    a. Fishing on reefs and lagoons
    b. Prohibited fishing activities
    c. Banned species in the Maldivian EEZ
    d. Reporting of fishery activities
    e. Issuing of permits in relation of fish processing and export
    f. Conducting research in the EEZ
    g. Monitoring of foreign fishing.

    Article 7 of the Regulation refers to issuing permits for projects relating to fish processing and export. It states that parties or individuals wishing to start projects on fish processing and export shall obtain written permit from MoFA. This is to ensure that the investor does not face difficulties down the line due changes in the rules or otherwise.

2. **Guideline for Preparation of Fisheries Project Proposals:** This guideline is a direct outcome of the major shift of fishery policy beginning 2000 to encourage private sector investment following cessation of state control on export of fresh tuna. The guideline (for fishery and mariculture) is intended as an information package for start-ups for submitting their business proposal. The proposal is focused on the extent and nature of investment and its economic feasibility. As such information on investment planning, and financial feasibility is required. The last requirement in the guideline is the ‘Environmental Aspects’, which states development proposal should include an environmental statement that gives an account of the existing environmental conditions of the proposed project locations. An evaluation committee consisting of officials of MoFA and Department of National Planning evaluates the project. Finally, the Minister endorses the projects except that difficult cases are submitted for Fishery Advisory Board (FAB) for advice. Before any project is given the final approval, environmental impacts assessment study is required and its Decision Note should be presented to the Ministry. Prior to 2010 there have been instances where it was approved without the Decision Statement from EPA. These have been due to lack of coordination from between the Ministries.

3. **Regulation on Fishing for Large Yellowfin and Export of Large Yellowfin Tuna from the Maldives:** The regulation is intended essentially to license the fishery targeting large (>60-70cm fork length) yellowfin for export specifically into EU-territories. This includes the handline and longline fishery, which target yellowfin in the case former and the latter bigeye and yellowfin tuna. The move is also to comply with the EU – IUU (Illegal, Unregulated and Unreported) Regulation which requires to be complied with should exports occur into EU-territories. The regulation states that an export license shall be issued from the Ministry of Economic Trade. It also talks of the requirement of the health and safety certificate emphasising of quality of export. Finally it requires for longline vessel to have vessel monitoring systems and observes on-board should Ministry wants. There are also other requirements of issuing 'catch certificate'- a signed document by the captain of the vessel stating the fish comprising in the export shipments were caught by the vessel. MoFA has institutionalized a Catch Certificate Office in Hulhulé to deal with the paper work of export shipments. The catch certificate is essentially an instrument for used of chain of custody or in traceability of shipments.

4. **DRAFT Regulation on export of fish and fishery products in to European Union:** This is a draft regulation available on the website of the Ministry of Economic Development[7]. Formulated in reference to Law No 31/79 (Maldives Export Import Law), in the preamble it states that the regulation is now required due to increased volume of fish export into EU market and the need for Maldivian producers and processor to ensure the EU-Directives are complied with. It talks of various directives of the Council of the European Community and the competent authority in the Maldives, i.e., Maldives Food and Drug Authority (MFDA). The regulation has not come into force although MoFA's regulations help to comply with most of the EU Directives.

5. **Regulation on fishing for sale to fish exporters and licensing of fish and fishery and aquaculture products:** The Regulation is also related facilitating to comply with the EU-IUU Regulation. The regulation is about licensing of the facilities (fish processing, aquaculture ornamental facilities). The license is given for one year on renewable basis. The Regulation talks of providing catch certificates for shipments exporting into Europe, which information such as vessel registration number, and the date of catch of the fish the shipment contains. Compared to the Regulation in #3 this is a general regulation aiming to regulate fishing for export or sale of fish exporters and processors intending to export or sale to exporters, parties who hold live-fish for export and aquaculture facilities.

There are other regulations that indirectly relevant for the development project under considerations. These are mainly for fishing activities, boat-building codes.

### 5.3 REGULATIONS ON HEALTH AND SAFETY

1. **Regulation of food advertising:** The regulation is important for fish processors as significant proportion of the produce (packed fresh fish) is marketed locally. The regulation is specifically on advertising. It talks of the obtaining prior permission

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[7] www.trade.gov.mv/?lid=5, accessed January 2013.

from the Department of Public Health on any advertising and marketing campaigns on food products.

2. **Regulation on Food Hygiene Standards (health certificates)**: The regulation is intended to giving powers to government authority to inspect health and hygiene standards of outlets processing, producing and/or selling food products. Some the packing facilities have subsidiary outlets or they regularly supply to retail shop on Malé and on islands, and for the resort market. This regulation will apply to them.

### 5.4 OTHER REQUIRMENTS

1. **Island level regulations**: Following enaction the Decentralization Law the Local Government Authority has encouraged atoll/island council to make their regulations. Some Council have been able to formulate regulations relating to use of the harbour and garbage disposal on the island. These if exist in the project these will be applicable and relevant for the project.

2. Production of water and power generation takes place on project site. The regulation of Maldives Energy Authority (MEA) requires to register power production systems and regulation of the Ministry of Environment requires water production plant be registered at EPA if the production capacity exceeds 10 MT/day. The regulation essentially requires to the conducts comprehensive water quality tests from extraction area (borehole or sea), reject water discharge area and of product water.

3. A new regulation on waste disposal comes in to effect in February. This requires the waste producers also to be responsible to ensure the waste is disposed appropriately. Fish World Maldives Pvt Ltd is not expected to produce hazardous waste or special waste as described in the regulation.

# 6 EXISTING ENVIRONMENTAL CONDITIONS

Developing projects that require undertaking a full impact assessment study normally takes place in uninhabited islands. In such cases, description of existing environmental conditions cover the entire island; the terrestrial and marine environment. In such cases it is easy to determine the baseline conditions and also monitoring change relative to the baseline conditions over the life of the project. In such cases it is quite common to describe marine and terrestrial environment in separate headings and in considerable detail.

The commercial activities undertaken on Maalhos by the Fish World Maldives Pvt Ltd are different. The development and its activities are restricted to a small area allocated to the proponent. As such the activities take place in an enclosed area and have a small direct environmental foot print. Nevertheless because the project is embedded within the island community the indirect (or spill-over) effects are relatively large.

The area where factory is built was reclaimed about 5-8 years ago. Naturally the area is away from the village and the surrounding environment is also different. The description physical environment is therefore limited in scope as was also agreed at the Scoping Meeting. The key environmental issues of relevance to this project considered include physical aspects of the project area.

The components considered in this section are:

- Data collection methodology
- Geographical setting
- Coastal and marine environment
- Seawater quality
- Vegetation

## 6.1 DATA COLLECTION METHODOLOGY

As indicated earlier, the development work of the project has now started. As such this EIA draws existing information of the project location as well as field investigation to collect baseline data. Baseline data are important to determine reference points from which future trends or changes can be compared. Only qualitative data collection approaches were appropriate. Field investigations were conducted to supplement the available data, where it was lacking. Both qualitative and quantitative methods were used to collect data including field surveys; visual observations using photo imagery and interviews with key project personnel.

## 6.2 GEOGRAPHICAL SETTING

The island of Maalhos is located on north western rim of the Ari Atoll. Maalhos is the only island on the reef covering about 40% of the total reef area. The island is about 40 hectares in size. On north is the inhabited island of Feidhoo and in south in Himendahoo. In between the islands is the Maalhos Uthuru Kandu and Himendhoo Kandu (Figure 11). A shallow atoll rim reef of Ranfaru exists between Feridhoo and Maalhos.

**Figure 11: Location of Fish World Maldives Pvt Ltd on Maalhos Island.**

## 6.3 MARINE AND COASTAL ENVIRONMENT

The reef of Maalhos is quite distinct in character. This isolated oval-shaped reef is along the east-west axis. The western end of the reef is well-developed due to the exposed conditions of the ocean-ward side (Figure 11). There is no lagoon but an extended back-reef is well developed on the western side. Spur and groove formations is visible on the satellite photo displaying the dynamic and high-energy nature of the area.

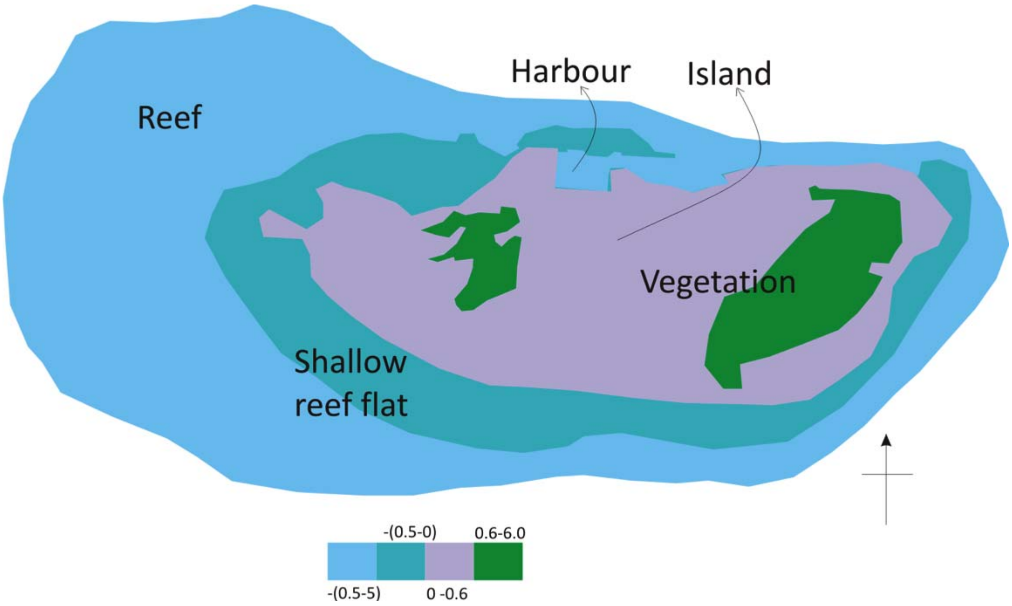


**Figure 12: Thematic map of Maalhos island to show the reef and vegetation cover. The elevation given is rough estimates.**

The distance from the reef crest to the visible edge of the slope is about 400-450 m on the western side, but only about 100 m on the east. Owing to no natural harbour, a harbour basin was dredged on the northern side of the island 5-8 years ago. Rubble-mound (granite) structures have been placed on the northern and north western side of the harbour giving adequate protection.

There appears to be 11 ‘environmentally sensitive sites’ around the area (in Alifu Atoll, see Figure 13. The locations of these sites and areas are only an estimate according to the EPA (Ibrahim Naeem, Pers. Comm. Oct 2013). The closest such area to the project site is gravel bed on the southern tip of the Ranfaru reef.

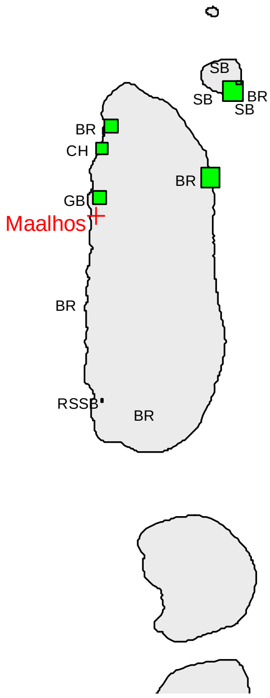


**Figure 13: EPA declared Environmentally Sensitive Areas around the project site; the size of the square is the area (drawn to log-scale): CH (channel), GB (gravel bottom), BR (bottom reef), SB (sand bank), RS (reef system) - Data source: EPA**

## 6.4 VEGETATION

At the project site, there is hardly any vegetation. As indicated earlier, the site is reclaimed area and only few trees are present during the time of survey. Only few (<5) coconut palm trees are present at the site.

The urban area of the Maalhos in the centre and so vegetation is present on either side of the island (Figure 14). Coconut palms dominate the vegetation cover of the island. However, large dhigaa, and hirundhu trees are also present in private plots.

**Figure 14: Sketch to show the extent of the vegetation around the urban. The harbour entrance the area and the foot print of the Fish World Maldives Pvt Ltd is shown.**

## 6.5 SOCIOECONOMIC CONTEXT

Maalhos does not have a large population; the last census showed around 450 people reside on the island. Like other islands around the area, many people on Maalhos depend on small-scale fishing as means of earning their living. Some of them have direct contracts with the nearby resort to supply fish and others simply sell their catch to resorts on opportunistic basis Many fisherman are also employed by some resort to for catching required for the resort.

The resorts around the area also employ quite a large proportion of the working population of Maalhos. Same amount of people or more also work from Malé since it is quite common for families to rent apartments in Malé for educating their children. According to ex-island office official, Maalhos people accord high on educating the children. Many either not happy about the local school or simply for the desire to provide a better education lives and works from Malé.

A popular café is operated on the island where crowd is always gathered for socializing, especially youth. Many who also visit the island, such as visiting safari boats or resort supply vessels make use of the café providing reasonable amount of income to the island.

It is reasonable to assume to that Maalhos will be an average island in terms of economic prosperity. A good harbour with exists on the island, and Island Councillors are keen to develop the island.

## 6.6 FISHERY RESOURCES

The viability of the project depends on sustained levels of fish catch by the fishermen. Since the proponent is proposing to pack and/or process both reef fish and tuna, both coastal and pelagic resources should be in good shape for the project to viable in the long term.

### 6.6.1 Reef Fishery

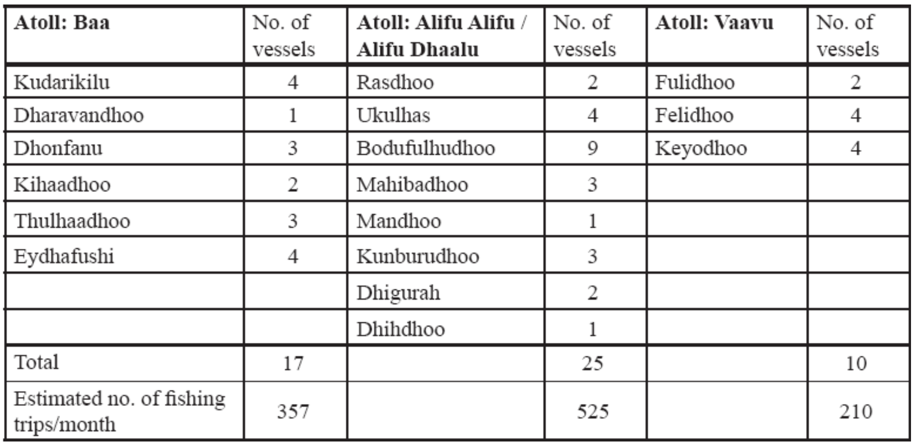
Traditionally Maldives does not have a targeted reef fish fishery. Inception of tourism beginning in mid 1970s started the reef fishery in the Maldives that we see have developed today. During middle of middle of 1980s export-oriented reef fisheries started[vii]. This lead to over-exploitation of some of the slow growing and easily exploited resources. Today grouper and other common varieties of reef fish are exported fresh and/or live to Hong Kong and other Far Eastern countries. The stock components in the some of these areas may have declined to levels that may not be sustainable.

Unlike tuna fisheries, many varieties in the reef fish fishery are slow growing, have low stock productivity with restricted distributions. Without adequate and effective management measures in place, they are likely to become over-exploited quite quickly. Rebuilding the stocks is always difficult, eventually leading to closer of the fishery and fishermen shifting to target different species.

Unlike tuna fisheries, nominal catch and reef fish fishing effort data are not recorded adequately. The catch is lumped into three categories; Groups 1, 2 and 3 depending on size and therefore information about a specific group of reef fish is limited. Over the last 10-15 years, the recorded ‘reef fish’ (non-tuna varieties) landings have stood around 16,000 – 19,000 mt per year. This amount is considered to be a gross under-estimate, particularly in the recent years, where fishermen in many atolls have converted from tuna fishing to entirely reef fishing.

Sattar (et. al, 2012) provides the most recent published account of reef fishing in the Maldives in the central atolls with some information on the project area. These were based on the results of the reef fish survey carried out by the Marine Research Centre (MRC) during 2006-2007. Table 3 gives reported number of vessel in the area with the estimate of number of fishing trips per month.

**Table 3: Number of Reef fish fishing vessel in Baa, Vaavu and Alifu Atoll for comparison: Source: Sattar et al. (2012)**



| **Atoll: Baa** | No. of vessels | **Atoll: Alifu Alifu / Alifu Dhaalu** | No. of vessels | **Atoll: Vaavu** | No. of vessels |
|---|---|---|---|---|---|
| Kudarikilu | 4 | Rasdhoo | 2 | Fulidhoo | 2 |
| Dharavandhoo | 1 | Ukulhas | 4 | Felidhoo | 4 |
| Dhonfanu | 3 | Bodufulhudhoo | 9 | Keyodhoo | 4 |
| Kihaadhoo | 2 | Mahibadhoo | 3 | | |
| Thulhaadhoo | 3 | Mandhoo | 1 | | |
| Eydhafushi | 4 | Kunburudhoo | 3 | | |
| | | Dhigurah | 2 | | |
| | | Dhihdhoo | 1 | | |
| Total | 17 | | 25 | | 10 |
| Estimated no. of fishing trips/month | 357 | | 525 | | 210 |

A total of 25 vessels were present at the time totalling over 500 reef fishing trips a month. In fact the records indicate Alifu atoll deploys more reef fishing efforts than two other popular atolls (Baa and Vaavu atolls).

Sattar et.al (2012) notes that reef fish fishermen in outer-atolls are disadvantaged compared with the reef fish fishermen in the Malé area. Resorts exert considerable influence in maintaining prices and how they contract out the fishermen. They also limit the supply of the fish simply by buying only where they require. The situation is that supply and therefore harvest is effectively regulated by the demand from the resorts.

The most common gear used by the fishermen is handline, followed by drop–line and trolling. These are extremely selective gears with almost no bycatch.

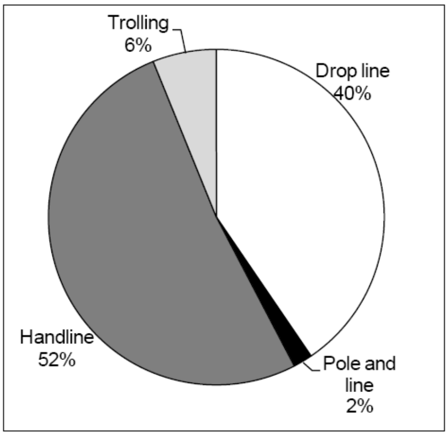


**Figure 15: Proportion of gear-type used by the fisherman during the survey of 2006-2007. Extracted from Sattar et. al, (2012)**

The most common varieties of reef fish caught are Carangids (jacks and travelleys), Scombrids (of neritic tuna species), Sphyraeinids (barracudas), Serranids (groupers) and Lethrinids (emperors) and Lutjanids (snappers).

The overall conclusion was that estimated harvest rates of the common reef fish varieties by unit area (1.7-3.5 m/km$^2$) in 2006/2007, in general, were below average levels published elsewhere in tropical reef settings. It was therefore concluded that at time, reef fish varieties in the Maldives may not be over-exploited.

### 6.6.2 Tuna Fishery

Tuna will also be a substantial component of the raw material processed in the factory. Most of the tuna products will be smoked and dried, targeted to the local market rather than resorts, although supplies to the resorts are expected to be considerable.

The tuna supplied to facility will be from pole-and-line and troll fishery. The former is essentially skipjack tuna (*Katsuwonus pelamis*) and the latter mainly neritic species of Kawakawa (*Euthynnnus affinis*) and frigate tuna (*Auxis thazard*). Handline caught large yellowfin is unlikely to be landed at the Fish World factory as there are other factories processing large yellowfin for export to EU Markets which should fetch better ex-vessel prices[8]

Unlike reef fish varieties, tunas are highly mobile with their stocks distributed to ocean-wide scale. Tagging studies in the Indian Ocean have shows that tags released in the Maldives may be caught in Sri Lanka gillnet fishery or in the purse seine fishery in the western Indian Ocean within a very short period of time, indicating that there is a single stock of skipjack in the Indian Ocean. Such movement behaviour renders management of tuna to be a

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[8] Ex-vessel prices of large yellowfin tuna caught on handline fishery range MVR 60-165 per kg.

responsibility of a regional fishery management organization (RFMO). The RFMO in the Indian Ocean is the Indian Ocean Tuna Commission (IOTC), the headquarters of which are located in Seychelles. Maldives is a contracting and cooperating party (CPC) of the IOTC since 2010.

In the Indian Ocean skipjack is fished from surface gears, such as gillnet (Sri Lanka, Iran, and Pakistan) and pole-and-line (Maldives), purse seiner (EU, Japan, Indonesia, Thailand, etc). Skipjack is normally not caught on longline gear. Reported catches from the total Indian Ocean stock and the assessed status is given in Table 4.

It is worth noting that Maldives Pole-and-Line Skipjack Fishery is now certified by the Marine Stewardship Council[9] which requires high level of management both within the Maldives and in the Indian Ocean (through IOTC) in general. To enable this, an MSC Client Action Plan is being implemented in the Maldives, which emphasises on monitoring, control and surveillance activities of the fishery.

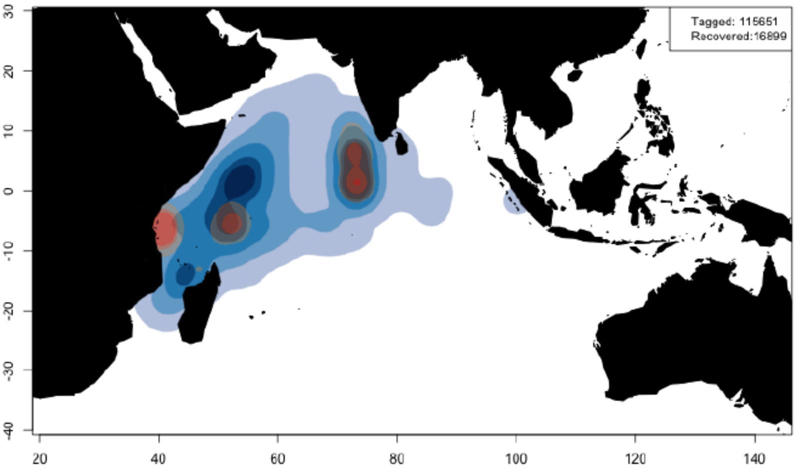

**Figure 16: Densities of release (red) and recapture (shades of blue) to represent movement and distribution of tagged skipjack tuna in the Indian Ocean (Source: IOTC, SC15, www.iotc.org, accessed, November 2013).**

**Table 4: Stock status of the three major tuna species of the Indian Ocean: Source: IOTC SC Report, 2012**[viii].**

| Stock | Indicators | Measure | Prev[10] | 2010 | 2011 | 2012 | Notes |
|---|---|---|---|---|---|---|---|
| Yellowfin tuna<br>*Thunnu salbacares* | Catch 2011:<br>Avg Catch 2007 – 2011:<br>MSY (1000 t):<br>$F_{2010}/F_{MSY}$:<br>$SB_{2010}/SB_{MSY}$:<br>$SB_{2010}/SB_0$: | 302,939 t<br>302,064 t<br>344 (290 – 453) t<br>0.69 (0.59 – 0.90)<br>1.24 (0.91 – 1.40)<br>0.38 (0.28 – 0.38) | 🟥 2008 | 🟨 | 🟩 | 🟩 | The decrease in longline and purse seine effort in recent years has substantially lowered the pressure on the Indian Ocean stock as a whole, indicating that current fishing mortality has not exceeded the MSY-related levels in recent years. |
| Skipjack Tuna<br>*Katsuwonus pelamis* | Catch 2011:<br>Avg Catch 2007 – 2011: | 398,240 t<br>435,527 t<br>478 (358 – 598) t | | | 🟩 | 🟩 | Recent declines in catches are thought to be caused by decrease in catch and catch rates in PS and PL. Catches in 2010 (428,000t) and 2011 (398,240t) |

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[9] http://www.msc.org/track-a-fishery/fisheries-search/maldives-pole-line-skipjack-tuna, accessed November 2013.

[10] Indicates the last year the assessment was done before 2010.

|  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
|  | MSY (1000 t):<br>$F_{2011}/F_{MSY}$:<br>$SB_{2011}/SB_{MSY}$:<br>$SB_{2011}/SB_0$: | 0.80 (0.68 – 0.92)<br>1.20 (1.01 – 1.40)<br>0.45 (0.25 – 0.65) |  |  | 🟩 | 🟩 | as well as the average level of catches of 2007–2011 (435,527t) are below MSY targets though may have exceeded them in 2005 and 2006. |
| Bigeye Tuna<br>*Thunnus obesus* | Catch 2011:<br>Avg Catch 2007 – 2011:<br>MSY (1000 t):<br>$F_{2011}/F_{MSY}$:<br>$SB_{2011}/SB_{MSY}$:<br>$SB_{2011}/SB_0$: | 87,420t<br>101,639t<br>114 (95 – 183) t<br>0.79 (0.5 –1.22)<br>1.20 (0.88 –1.68)<br>0.35 (0.26 –0.40) | 🟩 2008 | 🟩 | 🟩 | 🟩 | Recent declines in LL effort, have lowered the pressure on the Indian Ocean bigeye tuna stock, indicating that current fishing mortality would not reduce the population to an overfished state in the near future. |

**Traffic light colours indicate the degree of the stock status, red, orange, yellow and green; from over exploited (red) to healthy (green)

### 6.6.3 Exports and Fish Processing

Fish and fish products are one of the most important, if not the only visible exports from the Maldives. The exports generate much needed foreign exchange to the economy. A variety products are exported from with total declared value of the about US$ 140-160 million in the recent years (Table 5). Value addition has been a major policy of the government, which in principle should facilitate increase in total export value. However, during 2012 only 12% (5324 mt) were exported. However as the tree diagram of products in Figure 17 shows that processed products fetch much higher value in the market than unprocessed products (e.g. frozen tuna exported to Thailand). Exports of reef fish in relation to tuna little contribution only 4.6% of of the total.

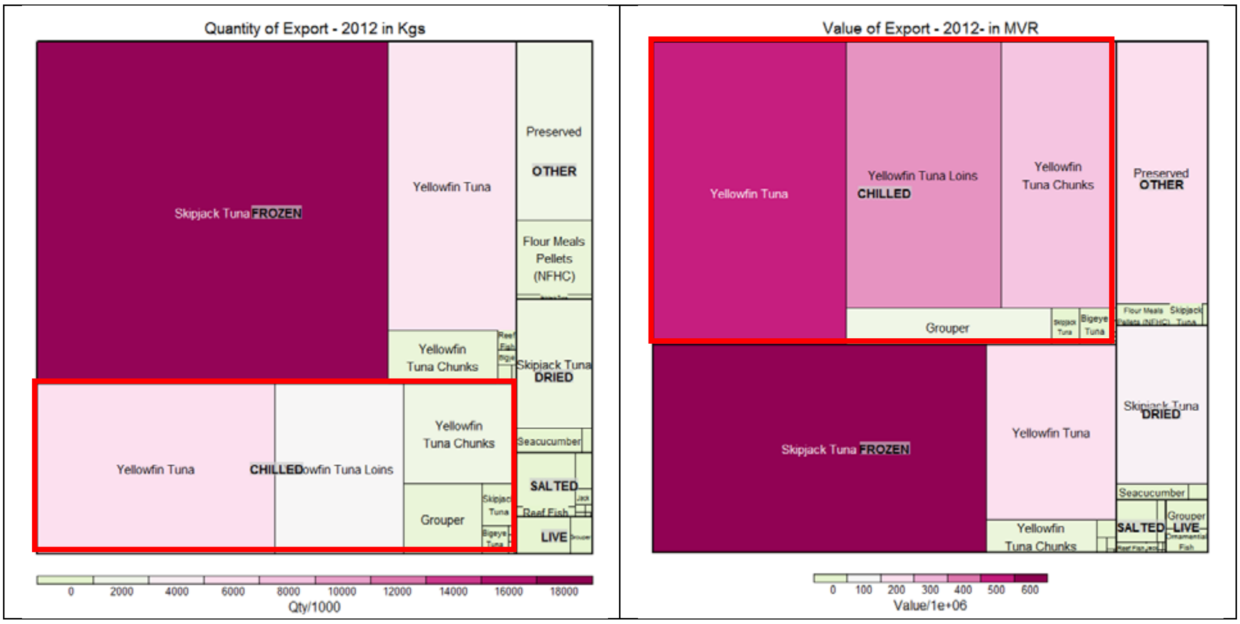

**Figure 17: Tree Diagram of exports products (its value and quantity) to show value of export by unit is significantly higher (coloured boxes)**

Statistics of the quantities of the fresh and processed fish quantities sold and consumed is not available, but considered to be substantial. Some estimates suggest that about 40% of the total national fish production is consumed locally. Assuming current total catches around 100,000 MT per year, this would mean 40,000 mt. If the tourism sector consumes roughly 7,000 – 8,000 mt of fish per year (assuming one million tourists spending on average 6 nights and resorts purchasing 1.2kg of fish per tourist night, see Sattar et. al 2012) , this would mean local consumption of is around 32,000 – 33,000 mt of fish per year.

**Table 5: Qty (in mt, except Live, which are in numbers) and Value (in Million MVR) of exports of fish products in various categories for 2012. Source: Maldives Customs Services, Compiled by MoFA**

|  | Qty | Value |
|---|---|---|
| Tuna | 39,880 | 2,323 |
| Reef Fish | 1,957 | 105 |
| Others | 233 | 11 |
|  | 42,070 | 2,439 |

|  | Qty | Value |
|---|---|---|
| Fresh | 36,746 | 2,058 |
| Processed | 5,324 | 380 |
|  | 42,070 | 2,439 |

|  | Qty | Value |
|---|---|---|
| Chilled | 12,111 | 1,209 |
| Frozen | 24,224 | 830 |
| Others | 2,887 | 223 |
| Dried | 1,710 | 136 |
| Salted | 727 | 22 |
| Live | 411 | 19 |
| Steamed | 0 | 0 |
|  | 42,070 | 2,439 |

# 7 IMPACT PREDICTION AND ANALYSIS

Various methods are available to identify the extent, magnitude and significance of environmental impacts of a development project; for instance checklists, matrices, expert opinion, modelling etc. Environmental impacts will usually be caused during both construction and operational phases of the project. As indicated earlier, at the time of writing this report about 90% of the development work complete.

Mitigation measures suggested in the report will focus on the existing environmental as well as impacts that may rise in the future based on consultations, expert opinion and observations. Even though Fish World Maldives Pvt Ltd does not export to EU market, MFDA has agreed to issue the biannual Compliance Certificate (Proponent pers. Comm, Oct 2013). Ministry of Fisheries will also have to issue the Fish processing License should they wish to export to the products. These arrangements suggest that packing process and its environment and health and safety issues will be assessed and audited regularly by the EU-Competent authority.

Information from various sources has been used wherever possible. Data collected during field surveys may be used to predict outcomes of various operational activities on related environmental components. Data presented in this report can also be used as a baseline for environmental monitoring of the project activities.

Possible impacts arising from operational activities of the facility are categorized into duration, reversibility, magnitude and significance. Impact magnitude and significance is further categorized by intensity of impacts (negligible, minor, moderate and major) for identifying best possible remedial (mitigation measures) action to be taken.

The impact identification checklist is given in Annex **7** and the summery matrix of the potential impacts and mitigation measures for Fish World Maldives Pvt Ltd facility operations are given below:

**Table 6: Impact Matrix to show the types of impact, their magnitude, significance and reversibility**

| Impact Causing Activity | Type of Impact | Duration | Reversibility | Magnitude | Significance | Mitigation measures |
|---|---|---|---|---|---|---|
| Large number of vessels using the harbour may lead to chronic pollution. | Direct | Long term | Reversible | Potential to be moderate | Currently insignificant | The harbour has a large entrance facing the east. At the time of the surveys, there are no signs of the pollution from hydrocarbon. It may be necessary to monitor the wave and currents to if oil pollution may be an issue. |
| Contamination of soil and ground water from oil spills / release of waster water | Direct | Long term | Reversible | Minor | Minor | -Construction of a concrete bund around the fuel tanks to protect against accidental spills. (done)<br>-Standardise the fuel storage take to fit into local regulations (done)<br>-Regular monitoring of leaks<br>-Take necessary precautionary measures during fuel handling and storage |
| Solid and hazardous waste | Direct | Long term | Reversible | Minor | Minor | -Small volumes of waste lube oil generated should be disposed of properly<br>-Encourage reuse of waste oil as lubricants<br>- Regular remove and deposal at Thilafushi site |
| Safety | Indirect | Long term | Irreversible | Moderate | Moderate | Install appropriate fire detection devices, fire alarms and fire extinguishers.<br>-Install pressurized recycled/treated water supply system of network of fire hydrants and fire fighting house reels locations. |
| Machinery in the complex could increase the ambient noise levels | Direct | On-going | Irreversible | Minor | Minor | Sound proofing the noise generating area; have proper mufflers in the exhaust of engines etc.<br>Wear noise-protection gear by staff |
| Odour and aesthetics | Direct | Long term | Reversible | Moderate | Moderate | -Daily collection and disposal of fish waste<br>Daily cleaning<br>-Appropriate housekeeping procedures |

## 7.1 WASTEWATER DISPOSAL

Wastewater form the facility would consist of the following

1. Grey water released from the toilets
2. Sewage water flushed from the toilets; since the staff does not live on the facility the volume of sewage released will be minimal.
3. Blood water mixed with disinfectants (chlorine) released from the factory floor
4. Fish oils mixed with water collected in trays during steaming
5. Grey water released from other forms of washing (sinks, and wash basins)

The grey water is collected in an underground tank and pumped outside to the reef on the northern side. The area is exposed to the ocean on the western side and so is turbulent allowing instantaneous mixing following release. The release pipe is placed below the surface close to mixing zone allowing mixing to occur easily.

With increased performance of the project activity, the potential for increased water pollution is likely to occur. Aspects of the project, which affect the water quality, are:

**Mitigation Measures**

- ✓ Ensure that end of the release pipe is well within the mixing zone outside the reef. A long-term approach may be to engage with the Island Council to establish proper sewer system on the island similar the ones in Maalhos island.
- ✓ Establish procedures for the dry removal of offal, using dry vacuum systems where feasible;
- ✓ Fit and use floor drains and collection channels with grids and screens, and / or traps, to reduce the amount of solids entering the wastewater;
- ✓ Equip the outlets of wastewater channels with screens and grease traps to recover and reduce the concentration of coarse material and fat in the combined wastewater stream;
- ✓ Avoid immersion and washing of open products (e.g. fillets) in water, as soluble protein may leak out and enter the wastewater effluent stream;
- ✓ Choose cleaning agents that do not have adverse impacts on the environment in general, or on wastewater treatment processes and sludge quality for agricultural application. Optimize their use through correct dosage and application. Avoid cleaners that contain active chlorine or prohibited, banned, or restricted chemicals

## 7.2 IMPACT OF FISH PPROCESSING AND PACKING OPERATIONS

Fish processing and packing operations typically consumes large quantities of water and energy and discharges significant quantities of organic material, both as effluent and as solid waste. However, there is very little use of hazardous substances. This report identifies major environmental impacts ways of reducing the consumption of resources, increasing yields and reducing the volume and organic load of effluent discharges:

Significant environmental improvement can be derived from simple modification to housekeeping procedures maintenance programs, which will lead at the cost savings and financial benefits[ix]. Most of the environmental enhancement suggestions given in the report are related to good housekeeping practices, work procedures, maintenance regimes and resource handling. Environmental impacts associated different stages of the fish processing and packing operations are outlined below:

### 7.2.1 De-heading

Typical water consumption rate for de-heading processes is approximately $1m^3$ per tonne of fish. The organic loading of wastewater generated from the de-heading process is relatively high, due to contamination with blood and flesh pieces. De-heading will be required to on almost every fish and it will prove to be helpful if water consumption can be reduced at every stage.

### 7.2.2 Filleting

Manual filleting of fish consumes large amounts of water for rinsing the fish and for cleaning knives and equipment. Often continuous rinsing is required to keep work areas free of fish remains. For filleting of un-gutted fish, water is also used for rinsing the belly cavity and for manoeuvring the fish into position before the head is cut off. Water used for cleaning and rinsing subsequently becomes wastewater, carrying with it fish scraps and entrails. Solids that fall to the floor are also washed to the nearest drain with water. The entrails and offal from the gutting of oily fish contain high levels organic content and easily soluble matter, and wastewater generated from the filleting of fish therefore has a high COD, in the range of 2000–6000 mg/L.

### 7.2.3 Skinning

The skinning of fish can contribute significantly to the pollution load of effluent generated. Soft fillets tend to get caught while skinning and are torn to pieces, reducing yield and increasing waste. The skinning process contributes about one-third of the overall COD load in the effluent stream.

### 7.2.4 Trimming and Cutting

Water is used for cleaning the fillets and cutting plates and for cleaning the workplace in general. In some operations, a constant stream of water is used to clean the cutting plates, conveyors and knives. In these situations, water consumption will be very high. As in many of the other processing areas, losses of materials from the trimming and cutting lines end up on the floor, and if work areas are not well designed, they can be washed to the drain, contributing to the organic load of the effluent stream.

### 7.2.5 Packaging, Freezing and Storage

Freezing and refrigeration consume large quantities of energy, and inefficient equipment and result in emission of refrigerant gases, such as ammonia. The consumption of electricity and of water can be quite high. If refrigerants are used there is a risk that refrigerant gases will be emitted to the atmosphere, contributing to the depletion of the ozone layer. There is also a risk of ammonia and glycol leaks, which can be an occupational, health and safety problem for workers, but can also result in environmental problems.

### 7.2.6 Collection and Transport of Offal

Fluming of offal is responsible for a considerable proportion of the effluent generated from fish processing. During transportation of the offal in the water flume, organic matter is dissolved in the water stream, contributing to high levels of COD and nutrients.

### 7.2.7 Unloading of Fish

'Bloodwater' is generated during unloading and initial washing at site before transporting to the cold storage the bloodwater can represent as much as 20–25% of the total organic load generated from the process.

### 7.2.8 Cleaning the Fish Processing Area

The water consumption for cleaning will be very high. The organic load contained in cleaning wastewater is high, containing fish wastes, which have been washed to the drain. Cleaning wastewaters also contain detergents and disinfectants. In addition, hazardous substances such as sodium hydroxide and sodium hypochlorite are sometimes used in conjunction with cleaning.

## 7.3 PRODUCTION OF FISHMEAL

Production of fishmeal can be a messy activity if not properly done and managed well. The production involves collection of fish waste from fish cutting process. The factory floor is designed that trimming, offal are collected in bins and kept in a separate area. The waste also includes pieces of material trapped in the floor drains.

The most visible and often offensive stage is transport from the factory to the fishmeal plant roughly 50-70 m from the factory. There would be minimum amount that may be required for economical operation of the of the fishmeal plant. In such cases it has to be stored in area or kept in the factory area where temperatures are lower.

Forklifts will be used to transport the collection to the fishmeal plant. Forklifts can be noisy and their use would generate SOx and NOx particles released to the air, potentially causing pollution.

**Mitigation Measures:** At all times, waste bins should be covered to minimize smell and attraction of flies. Flytraps should be used inside the factory and collection area. The fishmeal plant flow should be kept clean at all times. If the small amount of the fish waste are produced that may not be sufficient for economical operation of the plant, they should be disposed to the sea quickly.

## 7.4 IMPACT OF USING THE HARBOUR AREA

Harbour traffic is expected to increase and this increase will multiply when socio-economic conditions of the community improve. Increased traffic would mean potential for increased pollution of the harbour.

Fortunately the Council has rules in place on the use of the harbour (Figure 18). The billboard display the rules summarised in 13 bullet points reminds people on proper and good use/practice of the harbour. The proponent is asked to encourage fishermen to follow the rules. The first rule is banning direct input/ spill of oil. The second rule on efficient alongside along the seawall.

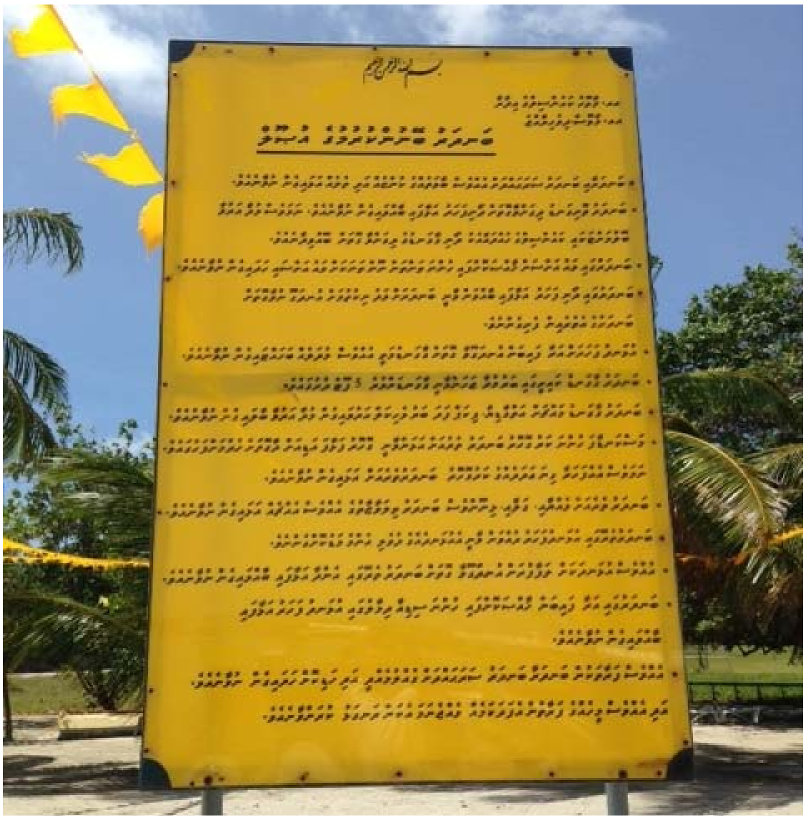

Figure 18: Impacts of using Harbour

**Mitigation Measures:** All fishing vessels, including fuel barges should follow the rules. The site manager / supervisor / guards should ensure the fishermen and boat crew follow the rules.

### 7.5 ENERGY CONSUMPTION

Energy is used for operating machinery, producing ice, desalination, pumping, and cooling. Consumption of energy depletes fossil fuel resources, also produces air pollution and greenhouse gas emissions, which have been linked to global warming.

Energy for the operations is generated from 2 sets installed at the powerhouse. At present the overall condition of the powerhouse may not comply with the standards of the Maldives Energy Authority. These would include adequate improvements in exhaust, fire and safety equipment, fuel storage and delivery.

**Mitigation measures:**

- Registration of Power Generation plants with Maldives Energy Authority
- Registration of RO plants with Environmental Protection Agency
- Carry out regular maintenance to optimize energy efficiency of equipment

## 7.6 GROUND WATER AND SOIL CONTAMINATION

Soil contamination through oil leakage at the fuel handling area may require regular monitoring and supervision. There have been instances, in other fish processing facilities, refuelling of day fuel tanks take place in open area (un-bunded). Leaks and drips form the hand-pump or during removal and insertion of pipes have, over time, caused visible contamination of the soil in the ground.

The source water for RO plant is extracted from a borehole in the compound. The borehole was made to the specification in the guideline published by the EIA. It is therefore unlikely to contribute salinization of the fresh water aquifer of the island.

**Mitigation measures:**

1- Bund the fuel storage tank are to protect against accidental spill or partial or even total collapse of the tank
2- Standardise the fuel storage tank and take necessary precautionary measures during handling and storage.
3- Regular monitoring of leaks

## 7.7 SOLID AND HAZARDOUS WASTE

In additional to the general waste produced by staff in their workplace, in the kitchen and staff canteen and that generated by fishing vessels in the harbour, there will be fish waste that may not be processed into fishmeal. Fish processing produces about 40% of the fish's raw weight as waste. Nearly all are harvested (e.g., head, belly, trimming, vertebrae, operculum, fins). Some of these may also be used for cooking Rihaakuru – a delicacy among the locals although the proponent has no intention of producing Rihaakuru. However, at times when fishmeal production does not take place, it may be good idea to harvest them for sale or for cooking Rihaakuru

At present the solid waste generated on the facility consisted mainly of general domestic waste. Such waste generated onsite are taken to Maalhos waste management area. Fish waste (skin, fins) generated by facility is transported off reef and dumped into the open ocean. Disposal of large quantity of fish waste into the open ocean may result in feeding behavioural change of fish living in the dumping area.

**Mitigation measures to reduce fish packing waste are listed below:**

- Use of sharpened cutting gear
- Adequate training for each worker on their work
- Avoiding over-stocking by undertaking supply audits
- Elimination of unnecessary packages and packaging in the product
- Maintenance of appropriate storage conditions in the warehouses (including humidity, temperature, eliminating rodents)
- Use of folding boxes and plastic recyclable boxes instead of wooden boxes
- Small volumes of waste lube oil generated should be disposed of properly
- Encourage reuse of waste oil as lubricants

## 7.8 ODOUR

Odour generation can be an important environmental issue. The main causes are the storage and handling of waste materials, and odorous emissions during the processing and packing of different products. Odour is not a significant issue in the packing facility area as the raw material purchased has already had their gills and guts removed. However, transport of fish waste to the fishmeal plant area and at times during the operation of fishmeal plant odour may be an issue. Odour may also be issues during steaming, smoking and drying.

The issue may be seasonal, related to direction of the wind likely to become an issue only during southwest monsoon when blows towards the village.

**Mitigation Measures:** Equipment should not be overloaded otherwise it may fail to escape odour. Equipment should be vented at a controlled rate through ducts connected to the odour reduction equipment. Condensers and odour reduction equipment should be designed to cope with all likely operating conditions (sw monsoon season). Constant vigilance from the part of the management staff at all levels is essential if odour control measures are to be effective. Complacency and lack of concern lead to lax supervision and unsympathetic handling of complaints from the people on Maalhos.

## 7.9 SOCIOECONOMIC IMPACTS

In addition to opening up of a new avenue for employment, entrepreneurship operations of the facility contribute to the food security and self-sufficiency of the country. Other beneficial impacts are:

1. Direct economic effects include increased government revenue and increased employment opportunities. Indirect economic effects will include increased earnings high revenue from export of fresh fish and employment by the island’s support infrastructure development including the construction, supply and transport service
2. Activities of the facility contribute to GDP growth by providing a range of direct and indirect economic and social benefits at the national and local levels.
3. Opportunity for gainful employment for Maalhos people. According to the proponent
4. Increased certainty for fishermen that their catch would be sold for ready-cash on a regular basis.
5. Improved efficiency of the resort operation by cutting down staff, equipment and infrastructure for fishing, storage, processing

The presence of Fish World Maldives Pvt Ltd also benefits island community in indirect ways. The presence of the Fish World Maldives Pvt Ltd will encourage fishermen to invest in fishing vessels. Also regular visits of the fishing vessels contribute to the island economy as some of them make stopover spending a day or two on the island.

# 8 ALTERNATIVES

The principle of alternatives in EIA study is to make a positive influence on decision making at the earliest possible opportunity and thinking proactively about options and alternatives- it is important to facilitate any effort to enhance the environmental performance of the proposed development at the beginning of the project planning stage rather than at the later stage of the project development. It is often better to pre-empt adverse impacts at the early stage of the project implementation. Options and alternatives should be considered when adverse environmental impacts are expected, and in considering alternatives, the primary consideration is whether applying the precautionary principle, the project is shown to be environmentally acceptable. Unfortunately, in the Maldives the process of influencing for alternatives is extremely limited or not possible. In many an instance decision for the project is already made and committed before the EIA is complete. Alternatives are considered at much lower level, which is often difficult influence.

## 8.1 NO DEVELOPMENT OPTION

No development is not an option since the project developments have already taken place. The project development will take place and a practical approach would be to consider mitigation aspects of the project activities likely to cause significant environmental impacts. This has been addressed in Section 7.

## 8.2 ALTERNARIVES

At the initial stages the proponent expects to produce fresh products targeted for tourist resorts. When the processing (steaming, smoking and drying) starts the proponent proposes to use firewood from the local woods or purchase woodchips from the carpentry facilities. Alternatives for locally sourced firewood for smoking and drying should be considered early in the operation phase. If the production volume is small to justify use of locally sourced firewood, measures may be taken to ensure areas of local woods are not cleared off under-growth. Selective and managed collection of coconut husks, shed palms and fronds may be encouraged. This should be reviewed in subsequent years and alternatives considered.

# 9 ENVIRONMENTAL 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.

## 9.1 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

## 9.2 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 ground water (pH, , electrical conductivity, total oil (Hydrocarbon) and faecal coliforms), seawater quality (turbidity, dissolved oxygen, phosphates, nitrates COD and BOD).

**Table 7:** Environmental Monitoring Program for Fish World Maldives  Pvt Ltd facility at AA Maalhos

| Indicators | Measuring parameter | Survey Technique | Frequency | Baseline/References | Cost (USD) |
|---|---|---|---|---|---|
| Water Quality of Harbour | Nitrate (µg/l), Ammonia, Phosphate, COD, colliform and faecal colliforms | Sampling and Laboratory Analysis | B-annual | Baseline data available for this study | 100.00<br>Part responsibility of Council |
| Ground Water quality around fish meal plant area | Nitrate (µg/l), Ammonia, Phosphate, COD, colliform and faecal coliforms,<br>Presence of oil | Sampling and Laboratory Analysis | B-annual | Baseline data not available, but considered 'normal' | 100.00 |

## 9.3 MONITORING REPORT

Based on the data collected, a 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.

## 9.4 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 in Annex **8**.

# 10 STAKEHOLDER CONSULTATIONS

Ministry of Fisheries and Agriculture and Maalhos Island Council were not present at the Scoping meeting held in EPA[11]. What is required from the Ministry of Fisheries and Agriculture is the permit for fish processing and export, issued only after the submission of the Decision Note. It is also the request from the Ministry of Fisheries and Agriculture to facilitate collection of catch and effort data at the facility to support fisheries monitoring and management.

During the field visit consultations were held with member of the Maalhos Council. Present at the meeting were five members of the Council (Figure 19). The Council members were briefed about the project and the importance of the Council endorsement and requirement for acknowledging the EIA report before the proponent can submit to EPA.

The Council informed that reclaimed area south of the harbour is for commercial lease. Plots of 1,200 sq feet have been marked and incorporated in the island-planning chart (Annex **6**). Earlier the Council had wanted to lease some of the plot to develop café and hotels. The plot closest to the village was actually leased and developed to a café. Unfortunately for economic reasons, the developer was not able to continue. Currently the buildings are left idle.

The Council leased 5 plots to Fish World Maldives Pvt Ltd for establishing the fish processing and packing facility in 2011. Council expects them to obtain the required clearance, including the environmental clearance from the government authorities before staring the work.

**Figure 19: Council Meeting that took place Maalhos Council Office, 20, September 2013**

Members expressed they would be concerned if the proposed processing and packing activities would create environmental and or health issues on the island. In this regard they expect standards are maintained in all stages of the development and operation.

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[11] Island Councils informed the Consultant they find it difficult to attend meetings with no lead time. Travelling to Malé is very expensive and with the budget cuts it is proving to be difficult to attend meetings in Malé

Finally it was communicated that EIA report may only be submitted after the Council has acknowledged the receipt the copy. The council unanimously endorsed they do not anticipate any issues in the proposed projects and its activities.

# 11 CONCLUSIONS

The fish processing facility developed by Fish World Maldives Pvt Ltd is on Maalhos, Alifu Alifu Atoll. The produce from the facility is fresh fish products targeted for tourist resorts and processed products for local outlets in Malé. The proponent is not ruling products targeting export market in which case the facility has to be fully compliant with MoFA and MFDA regulations for export of fish and fishery products with bi-annual inspection of the facility by MFDA and issuing of Compliance Certificate. The proponent also proposes a fishmeal plant to make use of the fish waste rich in protein, initially targeted for export but expects to find markets in Maldives when the mariculture industry starts.

The project has a number of attractive features. It creates incentive for the tourist resort by offering safer and standardized fresh fish products, encouraging them to completely outsource the delivery of fresh fish to their needs. In doing so it creates secure market space for local fishermen especially in Ari Atoll where many depend their livelihood on small-scale reef fishing. The Project also creates opportunities for improved monitoring and fishery data collection by the government authorities.

The development takes place on Maalhos Island, Ari Atoll, on the reclaimed land west of the harbour away from the village. The main development is a self-contained fish processing facility including water, power and ice production required for the product. A second building, about few tens meters, is used to produce processed products (smoked fish, dried fish and fish meal), which is to start in sometime after the core activities of fresh production starts gets into gear.

Negative environmental impacts include potential for pollution of harbour through chronic release of fuel oil, fish waste and blood water. Although minor, smell could be issue during certain periods of the year when processing (steaming, smoking and drying) start. Use of oils (waste oil, refuelling, transport) may cause contamination of soil but on a negligible scale. Mitigation measures were proposed for negative impacts causing activities and processes. Provided that measures are taken the negative environmental impacts were considered to be minimal.

As usual in such development projects, overall positive environmental impacts outweigh the minor negative environmental impacts. Scio-economic development aspects of island community were more important. The project is expected to attract more people (fishermen) creating more business opportunities, increased transport opportunities, more secure livelihood opportunities for people, not only Maalhos, but surrounding fishing communities, who have been deprived from fishing following the total shark ban.

The unique, innovative and a special aspect of the project is its link with the tourism. The project creates market space (for fishermen) and improved efficiency and health and safety of fishery products. Most importantly it adds value to the catch supporting government's over-arching objective of sustainable utilization of the fishery resources.

The moderate investment and it setting on an inhabited island surrounded by popular reef fishing community with large number of tourist resorts makes the project a very attractive.

# 12 ANNEXURE

Annex 1: Approved ToR of EIA Report of Fish World Maldives Pvt Ltd, AA. Maalhos.
Annex 2: Layout Dawning of the Fish World Maldives Pvt Ltd
Annex 3: Permit of sale of food products from the Island Council.
Annex 4: Communications from MFDA on approval of factory floor layout
Annex 5: Approval letter from MFDA on the ice-plant design
Annex 6: Drawing from the Island Council to show the plots on the reclaimed area where plots for Fish World Maldives Pvt Ltd have been allocated
Annex 7: Impact Identification Checklist for the project
Annex 8: Commitment Letter on proponent on environmental monitoring
Annex 9: Sample water quality tests at the Fish World Maldives Pvt Ltd.

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