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Nijhum Dwip National Park Management plan

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Acronyms

ACF	Assistant Conservation Officer
ADB	Asian Development Bank
AIGA	Alternative Income Generating Activity
ANR	Assisted Natural Regeneration
BFD	Bangladesh Forest Department
BO	Beat Officer
BRAC	Bangladesh Rehabilitation Assistance Committee
C	Celcius
CBACC-CF	Community Based Adaptation to Climate Change through Coastal Afforestation
CBD	Convention on Biodiversity
CBO	Community Based Organization
CDSP	Char Development and Settlement Project
CMO	Co-Management Organisation
CREL	Climate Resilient Ecosystems and Livelihoods
DFO	Divisional Forest Officer
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EPI	Expanded Programme on Immunization
FAO	Food and Agricultural Organisation of the United Nations
FAO	Food and Agricultural Organization
GIS	Geographical Information System
GoB	Government of the People's Republic of Bangladesh
GPS	Global Positioning System
ha	hectare (2.47 acre)
IBA	Important Bird Area
IPAC	Integrated Protected Area Co-Management
IPM	integrated pest management
L.S.	Lump Sum
LSU	Livestock Unit
MIST	Management Information System Tracking
mm	millimetre
MTT	Management Tracking Tool
ND	Nijhum Dwip, Nijhum Dwip
NDNPDP	Nijhum Dwip National Park Development Project
NGO	Non-Governmental Organisation
NP	National Park
NTFP	Non-timber forest products
NWC	National Wildlife Center
PA	Protected Area
RIMS	Resources Information Management System
RO	Range Officer
SMART	Spatial Monitoring and Reporting Tool
SMART	Specific, Measurable, Achievable, Replicable and Time-bound
SRCWP	Strengthening Regional Cooperation and Wildlife Protection project
Tk	Taka
UNDP	United Nations Development Programme
UNDP	United Nations Development Programme
WCPA	World Commission on Protected Areas
WNCC	Wildlife and Nature Conservation Circle

Executive summary

The purpose of this management plan is to give direction to the management and development of Nijhum Dwip National Park, including objectives, strategies and actions. The vision and strategy are based on an analysis of the key values and threats of this park. This Management Plan is the prime guiding document for other plans in relation to Nijhum Dwip NP. This plan focuses on management of the area covering all conservation management aspects. Although the plan is extensively dealing with issues such as public relations, awareness, education, policy and research, the document itself is not meant as a tool in those fields to keep its scope clear. Other plans and documents may be required to elaborate such related aspects.

The management plan takes into account (a) current practices of forest management in Bangladesh, (b) recent developments toward co-management under the new Wildlife Act (2012) and (c) international standards following the Convention on Biodiversity and Bangladesh' commitments in that regard. The World Commission on Protected Areas' "Guidelines for Management Planning of Protected Areas" have been used as a template.

Protected area description

Nijhum Dwip and its associated islands are located in the Meghna estuary in the south of Bangladesh. The islands form since 2011 a separate Union as a part of Nilvohoi Upazila based at Hatiya Island. The islands have evolved in the middle of the last century as a result of forest plantation and other stabilizing measures at a number of sand bars. Soils are alluvial, composed of clay and silt. The islands are drained by a numerous creeks and all water in creeks and surrounding rivers is brackish. The park's weather conditions are characterized by a monsoon climate and frequent cyclones. In relation to climate change, average temperatures and rainfall appear to increase gradually. The natural conditions combined with afforestation for coastal protection, human settlement and agriculture have resulted in a several types of land cover providing a variety of habitats, such as mangrove forests, grasslands, agricultural landscapes and a variety of marine habitats. The area harbours a high variety of animal species, particularly birds (over 100 species) and fish (over 50 species).

The stabilization of the islands by afforestation and the wealth of natural resources have attracted a growing human population, which have permanently settled at the main island. Due to the accessibility of the island, its social infrastructure is poor. Most people are involved in fishing and cultivation of crops, mainly paddy. Apart from that livestock and non-timber forest products are important sources of livelihood. Following the fast growth of the human population, several NGOs and projects have supported social development. The beauty, serenity and wildlife of the park attract an increasing number of tourists, which forms another important source of income for the islanders.

In 2001, the area has been gazetted as a national park which covers over 163 km^2. According to the definition, the park should be managed as a Category II protected area. Apart from that it is part of the Ganges-Brahmaputra-Meghna Delta Important Bird Area (IBA). The terrestrial part of the park is managed by the Bangladesh Forest Department (BFD) while the Bangladesh Fisheries Department manages the marine part. The management and protection was in 2014 assured by 13 staff based at the beat office at Namar Bazar and 3 other locations. Infrastructure for accommodation and mobility of the protection staff is very poor. In 2014 no systematic surveillance and law enforcement strategy was applied, but the development of co-management has started with project support.

Ecological and socio-economic values

The key values of Nijhum Dwip National Park are mainly determined by the dynamics of the coastal ecosystem characterized by erosion, accretion, marine salinity fluctuations and weather seasonality. The area offers outstanding habitat for fish and migratory birds and harbours several cetacean species and marine turtle species. After release of a few spotted deer in the 1970s, a deer population is developing which had a peak in the period 2005 - 2007, but appears to stabilize now at owner number. The most important contribution to biodiversity conservation of the park is the presence of large numbers of migratory bird species of international significance, including several globally threatened species, and the availability of important habitat for fish, cetaceans and marine turtles, as well as the presence of breeding grounds of several fish species including Hilsha, a major commercial species.

The socio-economic importance of the area is the result of its contribution to fisheries in the Meghna estuary and other livelihood resources. The planted mangroves play an important role for coastal protection and carbon sequestration. An increasing number of tourists enjoys the landscape and wildlife, particularly the significant deer and bird populations, contributing also to the local economy through their spendings.

Management issues

The growing human population results in increasing pressure on land and resources of the park, manifested by land tenure issues and illegal unsustainable resource extraction. Particular issues in this regard are encroachment, predation by feral dogs and the serious overstocking with livestock involving also mangrove destruction by livestock.

The widespread cases of illegal and destructive activities by resource users show that awareness regarding sustainable resource use and conservation among the stakeholders is poor and that law enforcement is not effective yet. Another factor complicating the task of protection staff is the limited resources and facilities for protection, including lack of required knowledge and skills beyond forest management.

Increasing tourist numbers require measures to manage impacts such as noise, pollution, waste and wildlife and habitat disturbance.

Vision and management objectives

In 2014 the area was not managed as a Category II protected area (national park) since consumptive use was taken place in all habitats, which should imply reclassifying the area from national park in Forest Reserve or another protection category allowing consumptive use. This management plan is based however on the assumption that Nijhum Dwip National Park will be managed as a National Park according to the international definition and in the frame of the Bangladesh National Biodiversity Strategy and Action Plan and the Bangladesh Wildlife Act (2012). The management objectives of the plan are:

(1) Protect and maintain physical, biological and aesthetic features of Nijhum Dwip National Park as example of typical estuarine floodplain ecosystem

(2) Reinforce and maintain coastal protection

(3) Increasing the revenue generation potential of the Park

(4) Realizing and exploiting the Park's potential as venue for tourism based on wildlife, recreational, educational, cultural and aesthetic appeal

(5) Integrating the National Park into local and regional development process, especially surrounding local communities to ensure wider acceptance of the Park's values

(6) Improving the BFD's staff welfare, motivation and capabilities

Zoning

The management prescriptions and measures of the plan are oriented in the different habitats and locations of the area on the basis of a zoning plan which has been elaborated in the scope of the Bangladesh Wildlife Act (1912) and international guidelines. The following zones are proposed:

- Nature conservation zone
- Migratory bird conservation zone
- Eco-tourism development zone
- Forest conservation zone
- Forest plantation zone
- Rehabilitation zone
- Management infrastructure zone
- Livestock grazing zone
- Fishing zone
- NTFP collection zone
- Habitation and agriculture zone

Management actions

A 5-year workplan is elaborated to realize the management objectives. The workplan involves the following components:

1. Management of the physical environment
   - Zoning
   - Boundary demarcation
   - Solving land issues
2. Management of the biological components
   - Forest plantation
   - Control of dogs
   - Control of livestock
   - Surveillance
3. Community conservation programmes
   - Conservation awareness
   - Establishment of co-management
   - Promotion of conservation based enterprises
4. Tourism development
   - Ecotourism development
   - Facilities development
   - Quality management of accommodation, facilities and operations
   - Tourist communication and awareness
5. Reinforcement of protection administration
   - Improving transport
   - Communication improvement
   - Realizing office facilities and accommodation
   - Removal of old buildings from Namar Char beat office and Satapul
   - Procurement equipment
   - Improving staff performance
6. Smart patrolling
7. Research and information management

Monitoring and review

The purpose of monitoring is to assess the effectiveness and efficiency of the activities and the achievement of the management objectives. The results of monitoring and evaluation may be used to adapt the strategies to improve the management performance. The monitoring and evaluation plan provides for the annual review of operational plans, a five year work plan and an overall review period of the management plan of 5 years.

Monitoring involves measuring indicators related to the management context (e.g. threats), management performance, results achievement, outcome and impact. Biological monitoring is particularly required of birds, mammals (especially deer) and the vegetation in order to assess status of biodiversity and changes related to threats and management measures. Management performance monitoring is done by reporting on implementation and achievement of the annual operational plan and five year work plan. To enhance field monitoring (surveillance and biodiversity) the relevance of the application MIST-patrolling will be investigated. Data collection and reporting needs to be consistent with the Management Effectiveness Tracking model which BFD considers to adopt.

1 Introduction

1.1 Purpose of the management plan

The purpose of this management plan is to present a clear vision on the management and development of Nijhum Dwip National Park, including the management objectives, strategies and actions required for its realization. The vision and strategy are based on an analysis of the key values and threats of this park. The management strategy presented is flexible to cater for unforeseen contextual changes and innovative practices during the implementation period of the plan by adopting a cyclic and adaptive approach.

This Management Plan is the prime guiding document from which other plans for Nijhum Dwip NP flow, and this plan takes precedence in case of inconsistency. To ensure the "management scope" of the document, other functions of this document such as public relations/awareness, education, policy analysis and research are limited to the essential minimum. Related documents to the Management Plan may include more detailed zoning plans, visitor and business plans to guide its implementation as well as more specific species plans and status reports. Additionally, separate resource descriptions, policy documents, press releases on management activities and/or information documents on the park may have to be produced. The plan indicates the requirement of such studies and documents as needed.

1.2 Location of Nijhum Dwip National Park

The Nijhum Dwip and its associated islands Char Yunus, Char Kabira, Char Kalam, Damar Char and Char Johan are located in the estuary of the Meghna channel in the mouth of the Bay of Bengal. The islands are located about 31 km south west of Hatiya Upazila Sadar under Noakhali District. The main island of Nijhum Dwip is a cluster of connected islands, including Char Osman and Char Kamala, and it is isolated from Hatiya Island by Mokhteria channel. The total area of Nijhum Dwip is 4786 ha. It is delimited in the east by Meghna River, in the north by Mokhtaria Channel, in the west by Shahabaj River and in the south by the Bay of Bengal.

Geographically the island is located in between 22° 01' 01" to 22° 05' 02" north latitude and 90°03' 03" to 90° 03' 00" east longitude.

1.3 Constitution

A Government order in 1977[1] notified that all newly accreted land in the Meghna River estuary was to be managed by the Bangladesh Forest Department (BFD) for forest plantation to stabilize the land and accelerate accretion. After 10 years the land was to be leased out to farmers for agricultural purposes and settlement. In 1990 this period of 10 years under forest management has been extended to 20 years by government order[2].

The present land management status of Nijhum Dwip as National Park is defined in the notification of the Ministry of Environmental and Forest No MoEF (Sec - 3) 8/2001/298 Dated 08.04.2001 as per the power given under section 23(3) of Bangladesh Wildlife (Preservation)(Amendment) Act, 1974. According to the notification the National Park covers 40,390 acres of land (16,352.23 hectares) land, including Char Osman, Corner of char Osman, Char Kamala, Khaja's Char, Char Aftab, Char Muid , Char Balua, Char Kabira, Char Yunus, Char Johan, Char Bahauddin , Char Rawsan, and Char Kalam Reserved Forest. The notification does not mention Damar Char as part of the National Park.

In 2012, a number of planted chars have been gazetted as Reserved Forest by notification[3]. Approximately 10,000 acres of the island of Nijhum Dwip has been declared as reserved forest by the Bangladesh Forest Department (BFD).

1.4 Management planning approach

1.4.1 Institutional context

According to the Wildlife Act (2012), "*The Government may, for each sanctuary, prepare a management plan in accordance with the manner prescribed by rule*"[4]. In practice, elaborating a full management plan takes time; the whole process can easily take one year, but effectively engaging all stakeholders can take even more time.

Protected area management planning cannot ignore earlier and current standards and initiatives in Bangladesh, in the wider region and at international level. Synergy needs to be sought with these standards and initiatives, duplication avoided and inconsistency avoided regarding policies and approaches. Particularly national standards regarding (a) forest management planning and (b) co-management have to be taken into account as well as (c) national strategies in the frame of the Convention on Biodiversity (CBD) implemented through the National Biodiversity Strategy and Action Plan (GoB 2005), and (d) other international agreements related to biodiversity conservation. Obviously, the plan follows

[1] Letter No. 1/For.-80-75/539 dated 24/3/1977

[2] Letter No. 2/MoEF-192-90/583 dated 11/9/1990

[3] No.MoEF(Forest See-1)32/2012/529 and No.MoEF(Forest See-1)32/2012/530

[4] Rules for PA management planning are under preparation by SRCWP

all applicable policies and legislation of Bangladesh, as indicated in the sections on strategy and implementation where applicable.

1.4.2 Forest Management Planning

In the 1980s, procedures for Forest management planning were reviewed by the "Assistance to the Forestry Sector Project" (UNDP/FAO) resulting in a Forest Management Plan Manual (Balmforth 1988). As the focus of this planning approach is on forest, trees, forest management and exploitation, it is not directly appropriate for protected area management where management is supposed to emphasize conservation of biodiversity and wildlife in a natural setting. Nevertheless consistency with the characteristics of this model will facilitate adoption of protected area management planning in the routines of BFD. Some elements of this traditional forest management planning system require to be adapted in order to comply to a more up-to-date approach of integrated and sustainable management of natural resources, particularly:

- "*Forest and land base components*" need to be replaced by "*Biological, physical and socio-economical components*";
- "*Forest management objectives*" need to be widened to more holistic objectives covering all ecosystem services of the area in relation to the biodiversity conservation and development priorities of Bangladesh.

The Forest Management Plan Manual proposes a 10 year review cycle for the Management Plan with a 5-year review cycle for the Working Plan and an Annual Plan of Operations. A similar management cycle can be adopted for the Nijhum Dwip National Park Management Plan (section 8.8, page 72).

1.4.3 Co-management planning

The new Wildlife Act includes provisions for the participation of local stakeholders in the management and benefits of protected areas. The Nishorgo Support Project (NSP) and the Integrated Protected Area Co-management Project (IPAC) have developed a consistent approach over a longer period with regard to engaging stakeholders in sustainable natural resources management and the development of co-management of protected areas. The focus of these plans emphasizes however the role of forest dependent communities in conservation, but not so much the management of biodiversity in the context of national and international conservation priorities. Therefore the elements related to co-management of the Nishorgo approach are considered as much as possible within the context of the requirements set by biodiversity conservation priorities.

Although the co-management approach can contribute significantly to sustainable management of natural resources and biodiversity conservation as a result of improved stakeholder collaboration and benefit sharing, the development of co-management requires

also to be followed critically. Based on current experiences in Bangladesh, some specific issues of concern are:

- co-management organizations and the motivation of its members appear usually dependent on external financial resources rather than self-sustenance and intrinsic motivation;
- apart from being a mechanism for shared resource management, co-management may be used as a vehicle for donor agendas, which may confuse the prime objectives of the co-management system;
- local politics and individual interests may strongly influence the functioning of co-management organizations and play an important role in the selection of its members;
- so far co-management organizations appear hardly to follow a strategic plan (management plan), even when existing;
- protected area management plans need to address national and international responsibilities with regard to biodiversity conservation, which have, however, often a low priority at local level;
- responsibilities of the co-management organization and the role of FD field staff need to be clear to all actors in a co-management system.

1.4.4 International policy context

Bangladesh has ratified the Convention on Biodiversity (CBD) in 1992. Strategy 9 of the National Biodiversity Strategy and Action Plan (GoB 2005) formulated following the signing of this convention reads "*Enhance Protected Area management, recognizing the benefits of collaboration with local communities in their management (co-management)*", which includes that protected areas should be managed in keeping with the Ecosystem Approach as defined by the Conference of the Parties to the Convention on Biological Diversity (Decision V/6) which can be summarised as a strategy for the integrated management of land, water and living resources promoting conservation and sustainable use in an equitable way.

Article 8 of the Convention on Biodiversity (CBD) contains among others several specific references to protected area management by encouraging Parties to:

- Establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity;
- Develop, where necessary, guidelines for the selection, establishment and management of protected areas or areas where special measures need to be taken to conserve biological diversity;
- Regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use;

- Promote environmentally sound and sustainable development in areas adjacent to protected areas with a view to contribute to the protection of these areas.

1.4.5 PA management planning framework

To match international standards of protected area management planning, the planning procedure for Nijhum Dwip NP has adopted international good practices which have been elaborated in the IUCN/WCPA Guidelines for Management Planning of Protected Areas (Thomas and Middleton 2003). The management planning cycle according to this approach includes the following steps:

(1) Pre-planning – selection PA, planning team, scoping, process

(2) Data gathering – issues identification, consultation

(3) Evaluation of data and resources

(4) Identification of constraints, opportunities and threats

(5) Developing of management vision and objectives

(6) Developing of management options, including zoning

(7) Preparation of draft Management Plan

(8) Public consultation of the draft Management Plan

(9) Assessment of submissions, revision, final Management Plan

(10) Approval or endorsement of the Management Plan

(11) Management Plan implementation

(12) Implementation monitoring and evaluation

(1) Review and update of the Management Plan.

2 Description of the protected area

WHAT IS THE STATUS AND MANAGEMENT OF THE ECOSYSTEM ?

2.1 Protection status and authority

Nijhum Dwip is a National Park (Notification No MoEF (Sec - 3) 8/2001/298 Dated 08.04.2001) under section 23(3) of Bangladesh Wildlife (Preservation) (Amendment) Act, 1974.

According to the definition of protected areas, Nijhum Dwip National Park is a Category II protected area (national parks), which are *large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities* (Dudly 2008). Only non-consumptive resource use is allowed in such areas.

Nijhum Dwip National Park is part of the Ganges-Brahmaputra-Meghna delta Important Bird Area (IBA criteria: A1[5], A4i[6], A4iii[7]), listed by Birdlife International.

Nijhum Dwip has been proposed in August 2014 to the RAMSAR secretariat as a new designated as a wetland of international importance under Ramsar Convention.

As a National Park, the land area and the inland creeks are managed by the Bangladesh Forest Department. The fisheries resources in the waters around the islands are managed by the Fisheries Department of the Ministry of Fisheries and Livestock.

2.2 Historical information

Nijhum Dwip is a small island under Hatiya Upazila of Noakhali. A cluster of islands (mainly Ballar Char, Kamlar char, Char Osman and Char Muri) emerged in the early 1950s as an alluvium in the shallow estuary of the Bay of Bengal south of Noakhali. In these days it has been called Ichamoti Dwip, meaning "mine of prawns" and later the sandbanks drew the notice of a group of fishermen, who named it Baular Char (Hossain et al. 2013). The island was named 'Nijhum Dwip' (meaning Silent Island) by former Minister Amirul Islam Kalam in 1979 observing its isolation and mild nature.

[5] A1. Restricted-range species - Criterion: The site is known or thought to hold a significant component of a group of species whose breeding distributions define an Endemic Bird Area (EBA) or Secondary Area (SA).

[6] A4i. Congregations - Site known or thought to hold, on a regular basis, > 1% of a biogeographic population of a congregatory waterbird species.

[7] A4iii. Congregations - Site known or thought to hold, on a regular basis, > 20,000 waterbirds or > 10,000 pairs of seabirds of one or more species.

Before 1965, Nijhum Dwip had no permanent settlements, but people came with cattle from Hatiya by crossing Mokhtaria Khal. Their livestock (initially mainly buffalo) crossed by swimming after one animal pulled across the channel by a country boat. The first settlements were established at Nijhum Dwip in 1965 by a man called Osman and therefore it was called Osman Char at that time.

Due to the cyclone Bhola in 1970 the entire population, 1200-1500 people at that time (Hossain et al. 2013) of Nijhum Dwip has drowned. After the liberation war the Government decided to give 1200 acres of land to landless people. The first Keora plantations for coastal protection were established and in 1972 and later also Acacia has been planted. Between 1974 and 1978 BFD released 13 spotted deer on the island as well as one barking deer and 3 rhesus macaque (section 2.4, page 26).

In 1988 the Nijhum Dwip Foundation was formed to realize the settlement of more landless people. Nine clusters of settlements (cluster villages) were formed, each cluster accommodating 50 families (average 7 persons per family). For storage drinking water and other domestic use, 17 more ponds were excavated, two for each of the villages, except one which got one pond.

2.3 Geo-physical information

2.3.1 Climate

There is no meteorological station at Nijhum Dwip and therefore climate information is taken from the Meteorological Station at Hatiya assuming that the situation at Hatiya does not deviate much from Nijhum Dwip.

Nijhum Dwip has a tropical monsoon climate, characterized by basically four seasons per year: winter (December-February), summer (March-May), monsoon (June-September) and autumn (October-November). The average temperature across the island usually ranges between 11° to 29° C in winter months and between 21° to 38° C during summer (Figure 1, page 23). The average annual rainfall is 3257 mm (Islam 2009) and varies from 2500 mm to 4500 mm (Figure 2, page 23). Cyclones pass regularly, particularly at the beginning and at the end of the monsoon. Serious cyclones affecting Nijhum Dwip were among others Bhola in 1970, Cyclone 1991 and Aila in 2009 (Kader et al. 2013).

An analysis of climate change over the period from 1983 to 2007 with data from the Hatiya station of the Bangladesh Meteorological Department (Islam 2009) shows an increase of the annual maximum average temperatures in summer and winter as well as a decrease of the minimum average temperatures in summer and winter. Average rainfall tends to increase and most of this increase seems to be contributed by rains in the months of July and August (0, page 24).

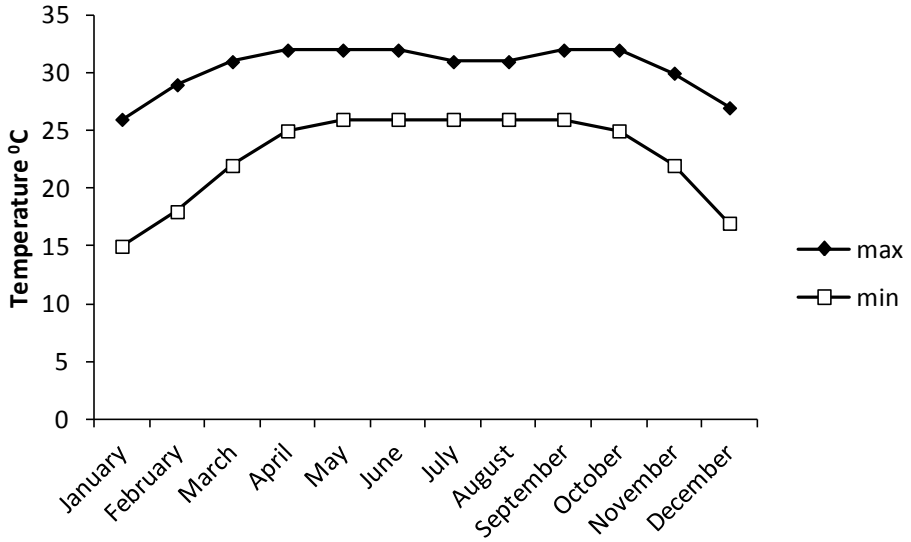

Figure 1. *Monthly average maximum and minimum temperature at Hatiya island (source: weatheronline.com).*

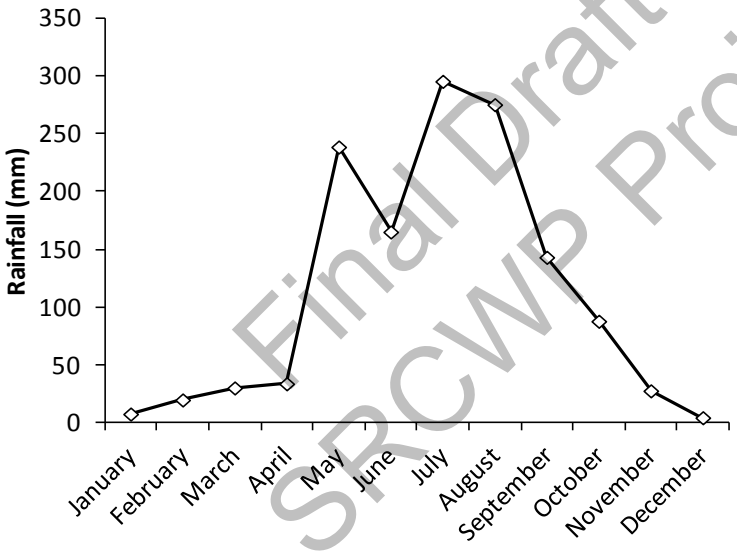

Figure 2. *Monthly average rainfall at Hatiya island (source: weatheronline.com).*

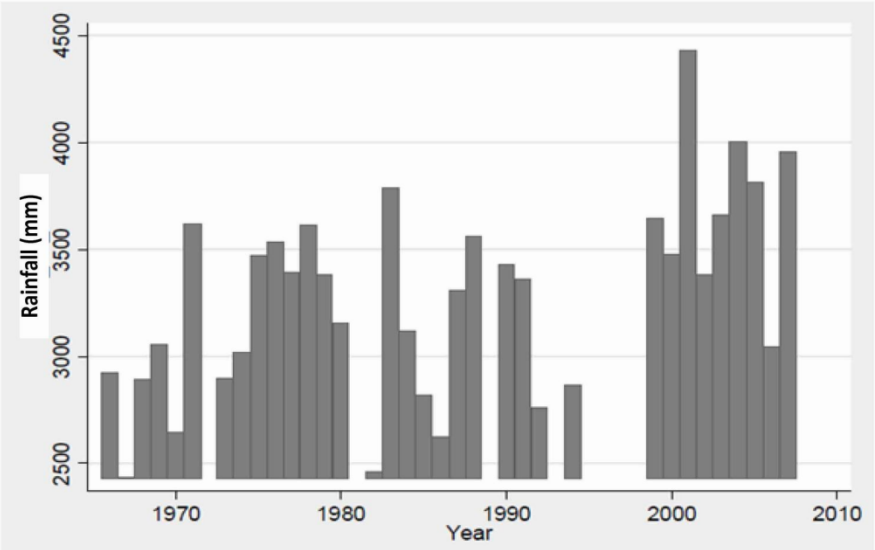

Figure 3. Annual total rainfall at Hatiya Meteorological Station from 1965 to 2007 (source: Islam 2009). No information is available for some years during this period.

2.3.2 Hydrology

There are several creeks running through the islands draining water to the main rivers around the islands and the Bay of Bengal. At each tide, these creeks also supply (brackish) water from the Bay to the mangrove forests and sparsely vegetated lands. Seventeen ponds for storing rainwater have been dug in the settled part of the main island, which are used as sources of water for domestic use, as well as for livestock and wildlife. Additionally four more ponds have been dug inside and on the edge of the forest intentionally to serve wildlife, but in the field it was observed that in practice they are more used by livestock. Salinity level measurements between 13 and 16 February 2014 with a refractometer resulted in the following values: 11 PTT in Meghna river at Hatiya Island, 17 PTT in Meghna river at Nijhum Dwip close to Chowdury Khal, 16 PTT in Mokhtaria Channel, and 3 PTT in the freshwater pond inside the mangroves of Chowdury Khal (N22°04.336'; E90°59.410'). These values show that even during the period of low discharge of the Meghna river (Islam 1999) the water around the islands is relatively light brackish and the water in the drinking pond is fresh during the dry season (Figure 2, page 23).

There is no irrigation system for crop production in the islands. Most people are getting drinking water from a deep tube well (Rahman et al. 2003) which have been made the Government and NGOs.

2.3.3 Geomorphology and soil

Physiographically the island is part of the Young Meghna Estuarine Flood Plain (Huq and Shoaib 2013).

Soils of the islands consist of calcareous alluvium, acid phosphate soil, grey floodplain soil and grey piedmont soils. These soils are saline and the PH values are neutral to slightly alkaline. The soils are well supplied with potassium and phosphate. These soils permit easy penetration of mangrove tree roots and agricultural crop roots and they are quite fertile.

A recent land cover analysis carried out with data from RIMS distinguished seven land cover classes on the island (Table 1, page 26, and Appendix 2, page 86)[8], which are the result of both natural factures (erosion and accretion) and human activities (forest plantation, deforestation, settlement and cultivation).

[8] It is noted here, that figures from IPAC (IRG 2012) show different areas of landuse classes: Mangrove plantations 6900 ha; Pasture land for deer 800 ha; Human habitat and agricultural land 1620 ha; and Water body, submerged chars and others 7032 ha.

Table 1. Land cover classification Nijhum Dwip (for map see Appendix 2, page 86)

Name	Soil	Vegetation	Land use	Nijhum Dwip (ha)	Damar Char (ha)	Char Kabira (ha)	C.Yunus, C.Kamal (ha)
1. Water body			navigation, fishing				
2. Recently accreted land	Clay, silt	Sparsely covered with colonizer *Oryza coarctata* (Dhani grass) and large areas of *Cynodon dactylon* (Durba grass)	livestock and wildlife grazing	1471	1822	24	2135
3. Beach wall	Sand		livestock grazing	62	138	13	13
4. Mangrove							
4a. Shrubland	Sandy silt, clayy silt	Usually early succession stage; grassland with developping mangrove speccies as well as shrubs such as *Ziziphus mauritiana* and *Phoenix paladusa*	livestock and wildlife grazing	14	34	15	
4b. Open woodland	Silt, sandy silt	Grassland, mainly Cynodon dactylon with scattered trees, mainly *Sonneratia apetala,* often deforestation observed	livestock and wildlife grazing	204	31		174
4c. Dense woodland	Sandy silt, clayy silt	Dominated by *Sonneratia apetala* (Keora) gradually replaced by *Exco-ecaria agallocha* (Gewa) and *Avicennia spec.* (Bain)	livestock and wildlife grazing	1716	132	162	2026
5. Anthropic land			Livestock, cultivation				
5a. Degraded forest	Sandy silt, clayy silt	Remaining keora trees and some grasses	Livestock, timber extraction	25			
5b. Cultivated land	Sandy silt, clayy silt	Mainly rice	Agriculture, mainly paddy	1061			2819
5c.Settlement	Sandy silt	Homestead garden, fruit trees and trees for cyclone protection (e.g. *Albizia saman, A. procera, Acacia. nilotica, Cocos nucifera, C. equise-tifolia and Swietenia mahagoni*)	Habitation, fish ponds, drinking water ponds, fruits	187			
5d. Fresh water pond			livestock and wildlife drinking	34	1		

2.4 Biodiversity

2.4.1 Flora

Nijhum Dwip is located in the Bio-Ecological Zone which is defined as "Offshore Island" (Nishat 2002).

Systematic (Feeroz and Deodatus 2003, Van Lavieren 1983) and non-systematic vegetation surveys in November 2013 resulted in 88 species identified (Appendix 4, page 89).

Broadly spoken, four different land types can be distinguished which are each characterized by different types of vegetation:

(a) Land formed by eolian deposition or marine/fluvial sedimentation not yet disturbed by human interventions - this type of land is covered by land cover categories 2, 3 and 4 as defined in Table 1 (page 26). Newly accreted land is mainly sparsely covered with colonizer *Oryza coarctata* (Dhani grass), older grasslands which are less frequently flooded mainly with *Cynodon dactylon* (Durba grass).

(b) Mangrove forest resulting from plantation and further natural succession, dominated by *Sonneratia apetala* (Keora) gradually replaced by *Excoecaria agallocha* (Gewa) and *Avicennia alba*, *A. marina* as well as *A. officinales* (Bain).

(c) Agricultural land, mainly cultivated with rice.

(d) Settled land which is actually a mosaic of constructions, fish ponds, homestead gardens, and tree belts with trees mainly planted for domestic use (e.g. *Albizia saman, A. procera, Acacia nilotica, Cocos nucifera, C. equisetifolia* and *Swietenia mahagoni*).

2.4.2 Fauna

Systematic and non-systematic surveys in November 2013 and February 2014 resulted in 80 different bird species, 6 mammal species, 9 reptile species and 4 amphibian species (Appendix 8, page 91). Apart from these taxonomic groups aquatic species are well presented in the park (Asadujjaman et al. 2012, Hossain et al 2005).

Birds

Birds are the most significant of vertebrates of the island in terms of diversity. A checklist of the Bangladesh Bird Club contains 171 species observed in several surveys in the period 2012 to 2014 at Nijhum Dwip NP, including southern Hatiya and Damar Char (Appendix 10, page 101). Of these species, 54 are potentially breeding species of the park. Nijhum Dwip and its surrounding waters and islands are an important area for wintering migratory birds, (including threatened species) such as Spoon-billed Sandpiper (*Eurynorhynchus pygmeus),* Asian Dowitcher (*Limnodromus semipalmatus),* Great Knot (*Calidris tenuirostris),* Indian Skimmer *(Rynchops albicollis)* and Spotted Greenshank (*Tringa guttifer)* (Bird et al. 2010, Hossain and Sarker 1997, Rabbi 2009). Common shelduck (*Tadorna tadorna*) is very common here while it is relatively rarely seen in other coastal areas of Bangladesh.

Mammals

The island is being colonized by various terrestrial species such as small carnivores and rodents (0, page 93). Between 1974 and 1979, 13 spotted deer and 1 barking deer have been released on Nijhum Dwip (Table 2, page 28). The spotted deer population has settled very successfully in the mangrove forest and feeds on mainly on the keora trees and the

different grasses on the non-forested parts of the island. According to BFD staff and villagers, the highest numbers of deer have been observed in the period around 2007. Since then, deer numbers have gone down to the current level.

The main mammal carnivores are the Asian golden jackal (*Canis aureus*) are common otter (*Lutra lutra*). Also stray village dogs are found in the forest predating on deer among others.

Some Rhesus macaque have been released in the 1970s, but they are assumed not to have survived on the island.

Table 2. Wildlife introduced at Nijhum Dwip (source BFD Noakhali)

Date	Number, gender	Species
22/11/1974	4 female	chital
05/09/1976	2 male	chital
05/09/1976	1 female	chital
15/04/1977	1 male	rhesus macaque
15/04/1977	1 female	rhesus macaque
15/04/1977	1 female	rhesus macaque
20/09/1977	1 female	chital
20/10/1977	1 male	chital
03/10/1978	4 male	chital
10/05/1979	1 male	barking deer

Cetaceans

Various dolphin species can be found in the waters around the islands (Smith et al. 2008), particularly Irrawaddy dolphins (*Orcaella brevirostris*) and less frequently finless porpoise (*Neophocaena phocaenoides*) and Indo-Pacific humpback dolphin (*Sousa chinensis*). During monsoon Ganges river dolphin is more common (*Platanista gangetica gangetica*).

However, little is known about dolphins in the area, as no research has been done on cetaceans in the Meghna estuary so far. During this period the other three species move probably further away into the Bay of Bengal. These north-south movements of habitat preference during the year are correlated with the changing turbidity and salinity of the water determined by the discharge of Meghna river (Islam 1999). Salinity levels in the dry season seem to be not favourable for Ganges river dolphin (section 2.3.2, page 24) that usually occurs at levels lower than 11 PTT (Smith et al. 2009).

Herpeto-fauna

Of the herpeto-fauna of Nijhum Dwip, four amphibian species were observed during surveys in November 2013 and February 2014 and 10 reptiles: 1 toad, 3 frogs, 2 turtles, 6 lizards and 2 snakes (0, page 93). Toads were found mainly in the human settlement especially on the dried portion of the island (*Duttaphrynus melanostictus*). Frogs were seen in aquatic (*Euphlyctis cyanophlyctis*), semi-aquatic (*E. hexadactylus* and *Hoplobactrachus*

tigerinus), agriculture lands and other swampy places (*E. cyanophlyctis*, *E. hexadactylus* and *H. tigerinus*) in the island.

Apart from the observed animals, it has been reported by villagers that Olive Ridley (*Lepidochelys olivacea*) used to breed at the southern corner of the island in the past. Different species of sea snakes are frequently caught in fishing nets. Around ten years ago also monitor lizard (Hossain 2004) was abundant on the island, but in 2013 and 2014 no trace of these animals has been found.

A python have been released in the 1970s and some islanders claim to have seen pythons. It is possible that some of them crossed Mokhtaria Khal from Hatiya.

Fish

The Meghna river estuary is the habitat of 53 fish species (Hossain et al. 2012) and *Oxyurichthys microlepis*, *Hemiarius sona, Arius thalassinus*, *Batrachocephalus mino* and *Arius caelatus* are the major contributory species (>6%) for both spatio-temporal scales. Water temperature and rainfall are major influential factors for the fish species distribution.

2.5 Cultural and aesthetic information

Since Nijhum Dwip is a very young island, there are no historic cultural monuments or other historic features. However, the pure and natural scenery and atmosphere is outstanding as it has hardly (yet) been disrupted by modern developments. The landscape stands for the process of how coastal Bangladesh has evolved from the sea.

2.6 Socio-economic information

2.6.1 Population

According to IRG 2012, the population of the island is around 20,000. However, estimates from different sources of the current population of Nijhum Dwip vary widely and range from 10,000 to 57,000. At a first glance some of these estimates seem to be highly overestimated, and an accurate census of the population seems to be very useful. However, even with the estimates on the lower side, the population density is quite high for a rural area with over 800 people per square km (excluding forest and newly accreted lands). The population is spread over 17 villages. Many settlers are coming from Hatiya and Tamijuddin after they lost their land due to erosion. As the population has settled here recently, all habitants have relatives in other places in Bangladesh, particularly on Hatiya. For the same reason, some people not living on Nijhum Dwip who are influential on Nijhum Dwip. There is no significant group of people from specific ethnic minorities living on the island.

Demographic information on the population remains poor despite family planning campaigns. Information sources are not well verifiable as most information is oral. The

average number of children of married women who reach the age of 40 for many years now is four according to some sources. Infant mortality is quite low due to Expanded Programme on Immunization (EPI) program launched by the government, while longevity is 70 years for men on the average and 80 years for women. Key informants said that the efforts of the community clinic health workers to provide health services such as prenatal health care, and vitamin and food supplements have resulted in decreasing infant deaths.

Emigration from the island is quite common among young men and women of the age range of 15 to 25. The proportion of migrating young people is increasing especially because they see more opportunities in urban centres. Despite the high emigration rate due to limited income and job opportunities at the islands, the population growth at the island is high. Taking into account the current population estimates, and the fact that resettlement of the island started in 1970 after cyclone Bhola, and also increased mortality due to Cyclone 1991, the average annual population increase at the island has been extremely high, often exceeding 10%.

2.6.2 Administration

Nijhum Dwip is administratively covered by the Upazila Nilvohoi, headed by the Upazila Chairman and administered by the Upazila Parishad based at Hatiya Island. Nijhum Dwip has received the status as independent Union since 2011 and is composed of 9 wards. The Union Chairman position is fixed for 5 years.

2.6.3 Social facilities

The majority of the islanders had elementary education. There are two government primary schools, six elementary school run by BRAC, one private junior school and about 17 non-formal education centres run by other NGOs. The professional level of teaching staff is generally limited and participation is low. Due to transport limitations very few manage to complete college or vocational courses on the mainland. Young boys and girls generally spend more years in school than average since they are also needed to help the family in agriculture or fishing.

Health services at the island are provided by a government community clinic which is run by paramedics. However, public health facilities and education are perceived inadequate by the islanders.

Electricity is generated by using small solar panels in the area and many households have electric devices such as radio, television sets, and electric fans.

There is a police camp to maintain the law and order situation on the island.

2.6.4 Accessibility

Nijhum Dwip is only accessible by boat. Water transport is available from Dhaka and from Subarna Char on Hatiya. Because of their relatively good roads and strategic location, Subarna char and Hatiya serve as the important entry points. Namar Char Bazar is the main marketing centre of agriculture and fishery products of Nijhum Dwip. A plan to connect the island of Nijhum Dwip with Hatiya by the construction of a cross dam has not been implemented.

2.6.5 Livelihood and resource users

Fishing and farming are generally the main source of livelihood and most people are engaged in activities directly related to fishing and farming (Figure 4, page 32). Fishing in the Bay of Bengal is done almost year round. Rice cultivation practices are generally simple using low yield varieties due to soil salinity.

Fish catch is sold to local middlemen at the main landing station of Namar Bazar for transportation to the nearby urban centres. There is only one fisheries association. An estimated 1,500 women and men are engaged in collection of crabs selling to local middlemen. Some people are engaged in seasonal honey collection from the (protected) mangrove forest. Honey has a high market value all over the country. Opportunities for non-agricultural employment are limited. All people are more or less dependent on the forest for fuel and construction materials. Most of the houses in the islands are made of wood and CI sheets roofing.

An estimated 10% of the population work as day labourer. People working in fishing trawlers may earn daily Taka 400. Exchange labour was common practice in the past, but it is now being practiced by less people as rural communities are increasingly drawn into the cash economy.

Fish, rice and vegetables are the prime commodities exported from the island through the middlemen or Aratdar. The fishermen and farmers are forced to sell through middlemen dictating the price at the Lamachar Bazar, because they cannot sell directly to the main markets or processing centres due to of lack of transportation facilities. Honey is also marketed here seasonally.

The small marketable surplus enables farmers to earn cash to pay for nonfarm products supporting their family or to improve their farm. Since cash income is low, commodity imports from outside the island are limited to basic goods: salt, spices, kerosene, sugar, clothing, house construction materials, electronic goods, medicines, fertilizers, pesticides, seedlings, and simple farm inputs. There is also a sizable and steady inflow of goods such as cheaper brands of cigarettes and other tobacco products.

Decision-making at family level is neither the monopoly of the man, nor of the woman. Decisions in borrowing money, celebrating special occasions, children's education, sale of

property, and marriage of children are normally shared. Men, however, dominate when it comes to the land development and finding other sources of income. Women on the other hand are in charge in food preparation, family health, and buying household needs.

Activity	Months											
	J	F	M	A	M	J	J	A	S	O	N	D
Hilsha fishing												
Goby fishing												
Shrimp PL collection												
Crab collection												
Fish drying												
Firewood collection												
Day labour												
Boat making												
Paddy culture (Rajashail)												
Betel leaf												
Livestock rearing												
Rainfall												
Cyclonic storm												

Figure 4. Seasonal activities of the fishing community and environmental features at Nijhum Dwip (source: Hossain et al 2013)

2.6.6 NGOs, CBOs and projects

Some NGO are active on the island, such as Red Crescent, BRAC, Proshika, and Human Development Centre.

An NGO named Ashi has established primary schools and some micro credit facilities.

The Char Development and Settlement Project (CDSP) has been active on the island. Its objective is to improve the economic situation and living condition of the population in the coastal areas of south-eastern Bangladesh with special reference to the poorest segment of the population. They have constructed cyclone shelters.

There are several community organizations in the islands looking after specific interests of the communities such as the fisherman association, a youth club, and a business community association. Some important projects are the following:

CBACC-CF

The project "Community Based Adaptation to Climate Change through Coastal Afforestation" (CBACC-CF) aims to enhance resilience of coastal communities as well as

introduce new options for income generation, by adopting the successful community-based adaptation intervention known as the "Forest, Fish and Fruit" (FFF) model. By planting protective and productive vegetation, with an elevated mound and ditch structure interspersed with fish nursery ponds, the FFF model not only provides additional sources of income, but has also established a 'green shield' surrounding some of Bangladesh's most vulnerable communities. Nijhum Dwip is one of the intervention areas of this project.

CREL

The Climate-Resilient Ecosystems and Livelihoods (CREL) program is running from 2013 to 2018, supported by USAID and implemented by the BFD and Winrock. The project promotes co-management in up to 25 protected wetlands and forests. One of the primary activities is the generation of alternate livelihoods for communities living in and around protected areas to ease pressure on dwindling, but highly productive forest and wetland resources. This will increase incomes while preserving vital forest and wetland habitats for future generations. The programme includes the development of Co-Management of Nijhum Dwip National Park.

SRCWP

The Bangladesh project "Strengthening Regional Cooperation for Wildlife Protection" is part of a regional programme "Strengthening regional cooperation for wildlife protection in Asia" funded by the World Bank. This programme focuses cooperation on wildlife protection between Bangladesh, Bhutan, India and Nepal. In Bangladesh its activities cover the development and implementation of the new legal framework for wildlife protection, crime control development, protected area management planning, protected area infrastructure development, capacity building for improved protection and a master plan for wildlife management. Under this project a subproject is funded, the Nijhum Dwip National Park Development Project (NDNPDP).

2.6.7 Climate change resilience

Eight cyclone shelters have been constructed with a capacity of 500-1000 people each; 5 have been constructed by CDSP, 1 by JICA, 1 by Red Crescent and 1 by Prochika.

2.7 Current land and resource use

2.7.1 Land tenure

Settlement of the island started in 1969 and subsequently the forest department undertook forestation by mangrove species. Initially, people stayed on seasonal basis and the territory of Nijhum Dwip was included in the Hatiya constituency in early 1970s. A large number of people losing their lands and homes due to riverbank erosion in nearby areas,

especially Hatiya, Shahbajpur and Ramgati migrated to the island as new settlers. Nine cluster villages were established and 50 families were settled in each village by the government with 2.0 acres of land for homestead and agriculture on long term lease.

Life at the island is hard and risky as people are very much exposed to natural stress due to weather and climate. Nevertheless, more and more people migrate to the island in search of new land for housing and cultivation, which results in increasing pressure on land.

2.7.2 Forestry

Location, climate, topography and soil of the island provide good conditions for extensive plantation of mangrove forest. There is a very good reproduction and natural regeneration of primary forest species. Since 1972 5,031.4 ha of forest has been planted on the main island of Nijhum Dwip according to the records of the Divisional Forest Office. Of these plantations, 1,452 ha (29%) has been lost due to encroachment, 1,929 ha (38%) through failed rooting and 111 ha (2 %) through river erosion. Approximately 2,509.1 ha 50% has survived. On Char Yunus survival of plantations (2500 ha) was 75 % and only river erosion was responsible for loss of plantations.

The afforestation work plan aims at the planting of 200 ha of mangrove forest every year.

2.7.3 Agriculture

According to the office of the Upazila Agriculture Officer there is 1525 ha cultivated land in Nijhum Dwip. Among the land 1420 ha is used for paddy cultivation and 2.05 metric ton paddy is produced per ha. So total 2911 metric ton paddy is produced in 2013-2014.

As agriculture is constrained by soil salinity, the cultivation of crops can be increased using saline resistant variety of crops. Some farmers are beginning to adopt crop diversification. Agriculture is dominated by monoculture of rice. Saline resistant rice variety is planted once in a year during kharif season[9]. The average yield of rice is generally lower than the national average. Farmers also produce vegetables during winter. Most of the farmers use chemical fertilizer specially nitrogen along with compost.

Rats are prevalent in rice fields. Sometimes birds and deer from the mangrove forest cause damage to crops. Also other pests may be responsible for crops loss. Farmers sometimes use nets to prevent crop raiding by deer. Chemical pest control is mainly done manually using hand spraying. A few farmers are adopting integrated pest management

[9] planting, cultivation and harvesting of any domesticated plant sown in the rainy (monsoon) season

(IPM) to control pests. If the infestation is severe, they use pesticides such as Karate[10], Folidol[11], and Predator[12]. No veterinary or pest control services are available at the island.

According to some islanders interviewed, farming practices are partly guided by their indigenous beliefs and rituals. Rituals are also conducted by some farmers to drive away evil spirits, and pests and diseases in their fields. Rituals in the form of ceremonies and offerings are conducted during planting and harvesting of their crops. Generally, traditional beliefs influence agricultural practices. Those farmers listen to birds; observe the wind, the moon and the tide before deciding on farming activities.

Since the majority of farmers own small farms and produce crops for family subsistence, they hardly apply post harvest practices except for seed storage. Sun drying of rice is done while rice milling is done with a mechanical rice grinder.

To meet the rising food and income requirements of the growing population in the islands, high-yielding varieties of rice and vegetables have been introduced by the government. These new varieties, however, are fertilizer-dependent and require more man-hours. While there is expressed willingness to adopt these technologies, the ability to do so is another issue. Majority of the people simply do not have the necessary funds to sustain these innovations. The innovations are feasible only to those with sizable land and money, with easy access to credit and the market, or those able to avail of limited government assistance.

[10] "Karate" is a commercial name of Cyhalothrin which is an organic pesticide. It is a pyrethroid. It has a low water solubility and is nonvolatile. Lambda cyhalothrin is moderately toxic in the technical form, but may be highly toxic via some routes in formulation, e.g. as Karate(http://pmep.cce.cornell.edu/).

[11] "Folidol" (Methyl Parathion) is one of the most toxic organophosphate pesticides which can over stimulate the nervous system causing nausea, dizziness, confusion, and at high exposures, respiratory paralysis and death (www.epa.gov). It poses a high risk to birds and aquatic invertebrates. It is very highly toxic to honey bees. The World Health Organization proposes a global ban on this pesticide.

[12] "Predator" (Chlorpyrifos) is an insecticide moderately toxic to humans, and exposure has been linked to neurological effects, persistent developmental disorders, and autoimmune disorders. Among freshwater aquatic organisms, crustaceans and insects appear to be more sensitive to acute exposure than are fish or the aquatic life stages of amphibians, although little data may exist for amphibians. Because of its combined high toxicity to bees and prevalence in pollen and honey, bees are considered to have higher risk from chlorpyrifos exposure via their diet than from many other pesticides

Table 3. Crop production from 2009 - 2014 at Nijhum Dwip (source: Agricultural Department Hatiya)

Economic year	Land Under Cultivation	Amount of Arable Harvest (ha)		Production metric ton/ha		Total metric ton	
		Rice	Vegetables & other	Rice	Vegetables & other	Rice	Vegetables & other
2009-10	1215	1180	35	1.90	4.5	2242	158
2010-11	1320	1250	70	1.92	4.7	2400	329
2011-12	1430	1360	70	1.95	4.9	2652	343
2012-13	1500	1410	90	2.01	5.2	2834	468
2013-14	1525	1420	105	2.05	5.25	2911	551

2.7.4 Livestock

Livestock husbandry is a very important activity on the island. In the past people from Hatiya brought their livestock by crossing Hatiya Khal by a boat pulling one swimming buffalo. The rest of the herd would follow. Nowadays the number of livestock on the island is significant (Table 4, page 36).

According to local farmers, 6 kg of straw is produced from 40 kg paddy. So the annual production of 2,911 tonnes paddy results in 436.650 tonnes of straw or 307.5 kg straw per ha. The straw provides food for livestock for around 2-3 months. The remaining of the year livestock depends on grazing the (mainly Cynodon) pastures on the char land of Nijhum Dwip. Villagers claim that their livestock does not graze in the forest. However a large number of cattle and buffalo tracks were found in the forest during surveys as well as live animals. There are 50-60 cowboys in Nijhum Dwip. They have around 50-70 cattle or buffalo per herd and guide their animals on char land.

Table 4. Number of livestock at Nijhum Dwip (source Agricultural Department Hatiya)

Livestock	**Number**	**Livestock Unit (LSU)**
Buffalo	3,220	3,220
Cattle	13,290	9,303
Goat	2,135	214
Sheep	3,529	353
TOTAL		13,089

2.7.5 NTFP

Non-timber forest products (NTFP) collected on the island include honey, fire wood, forest fruits, medicinal plants, crabs and fish from the inland waters. Since 2012, honey collection is regulated through a license system by BFD.

In 2014 four honey collectors were licensed to collect honey in the forests of Nijhum Dwip.

2.7.6 Fisheries

Most of the population including children is directly or indirectly involved in fisheries. Between 2009 and 2014 the number of fishermen is growing at a higher rate (10%) than the increase in catch (4.5%) (Figure 5, page 37). Hilsa (*Tenualosa ilisha*) and goby (*Gobioides rubicundus*, locally called cheowa) are the two dominant fish catches during May-October and November-April respectively. Other important catches are Bombay duck, mullet, ribbonfish, catfish, sharks, shrimp and crab. The average fish catch exported from Mokhtaria Ghats and Namar Bazar of Hilsa, Gobi and Lathe were respectively 1277, 1700 and 410 tonnes. The overall fish exports of these two Ghats were 3615 tonnes.

Fishery inside the forest is regulated through a license system by BFD. In 2014 eighteen fishermen were licensed to practice fishing inside the creeks of Nijhum Dwip.

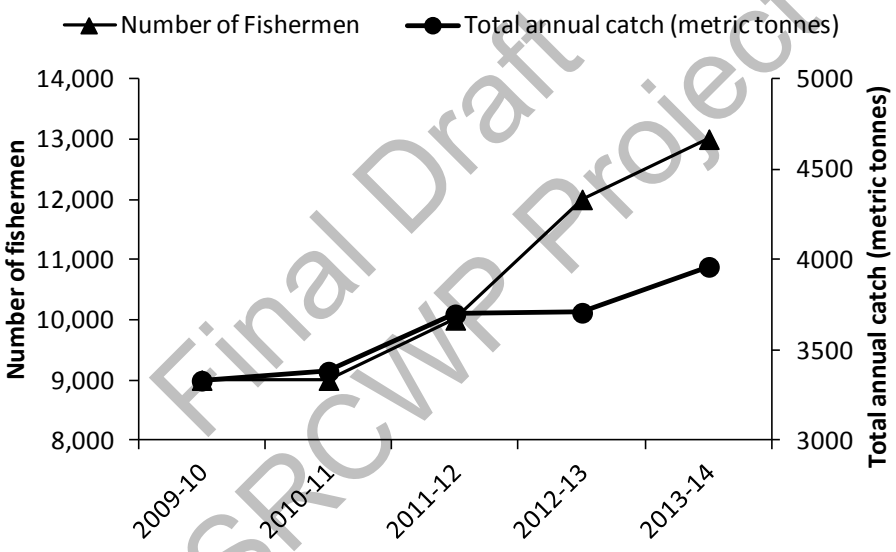

Figure 5. Development of the number of fishermen and the annual catch in metric tonnes at Nijhum Dwip (source: Agricultural Department Hatiya). Between 2009 and 2014 the number of fishermen is growing at a higher rate than the increase in catch.

2.7.7 Tourism

Tourists have to come to Nijhum Dwip by boat. The only regular connexion is a trawler ferrying between Mokhtari Ghat and Jahajmara Ghat on Hatiya. Most tourists come however with launches or trawlers arranged by themselves. At present tourists do not pay entry fees and therefore there are no statistics available on the number of arrivals and nights. Most of them stay in the launches or trawlers that bring them to the island. They go ashore briefly for a visit to the market and or make a walk in the forest with a local tour

guide hoping to see deer or other wildlife. Specific areas visited by tourists are Namar Bazar, Mokhtaria Ghat, Bander Tila, Komolar Char, Soakhali and Satopul. Country boats or trawlers may be hired locally to make a trip around the island and on channels in the forest. For sightseeing on the island, motorcycles are hired whose drivers function as guides along the network of narrow roads of which some are paved with cement. At Nijhum Dwip Namar Bazar, a guesthouse is available which has four rooms and a dormitory.

2.8 Management and protection system

2.8.1 Institutional setup and geographical layout

Nijhum Dwip National Park falls under the forest administration of the Jahajmara Range of the Coastal Forest Division, with its headquarters at Maijidi, Noakhali. This range has four beats: Char Osman (now Nijhum Dwip beat), Zahajmara Sadar, Char Kalam and Char Rowshan. The Jahajmara Range office is located at Hatiya island, while the Char Osman/Nijhum Dwip Beat office is based in Namar Bazaar, about 90 km south of the Coastal Forest Division's office in Maijdi and 31km south of Jahajmara Range headquarters.

The layout of the Nijhum Dwip protection of the BFD is as follows:

- Char Osman beat Office at Namar Char: 1 Beat Officer (dep. ranger), 1 Forest Guard, 2 Boat man. This beat has one office/dormitory building which roof has been damaged during the last cyclone. This roof has been replaced by a thatched roof since then. Furthermore, there are 4 inhabitable buildings, which are considered not repairable.
- Old Beat Office Satapol: 1 Moali and 1 Boat Man. This is currently a ruin behind a cyclone shelter used as school. The staff is housed elsewhere. This site is close to the new forest plantation site in the south of the island.
- Soakali at Mulagram Village: 1 Forester, 1 Forest Guard and 2 Boat Man. They live in a cyclone shelter.
- CDSP Building: 2 Forest Guards, 1 Moali

The staff capacity allocated to Nijhum Dwip is 30, but in February 2014 the actual staff number was 13, including one Beat officer (Ranger), one Forester, three Four Guards, two Plantation Moali and five Boatmen.

2.8.2 Protection infrastructure and logistics

Nijhum Dwip beat has 4 trawlers, of which only one is operational, one needs repair of the body and two are out of order and not repairable. There are no cars or motor cycles.

2.8.3 Resource management

For catching fish and collecting honey from the mangrove area, permission of the BFD through a license system is required. Despite the implementation of law enforcement, there is evidence of wide spread illegal cutting of trees, illegal collection of honey and wild plants, and poaching of deer. Most residents are aware of the various laws and policies related to biodiversity conservation, but they are not fully implemented. People violate these policies driven by their desire to improve their living conditions.

No systematic surveillance and law enforcement strategy is currently applied at Nijhum Dwip. The current practice is based on response to informations received by the forest officers.

2.8.4 Co-Management

In the beginning of 2014, co-management of the park is being developed by BFD with support of the CREL project (Climate-Resilient Ecosystems and Livelihoods). This initiative will result in the establishment of a Co-Management Organization, which will involve the local stakeholders in management decisions and benefit sharing.

By September 2014 Village Conservation Forums were formed in 22 villages located within or using the NP, and were linked in a federation (People's Forum) and the formal Co-Management Council and Committee (CMC) had also been formed.

3 Evaluation of values of the protected area

WHAT ARE THE OPPORTUNITIES AND ASSETS OF THE PROTECTED AREA?

The national park offers a wide range of ecosystem services which are perceived by the island population, but which represent also an ecological and socio-economical value and a much larger scale (Iftekhar 2008). An evaluation of the values of Nijhum Dwip National Park as described in the preceding chapter, reveals the key features of this park providing opportunities for sustainable development and conservation, which are described in the following sections of this chapter.

3.1 A dynamic and productive ecosystem

The coastal ecosystem is characterized by high physical and ecological dynamics due to erosion/accretion, regular flooding, salinity fluctuations and seasonally fluctuating sediment provision from Meghna river. These processes contribute to high turnover of nutrient cycles, which is on its turn reflected in among others a rich benthic biodiversity (Asadujjaman 2012), high abundance and productivity of fish, increased vegetation succession (Lugo 1980, Siddiqi 2011), and large numbers of (migratory) birds (Barri 2009).

3.2 Coastal protection

Nijhum Dwip is a "frontline" island with regard to cyclones and tidal surges threatening the coastal zone of Bangladesh. The planted mangroves on the island consolidate this cyclone barrier, fixing soil and breaking the wind and the waves. Therefore, the island has an important value for the southern coastal zone of the country, worth millions of Tk. for the prevention of potential loss of human life, crops, livestock, infrastructure and other things. The population consulted at Nijhum Dwip is committed to the maintenance of the National Park, because of its role in coastal protection which is perceived as an important value by them.

3.3 Fisheries

The creeks inside Nijhum Dwip and the surrounding waters form an important breeding area for fish and hence, the area represents an important economic resource for Bangladesh. Hilsa shed (*Tenualosa ilisha*) and goby (*Gobioides rubicundus*, locally called cheowa) are the two dominant fish catches during May-October and November-April respectively (Hossain et al. 2013). Other important catches are Bombay duck (*Harpadon nehereus*), mullet (*Paramugil parmatus, Sicamugil cascasia*), ribbonfish (*Lepturacanthus savala*), catfish (*Tachysurus thalassinus, T. tenuispinis*), sharks (various), shrimps (various) and crabs (various).

3.4 Other resources, livelihood

Apart from fish and agricultural land, the National Park provides a significant number of natural resources to the local population, such as honey, timber for among others house construction and fishing boat maintenance, fuel wood, plant parts used for medicine and more. Some potential resources which are not (yet) used, which is are for example the case for bee wax. Since 3 years, the Forest Department is collecting revenues through licenses for honey collection and fisheries in the forest channels (Table 5).

Table 5. Revenues from NTFP collected by the Nijhum Dwip Beat Office in return for licences for fishing, honey and wax collection in the forest

Product	2011	2012	2013
Honey	Tk 45,000	Tk 12,050	Tk 17,500
Wax	Tk 45,000	Tk 7,950	Tk 11,000
Fishing in the forest	-	Tk 832	Tk 33,500

3.5 Migratory birds

The island and even more so the surrounding waters and sandbars of Nijhum Dwip play a very important role for bird migration along the East Asian-Australasian Flyway. The area is particularly important for wintering migratory birds (Appendix 12, page 106), including threatened shorebird species such as Spoon-billed Sandpiper (*Eurynorhynchus pygmeus,* IUCN red list status "Critically Endangered"*),* Asian Dowitcher (*Limnodromus semipalmatus,* IUCN red list status " Near Threatened"*),* Great Knot (*Calidris tenuirostris,* IUCN red list status "Near Threatened"*),* Indian Skimmer *(Rynchops albicollis,* IUCN red list status "Vulnerable"*)* and Spotted Greenshank (*Tringa guttifer,* IUCN red list status "Endangered"*)* (Bird et al. 2010, Hossain and Sarker 1997, Rabbi 2009). Nijhum Dwip has the largest wintering concentration of Indian Skimmer in the world; probably over 50% of world population. However, the population of this bird is declining in Bangladesh. The main factors responsible for the global importance of the area are the inflow of rich sediments from the rivers and the tidal and seasonal dynamics of the ecosystem (see section 3.1, page 40).

3.6 Cetaceans

The Meghna estuary is important for the conservation of cetaceans. Various dolphin species can be found in the waters around the islands (Smith et al. 2008), particularly Irrawaddy dolphins (*Orcaella brevirostris,* IUCN conservation status "vulnerable") and less frequently finless porpoise (*Neophocaena phocaenoides,* IUCN conservation status "vulnerable") and Indo-Pacific humpback dolphin (*Sousa chinensis,* IUCN conservation status "near Threatened "). During monsoon Ganges river dolphin is more common (*Platanista gangetica gangetica,* IUCN conservation status "endangered").

The presence of cetaceans contributes to the prestige of the park and can be used as attraction for tourists and branding.

3.7 Emerging island (geomorphology)

The island of Nijhum Dwip is a young developing island in the Meghna estuary. It is in fact a showcase of the process of geomorphologic dynamics in the river delta which is as such a significant natural value of the area, attractive for tourists and offering opportunities for education and research on the formation and erosion of islands.

3.8 Large deer population

Since the 1970s a large spotted deer population has established of several thousand animals. The plantation of mangrove trees and introduction of this deer species and subsequent succession has lead to a situation which is similar to the initial stage of the original mangrove ecosystem as it was found along most of the Bengal coast in the past and still can be found in areas such as the Sundarban Forest and other mangrove areas along the Bengali and Indian coast. Larger animals such as deer are an element of attraction for tourists and a potential subject of ecological research relevant for wildlife and mangrove management.

3.9 Tourism

Tourism is an important source of income for the population of Nijhum Dwip but the current level of tourism is below its potential taken into account the poor transport, communication, marketing and facilitation. At present tourists do not pay entry fees and therefore there are no statistics available on the number of arrivals and nights.

The population consulted at Nijhum Dwip is committed to the maintenance of the National Park, because of its attraction value for tourism which is perceived as an important value by them.

The best areas for the development of nature based tourism are the mangroves and grasslands north of Nijhum Dwip Namar Bazar around Satakhali and Chowdury Khal. It is close to the best market of the island and the current guesthouse. The mangrove and khal landscape is the most varied and attractive of the island and appropriate for nature trails. The fresh water ponds attract deer and other wildlife. For bird oriented tourism and boat trips, the area northeast of Mokhtari Ghat is most attractive.

3.10 Climate change mitigation

Mangroves are among the ecosystems with a high rate of carbon fixation, higher even than rain forest (Pendleton et al. 2013). Mangrove degradation, therefore, contributes

significantly to global warming and, conversely, mangrove plantation and conservation mitigates climate change. In that perspective mangrove plantation and conservation is a potential source of carbon credits.

4 Analysis of issues and threats

WHAT ARE THE KEY CONSTRAINTS AND CHALLENGES FOR MANAGEMENT?

The principal constraints and threats which form the challenges for the management of Nijhum Dwip National Park are elaborated in the following sections.

4.1 Land use and tenure

Land formation and erosion processes of Nijhum Dwip are dynamic and this influences the status of the land continuously. BFD manages a large proportion of the land, but also settled villagers own land and even some people from outside Nijhum Dwip have stakes in land at the island. A land survey has been carried out on the island in 1959-1960 (Hossain et al. 2013). The last land survey of Nijhum Dwip has been done in 1995-96.

Different opinions exist between FD and Union Parishad on the land use status of certain parts of the island. Apart from this, gradual encroachment is occurring, particularly along the eastern border of the forest as satellite images show (Appendix 1, page 85). Temporary settlement in winter is also developing at Damar Char by livestock holders. However, these may later turn into permanent settlements when this island would be better protected from the influence of the sea. BFD is currently not managing this island, which is a key area for conservation.

A serious issue conflicting with the objectives of the national park is the leasing out of more than 500 ha of land on the north-western corner of Nijhum Dwip island. This part was called "Corner of Char Osman" and "Char Kamalla". All of it is part of the National Park, and partly classified as Reserved Forest, and partly classified as reserved Forest is in process, and as such under the authority of BFD. Under a different name, "Char Mahid", this part is being leased out by the Assistant Commissioner of Land (DC Noakhali) to unknown parties. If the grasslands of this part of the island would be converted into cropland and settlement it would result significant loss of grazing land for livestock and deer, and it would threaten important foraging and roosting areas along the western and north western coast. Moreover, an important natural area would be lost, which is currently enjoyed by tourists and which has significant potential for further tourism development.

Shrimp frye fishery is practiced along the shore , particularly in areas with newly accreted land. This activity disturbs migratory birds when done close to roosting sites.

4.2 Illegal resource extraction

Traces of illegal resources are obvious in the forest. Felled trees are found regularly and the cutting of trees was heard daily during surveys in November 2013 and February 2014. No direct traces of deer poaching have been recorded, but in the same period 400 kg deer

meat was seized at a ferry sailing from Hatiya. Systematic surveillance requires intensification at the islands to counter these illegal activities.

Poaching is not frequently recorded by BFD. The last recorded case dates from 2005 when deer were poached by a local Government official.

4.3 Deer and dogs

After the release of the spotted deer in the 1970s, their number increased rapidly and there has been a period where they caused significant damage in paddy fields by nightly grazing. Intensive guarding of the fields and chasing of the animals has solved this problem. Since 2005 4 drinking ponds were dug in the forest to distract the deer from the villages and paddy fields: 1 was made by the Upazila Parishad (2005), 2 by BFD (2008) and the digging of the fourth was a local initiative.

Re-analysis of a survey done in 2006 of the deer population at the island gives an estimated population of 15,000. In that period deer entered regularly in the villages and paddy fields to eat and drink. During the deer survey mentioned, hundreds of deer carcasses were found in the forest (M. Feeroz pers. comm.). According to several local sources, the deer population has decreased since 2007 to the current level and the number of deer entering into paddy fields and settlements has dropped significantly according to the villagers. The creation of four drinking ponds in the forest has certainly eliminated one reason for deer to come to the village.

A deer survey in February 2014 in the Mangrove forest only (Appendix 11, page 105) resulted in a population estimate of 1320 animals. Animals observed appeared to be in a healthy state. The following possible causes have been mentioned for the decline of the deer population number between 2006 and 2014:

(1) mortality due to cyclones and tidal surges in 2009, 2012 and 2013;

(2) population decrease due to predation by village dogs forming packs in the forest;

(3) population decrease due to increased predation by what is called "fox" by the villagers, but appears to be jackal (*Canis aureus indicus*) in reality;

(4) population decrease due to poaching;

(5) population decrease due to food limitation due to overstocking (which is a normal and natural cause for the stabilisation of wildlife populations);

(6) migration of deer to the other islands which all seem to have deer populations of similar densities now;

(7) some over estimation of the population in 2006 due to the fact that fixed band survey method has been used.

Both numerous dog and jackal tracks have been found in the forest during surveys in November 2013 and February 2014, and one feral dog has been seen stalking deer during one of these surveys. Jackal has been observed during the survey of February 2014 and the population in the forest has been estimated at 13 based on these data. The number of stray dogs, mainly hanging around at the eight markets of the island, has been assessed at 245. Approximately 300 more dogs are held by some villagers dispersed over the island for guarding. Most probably, the deer population is determined by a combination of the factors mentioned above, but the relatively healthy appearance of the animals and the number of fawns indicates that food shortage is not an important factor at present (2014).

4.4 Livestock

The vast grasslands on newly accreted land attract large numbers of different types of livestock herded by "cowboys". Buffalo are mainly owned by local elites, while cattle, goat and sheep are usually owned by small holders. However, livestock tracks which are found everywhere in the forest (particularly cattle and buffalo, goat and sheep not so much) show that livestock enters also frequently into mangrove forests. The survey in February 2014 gave an estimate of 85 cattle and 450 buffalo inside the forest. According to BFD staff livestock grazing and the associated presence of people causes disturbance of deer.

The water ponds inside the forest appear to attract livestock into the forest. An inspection (12 November 2013) of one of these ponds near Chowdury Khal (for location see Appendix 13, page 108) showed many cattle tracks around the pond, but hardly any deer track. Many deer tracks however were observed nearby in the Cynondon grassland around the pond. So an undesired side effect of the establishment of water ponds in the forest may be the increase of pressure on the forest by livestock attracted by these ponds. The importance of the ponds for the deer however has yet to be proved.

Foresters take livestock out of the forest and bring them to the Khowar[13], where owners need to pay to get them back. The current beat officers remembered 5 occasions where forest staff has been beaten up by villagers in response to such actions.

Approximately 1600 ha of pasture of the island support approximately 13 Livestock Unit (LSU) per ha. Assuming that livestock supplements 25% of its annual food intake with paddy straw, the current stocking rate is 9.75 LSU/ha. This indicates serious overstocking of the pastures of Nijhum Dwip, if we take as a reference saline pure Cynodon dactylon grasslands in USA, which have been calculated to sustain 1-1.2 LSU/ha (Alonso 213).

[13] enclosure where straying livestock is brought

4.5 Climate change

Climate and weather have a significant impact on the island in the form of flooding and tidal surges accelerated by bad weather conditions (Islam 2009, Kader et al. 2013). Several serious cyclones have hit the island, and even more recent incidents have taken place, such as a tidal surge which hit the island on 10 April 2012, which resulted in one person drowned, approximately 3000 livestock lost and 400 houses damaged[14]. Climate change is expected to increase this type of impacts. Additionally, forecasted rising temperatures (Islam 2009) may influence life cycles and habitat suitability of animal and plant species.

4.6 Tourism

Since tourism numbers are still relatively low, tourism does not impose (yet) an additional burden on law enforcement. However, control of law and order is important for the tourism image of Nijhum Dwip. A rumour a couple of years ago on dacoits operating in the vicinity of the island caused for example a dramatic drop in tourist visits, requiring several years to recover.

However, even now the behaviour of some tourists is at some occasions disturbing for wildlife and the serenity of the island. For example, there is a practice of bringing high power music sets to the island to accompany picnics or even the shopping activities in the local bazars.

The principal limiting factors for further development of tourism are lack of transport opportunities to the island and lack of facilities such as picnic sites, trails and accommodation. If these barriers will be reduced, the pressure and related treats of tourism on the island will increase and require mitigation.

4.7 Relation between population and BFD

Although good collaboration exists at certain levels between the BFD staff and the local population, there are obviously the following issues which are causing frictions:

- livestock roaming in the forest and consequently being taken by surveillance staff,
- in some cases claims on the status of land on both sides,
- illegal resource extraction in the forest,
- encroachment of cultivation into the forest.

Such issues lead sometimes to conflicting situations, and a negative attitude of individuals towards BFD staff.

[14] (http://newagebd.com, 10/4/2012)

4.8 Staff accommodation and facilities

The following factors constraint the operational capacity and motivation of the Surveillance staff:

- poor accommodation,
- inadequate office space,
- limited communication facilities (no internet, poor mobile network),
- insufficient mobility,
- basic social infrastructure, particularly not optimal for families.

4.9 Lack of information on resources

Crucial information for management is very scarce and not shared with all stakeholders. The boundaries of the park and reserved forest are not clearly mapped; statistics on population and economic activities unreliable, and management related activities such as law enforcement not very accessible. This complicates taking the right management decisions and negotiations in resource and land use conflicts.

5 Vision and objectives

PRIORITY DIRECTIONS TO MOVE AHEAD

5.1 General framework

According to the NBSAP (GoB 2004), the primary objective of Bangladesh' biodiversity conservation policy is "*to establish conditions to conserve, and wherever necessary, to restore the biodiversity of Bangladesh as an essential component to ensure the wellbeing of the present and future generations, and equitable sharing of benefits*". This involves among others the maintenance and improvement of environmental stability for proper functioning of ecological systems, and ensuring the preservation of the unique biological heritage of the nation as an asset for the benefit of the current and future generations.

As a result of the environmental dynamics of Nijhum Dwip, the area unites a number of important biological and socio-economical values, which are significant for Bangladesh and beyond its borders at regional and global level. Coastal protection and the revenue potential to be gained from tourism are considered as the most important values by most stakeholders. However, the regional and international importance of the area as breeding area for fish and wintering area for migratory bird deserve to be acknowledged as well.

5.2 Scope and limitations of managing Nijhum Dwip

Despite the significant ecological and socio-economic values of Nijhum Dwip, the management system applied in 2014 did not comply with the standards for national park management according to the international definition[15], as consumptive resource use is widely practiced in the marine as well as in the terrestrial parts of the park. Moreover, the terrestrial part is partly managed as a man-made plantation forest and partly as a livestock ranch, without having a managerial scope for natural habitats for all of its natural components.

This management plan is based on the assumption that the status of National Park for Nijhum Dwip will be maintained, which should involve a shift from an emphasis on consumptive use towards non-consumptive and sustainable use of the park. However, the National Park status should be dropped and the area reclassified into Reserved Forest in case at a later stage it would be decided that biodiversity conservation is not a management

[15] According to the definition of protected areas, a National Park (Category II) is a large natural or near natural area set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities (Dudly 2008). Only non-consumptive resource use is allowed in such areas.

priority and management should only focus coastal protection and consumptive resource use. In that case the area would become Category VI, if resource use would be made sustainable, also implying halting illegal forest exploitation and encroachment as well as drastic reduction of livestock numbers.

The pressure associated with the humans attracted by the ecological values of Nijhum Dwip requires to be managed in order to realize sustainability of the islands' ecosystem wealth and benefits. Particular issues requiring attention are the control of various domestic animals roaming the islands, forest encroachment, unsustainable fishing practices and in the future most probably the impact of tourists.

5.3 Objectives

The long term vision of the management plan for Nijhum Dwip is to maintain the natural coastal landscape with mangrove forests, creeks, grasslands, beach walls, intertidal zone and its surrounding water with its associated wildlife through collaboration between BFD and communities based on co-management. Priority will be given to the conservation of internationally important water bird populations, as well as to the control of hunting, trapping and other unsustainable interference of people and domestic animals in the ecosystem including livestock and stray dogs. Human settlements and agriculture will be limited to areas used in 2014, but community livelihoods will be strengthened to resist hazards through better adapted cropping and diversification including development of responsible tourism and sustainable fisheries in the waters of the national park.

In the perspective of the context sketched above, the following management objectives are proposed for Nijhum Dwip National Park, based on the assumption that the National Park status of the area will be maintained:

(1) Protect and maintain physical, biological and aesthetic features of Nijhum Dwip National Park as example of typical estuarine floodplain ecosystem

- Research, surveys and monitoring of biodiversity resources to understand ecological values, processes and threats;
- Regulate land use through zoning and zone demarcation of the area, taking into account land value and function as well as crucial and vulnerable habitats of wild species;
- Protect crucial habitats such and resting and foraging sites of migratory bird species and reproduction areas for fish species;
- Control invasive species, including straying domestic animals in vulnerable habitats;
- Develop and implement effective surveillance and law enforcement and consider introduction of smart patrolling with MIST.

(2) Reinforce and maintain coastal protection

- Afforestation with mangrove species;
- Forest protection.

(3) Increasing the revenue generation potential of the Park

- Determination of economic values of the park including current illegal off-take;
- Develop entry fee collection from tourism;
- Promote private investment in tourism development;
- Develop resource collection taxation and benefit sharing mechanisms.

(4) Realizing and exploiting the Park's potential as venue for tourism based on wildlife, recreational, educational, cultural and aesthetic appeal

- Develop tourism infrastructure (board walk, information facilities, observation shelters, nature trails, ...);
- Promotion of tourism in urban centres of Bangladesh;
- Support local and private initiatives in the field of tourism development;
- Control impact of tourism (pollution, animal disturbance, noise disturbance, ...).

(5) Integrating the National Park into local and regional development process, especially surrounding local communities to ensure wider acceptance of the Park's values

- Create awareness among stakeholders including local resource users as well as key actors determining land and resource use, involving also local educational institutes;
- Establish co-management and benefit sharing.

(6) Improving the BFD's staff welfare, motivation and capabilities

- Enhancing office and accommodation facilities for BFD staff, including drinking water, power supply and internet connectivity.
- Improving logistics and mobility (boats, motor cycles).
- Improving field equipment (uniforms, arms, telecommunication equipment, GPS, ...).
- Training (law enforcement, co-management, and ecotourism).
- Investigating the feasibility of introduction of smart patrolling (MIST).

6 Zoning plan

HOW TO PLAN MANAGEMENT IN DIFFERENT PART OF THE PARK

6.1 Zoning in the Bangladesh Wildlife Act (2012)

The Bangladesh Wildlife Act (2012) distinguishes and defines the following zones inside and outside protected areas:

- Section 10: “corridor” means a passage or area in the margin of a protected area through which the wildlife can move from one forest or area to another forest or area and which is declared as corridor through official gazette notification under section 20 of this Act;
- Section 12: “core zone” means the most important existing forest area within a protected area, which is rich in biodiversity and where extraction of all kinds of forest produces are prohibited for safe reproduction of wildlife and which is managed for regulating entry of visitors and declared as such through official gazette notification under section 20 of this Act;
- Section 27: “buffer zone” means forest lying in the margin of protected area, except core zone, or degraded forest area adjoining human habitation, where local community people are inclined to harvest forest produce and where there is scope for short rotation participatory forestry in harmony with plant species of the protected area and development of which ensure protection of biodiversity and which is declared as such through official gazette notification under section 20 of this Act;
- Section 36: "landscape zone" means a public or private area outside the boundaries of designated sanctuary, national park and eco-park that regulates the biodiversity of the protected area and which is managed to maintain similar landscape of the protected area for deterring degradation of the protected area and ensure safe movement of wild animal, and notified as landscape zone under section 20 of this Act ;

Since Nijhum Dwip is an island, "corridor zone" as such is not really applicable here. However, the island plays an important role as stepping stone in animal migration, and the (re)settlement of species from Hatiya is important for the development of the island's ecosystem.

6.2 International good practices

Zoning inside protected areas is particularly useful for the handling of large multi-purpose and multi-dimensional protected areas, and for providing connectivity between core areas (Launched and Burdened 2011). It is also an appropriate tool for accommodating a variety of governance types or mixed tenure arrangements within a single designated

protected area. The following types of zones are often applied in protected areas in different parts of the world:

(1) Special and/or unique values zone for particular protection of specific features (biological, cultural, geological) of the protected area;

(2) Primitive/wilderness zone for the full preservation of landscapes and ecosystems;

(3) Limited development zone for the protection of natural areas used for tourism, education and research and allowing limited developments (particularly road infrastructure) to facilitate these activities;

(4) Intensive development/services zone for the establishment of for example protected area offices and tourism facilities;

(5) Traditional and indigenous use zones, for sustainable resource utilisation by traditional/indigenous users;

(6) Rehabilitation zone, for restoring degraded habitats through management measures.

6.3 Zonnig in Nijhum Dwip NP

Zoning in Nijhum Dwip NP should take into account both the Wildlife Act and international good practices. The Wildlife Act deals with external zoning while international good practices would contribute more on effective zoning inside the protected area. A zoning plan and management matrix for Nijhum Dwip NP is presented in Table 6 (page 53) and a map presenting provisional zoning is presented in Appendix 4 (page 88). The proposed zoning plan is meant to be used as a starting point for a consultative process with all stakeholders to establish the boundaries of the zones. Subsequently, zoning boundaries should be determined by GPS in the field and where necessary consolidated concrete markers need to be positioned in the field.

Specific areas may need to be protected as "Special and/or unique value zone", e.g. shore land to protect migratory birds from shrimp fishery, and specific waters for the protection of cetaceans to avoid drowning in nets. Some zones allow non-consumptive use (e.g. low-impact tourism), other zones may allow sustainable resource use (e.g. livestock grazing, fishing and NTFP collection). The following specific zones are proposed (see Appendix 4, page 88 for indicative location of areas):

- NC- Nature conservation,
- B - Migratory bird conservation,
- T- Eco-tourism development,
- FC- Forest conservation,
- FP- Forest plantation,
- Rehabilitation of habitat (not mapped),

- Management infrastructure (around BFD buildings, not mapped),
- L- Livestock grazing,
- Fishing (all water not covered by other zones),
- H - Habitation and agriculture.

Table 6. Management matrix for protected area management zones in Nijhum Dwip National Park (map: Appendix 4, page 88)

Nijhum Dwip Management zone	Wildlife Act	Utilisation according	Locations	Utilisation	Restrictions	Measures
· NC - Nature conservation · B - Migratory bird conservation	Core zone	Special and/or unique values zone	· selected forest · grasslands · specific breeding sites, · migratory bird resting and feeding sites	· research, coastal protection	· no other access	· surveillance
· T- Eco-tourism development	Core zone	Primitive/ wilderness zone	· Part of mangroves	· research, coastal protection, zero impact tourism	· no other access	· surveillance
· T- Eco-tourism development	Core zone	Limited development zone	· Areas developed for tourism used for simple infrastructures such as hides and bridges	· tourism, research, coastal protection	· noise, air and water pollution control , no other access	· surveillance, basic tourism infrastructure development
· FC- Forest conservation	Core zone	Primitive/ wilderness zone	· Mangroves	· coastal protection, research	· no other access	· surveillance, enrichment, ANR
· FP- Forest plantation	Core zone	Intervention zone	· newly accreted land	· coastal protection, research	· no other access	· surveillance, afforestation or ANR
· Rehabilitation	Core zone	Rehabilitation zone	· Encroachment, degraded mangroves	· research	· no other access	· surveillance, habitat restoration
· Management infrastructure	Core zone or Landscape zone	Intensive development/services zone	· Offices, staff quarters, tourism facilities (buildings)	· BFD accommodation and management, tourism	· noise, air and water pollution control	·

Nijhum Dwip Management zone	Wildlife Act	Utilisation according	Locations	Utilisation	Restrictions	Measures
· Management infrastructure	Landscape zone	Rehabilitation zone	· Abandoned office building space	· Rehabilitation activities	· noise, air and water pollution control	· clearing of waste, old buildings, etc. · plantation, ANR
· L- Livestock grazing	Buffer zone	Zoning for traditional and indigenous users	· Grasslands open to grazing	· grazing, tourism	· resource use regulated by BFD, noise, air and water pollution control	· surveillance
· F - Fishing	Buffer zone	Zoning for traditional and indigenous users	· Khals open to fishing	· fishing, tourism	· resource use regulated by BFD, noise, air and water pollution control	· surveillance
· NTFP collection	Buffer zone	Zoning for traditional and indigenous users	· Forest open to use of NTFP	· NTFP collection, tourism	· resource use regulated by BFD, noise, air and water pollution control	· surveillance
· H - Habitation and agriculture	Landscape zone		· Areas with natural vegetation surrounding protected areas	· habitation, fishing, grazing, tourism, small scale agriculture	· resource use regulated by BFD, noise, air and water pollution control	· surveillance, awareness

7 Management prescriptions and actions (5 year work plan)

7.1 Management of the physical environment

7.1.1 Zoning

A zoning plan will be proposed in the plan based on consultation with the managers and other stakeholders (see also section 6.3, page 53).

7.1.2 Boundary demarcation

To indicate the different utilization zones in the park for users and managers it is convenient to demarcate zones inside the park. There are three approaches which should all be used as far as possible:

(1) description of boundaries using landscape attributes as reference;

(2) physical demarcation of park boundaries and management zones in the terrestrial parts of the park by vegetation clearing, demarcation tree planting, or placing concrete markers, and physical demarcation of park boundaries and management zones in the marine parts of the park by buoyage[16];

(3) by registering boundaries with a GPS and storing the data in a GIS system at RIMS; these GPS boundaries can be mapped on different thematic maps.

As boundary demarcation in waterways with buoys is new for Bangladesh, it is recommended to start with a pilot of for example 4-8 km (5-9 buoys) and evaluate effectiveness and sustainability. Buoys should be well anchored with heavy concrete anchors and iron chains.

7.1.3 Resolving tenure and encroachment issues

The zoning of the park needs to be endorsed by the Union Council. Pending issues regarding tenure conflicts and encroachment will be resolved with the Union Council.

[16] buoys (75 cm diameter, 250 cm height) to be placed every 1000 m along boundary

7.2 Management of biological components

7.2.1 Forest plantation

Villagers express their wish to plant more Keora at newly accreted land (including newly formed islands) for protection against flooding and erosion as well as to extend the land area of the island. However, all newly accreted land should not be converted immediately into planted mangroves as this land is very important for birds and grazers, while forest would prevent access of these animals groups. Forest plantations are therefore only recommended in the areas crucial for coastal protection, which is mainly on the southern side of the islands.

Areas recommended for planted are situated on newly accreted land in the southeast of Nijhum Dwip main island and on Damar char (Appendix 4, page 88). Areas to be planted yearly depend on annual accretion, which varies from year to year. Averagely, 100 to 200 ha is recommended to be planted at each of these locations. However, it is important to minimize loss of crucial grassland for birds, deer and livestock. The current drive from (international) donors to plant forest to improve climate change resilience is therefore also to be coordinated critically.

Enrichment planting is normally not practiced and recommended in the core zone of a National Park as its objective is protection of a natural ecosystem, unless coastal protection is at stake. It is important to monitor intensively for 3 to 5 years (fixed quadrates, section 8.3, page 70) to record the vegetation development and succession following rigorous measures to stop livestock entry in the forest, and to evaluate after that if any enrichment planting is required.

7.2.2 Control of dogs

Village dogs straying and hunting in the forest form a constant threat to wildlife and increase the risk of transfer of rabies to humans. Dogs without control of owners should therefore be eliminated from the island. This can be done by shooting, tranquilizing and/or trapping. Collaboration with the other island authorities is required.

Golden jackal is the natural predator of deer and needs to be protected as one of the natural factors controlling the deer population.

7.2.3 Control of livestock

Livestock roaming over the island compete with wildlife, while transferring zoonotic diseases and destructing the forest. However, livestock provide also important food resources and income to the island population. Therefore livestock needs to be managed in

such a way that competition and contact with wildlife as well as forest destruction are minimized, while possibilities for grazing are not limited unnecessary.

The following measures are applied to counter the impact of livestock:

- Zoning - interdict the entry of livestock in forest and remove livestock in cases where livestock is found in the forest. Reservation of determined grasslands for wildlife can also be considered. The zoning plan needs to be made with consensus of all stakeholders.
- Fencing - a barbed wire fence may be erected along the eastern boundary of the forest of the main island between the forest and the agricultural land, which would at the same time act as zoning demarcation. Barbet wire fences are however often not appreciated by local people. Therefore it is recommended to include livestock proof gates at regular distances.
- Drinking ponds - a study is required on the effect of the presence of ponds inside the forest on the distribution of wildlife and livestock. The location management of ponds in the forest needs to be reviewed based on this study.

7.2.4 Release of animals in the park

In the past several wild animals have been released in Nijhum Dwip NP (section 2.4.2, page 27). The introduction of animals in protected areas and the problem of dealing with confiscated animals requires the development of a general national policy for the translocation of animals.

Translocation causes stress to all wildlife and may lead to death of individual animals due to starvation, inter- and intra-specific competition and predation. The best place to release an animal is the place where it came from as it is familiar to the resources and threats of that area. Animals can only be introduced in an area (a) when there is no immediate risk of interspecific and intraspecific competition, (b) when the area is large enough to support the species, (c) when the habitat in area is suitable for the species, (d) when there is no risk for the transfer of (exotic) diseases to the area, (e) when the species does bring other wildlife species at risk, and (f) when no serious human-wildlife conflicts are to be expected. Exotic animals should never be released in the wild, but either be retained in captivity or euthanised if maintaining in captivity is too expensive or inconvenient. If translocation is justified according to these criteria, appropriate measures have to be taken for the habituation of the animals to the area.

Opposite to the risks of the translocation of animals is the wish to (re)introduce animals in areas where they do not occur at the moment of introduction in order to change or restore ecological functions of that area or to expand a meta-population of a threatened species. Since the criteria and mitigating measures for translocation are complex and

specific for areas and species, any release of wild animals needs to be consulted with wildlife experts and a sound translocation feasibility study and plan needs to be prepared.

7.2.5 Surveillance

At present, no systematic approach exists for surveillance and protected area monitoring at Nijhum Dwip. Frequent and structured surveillance of the forest is required to control legal and illegal resource use, as well as for biological monitoring. Resource use control includes forest use, livestock grazing, fisheries, NTFP collection and illegal hunting.

MIST is a smart and integrated system for the recording of collected GPS data and observations related to law enforcement and ecology. The system is a powerful tool for monitoring of law enforcement and the ecosystem, allowing spatial and statistical analysis that can be used for measuring patrolling effectiveness as well as for patrol planning. The system has been developed by CEGIS for the surveillance of the Sundarban Reserved Forest and this system is based on similar systems that have been operational in other countries in several continents for about 15 years. It is worthwhile to assess the feasibility of the introduction of MIST to support surveillance of Nijhum Dwip.

Both with and without MIST, patrolling schedules have to be prepared and patrol reporting implemented. Patrolling schedules need to avoid predictable patrolling patterns, and a protocol needs to be established to keep them secret. Patrols should cover regularly all forested and not forested parts of the park as well as the surrounding waters.

7.3 Community conservation programmes

7.3.1 Conservation awareness

Conservation awareness programmes should be implemented by the WNCC to the following target groups: schools, resource user associations, law-enforcers/police, local authorities (Union). Apart from general nature conservation, these programmes should cover climate change, forest protection, and human impacts in Nijhum Dwip NP.

7.3.2 Establishment of co-management

Co-management has proved to improve conservation of natural resources and biodiversity in many protected areas over the world. The interest to contribute to sustainable management and conservation increases when responsibility is given to local stakeholders in decision making on resource management. The establishment of co-management has to be carefully planned and based on practices that have proved to be effective. It is advisable to adopt the model that is in development the last decade and

which has been supported by projects such as the Nishorgo Support Project, IPAC and CREL (anon. (c) undated).

Key tasks in establishing well functioning co-management will include:

- Motivation of the stakeholders,
- Building capacity of these new institutions and their members,
- Development of benefit sharing mechanisms (particularly establishing visitor entry fee collection, with 50% returning from government to the CMC,
- Collaboration and consultations so that roles and responsibilities for implementing this plan are agreed between co-management stakeholders,
- Refining the application of this plan through negotiation and consensus among the relevant users and stakeholders - particularly regarding sustainable levels of use in zones where natural resource uses are permitted (for example, local fish sanctuaries and fishing limits within relevant parts of the PA, limits on grazing areas and intensity or seasons of grazing, limits on shrimp fry collection, crab collection and collection of other NTFPs),
- Establishment of Community Patrol Groups to work with FD in protecting key components of the NP ecosystem,
- Developing local adaptation plans at village levels,
- Developing capacity to mobilize resources (funding from government, projects, NGOs, private sector and others to implement actions under this plan - in particular actions to sustain these villages and enhance adaptation to climate change and hazards while reducing exploitation and pressure on ecosystems, biodiversity and key species),
- Regular review of activities and implementation in the CMC.

7.3.3 Sustainable resource utilization

To improve sustainable livelihood of local populations and to reduce the impact of unsustainable resource use, farmers, fishers, livestock holders and collectors will be assisted by improving their practices and resource use planning. These activities will be developed in a participatory way with resource user groups with support from NGOs. Examples of such activities are:

- Development of sustainable fisheries, including resource conservation by sanctuaries and introducing and imposing sustainable fishing approaches and gear.
- Promotion of environment friendly higher return agriculture that is better adapted to climatic hazards and trends
- Organizing livestock owners to develop a livestock management plan based on carrying capacity of the available grasslands taking into account biodiversity conservation priorities.

7.3.4 Alternative Income Generating Activities

With support from NGOs, Alternative Income Generating Activities (AIGA) will be developed. Such activities can be related to delivery of services to tourists (section 7.4, page 62) or the local island population, as well as other business opportunities. At present, the most common AIGAs are poultry, livestock, day labourer, small business and fish farming (Rahman et al.). Other possibilities could be home gardening, duck- chicken- and goat rearing, making fish traps and gear, oyster and crab cultivation, bee keeping, cultivation of meley grass for mat weaving, tree nurseries and paper bag making.

7.3.5 Promotion of conservation based enterprises

The development of conservation based enterprises is in the first place the task of private people, collectivities and NGOs. The park managers should promote and support this type of development by taking into account opportunities in the management system (e.g. zoning, ecotourism development, resource extraction and marketing of the protected areas.

7.4 Tourism development

The role of BFD with regard to tourism is facilitatory and regulatory. The marketing of tourism is in the first place a task of the private sector that is better placed to deliver the required services in response to the demands. The following actions are required:

(1) Elaboration of a tourism management plan.

(2) Zoning of tourism activities to reduce friction between tourism and other economic activities and biodiversity conservation. Concentration of tourism near entry points in north and south (Mokhtari Ghat and Namar Bazar).

(3) Facilities development, such as nature trail from Nijhum Dwip Namar Bazar to Chatakali and further to the grasslands of the corner of Char Osman with simple and "traditional" but stable wooden bridges and hides for bird and deer watching.

(4) Quality management of accommodation and facilities.

(5) Impact reduction of tourism, including garbage management, noise reduction of launches and amplified music.

(6) Adoption and communication of a code of conduct for tourists (Appendix 14, page 109).

(7) Information and promotion.

(8) Awareness and education.

7.5 Reinforcement of protection administration

7.5.1 Improving mobility

Currently only one trawler is operational for BFD, while four were available in the past. Trawlers are required for the connection and supply from the main land and for support of surveillance on the island (in channels) and in the surrounding waters. Apart from that, trawlers are every now and then not operational for maintenance and repair. Therefore, a minimum of two trawlers is required to be able to mobilize staff permanently; one will be stationed in Namar Bazar, the other in Mokhtari Ghat in order to cover both sides of the park. Moreover, some motorcycles are important for the mobility at the island, which has approximately 20 km of roads and tracks.

The following mobility equipment is therefore proposed:

- motorcycles 4
- bicycles 6
- trawler 1

7.5.2 Communication facilities

The mobile telephone provider Robi Axiata Limited has recently created a mobile phone areal at Namar Bazar. Staff need to be provided with mobile phones.

7.5.3 Office facilities and staff accommodation

The current buildings are not adequate to support the office and accommodation requirements of the staff. The following infrastructure is planned to be constructed with funding from SRCWP (Appendix 13, page 108):

- Park office and dormitory (capacity 8 staff) at Soakhali, Bandartilla (Location: N22 02.408 E91 00.743)
- Guest house and watch tower[17] beside the Beat office at Namar Bazar (Location: N22 02.554 E90 58.854)

At the same time serious attention should be paid at the old buildings which are found at Namar Bazar and Satapul. These buildings are rotting away and give a very bad impression

[17] The watch tower should be reconsidered. The current design (60 feet hight) will result in a dominant structure visible from all sides and the site selected is not an appropriate place to observe wildlife. Such huge structures should better be avoided in this pristine landscape. Much lower structures with a modest and ecofriendly design located near places frequented by wildlife are far more attractive for visitors and impact less the environment.

of the area to visitors. Steps need to be taken for the demolishment of these buildings and cleaning of the areas and the rehabilitation of the natural vegetation.

7.5.4 Equipment

To improve the functionality of the field staff with regard to surveillance and biodiversity monitoring the following equipment is required:

- GPS (waterproof) 2
- binoculars (waterproof) 2
- cameras (waterproof) 2
- laptop 1
- rechargeable torches 8
- steel armoires for storage of equipment

For the control of stray dogs tranquilizer guns and/or blow pipes are required.

7.5.5 Staff capacity and performance

The current staff number is insufficient to deal with the challenges of the management of the park and needs to be increased (Table 7).

Skills and knowledge of staff will be brought up to date for better performance through training on information technology, GPS, protected area management, surveillance, ecotourism and other subjects determined deemed necessary during the implementation period.

Table 7. Current and required staff number at Nijhum Dwip NP

Staff	Nov-13	October 2014	Required
ACF		1	1
Forest ranger		1	1
Deputy ranger	1	0	2
Forester	1	2	4
Forest guard	4	8	12
Boat man	5	6	8
Trawler Driver		1	2
Speedboat Driver		1	2
Cook		0	2
Trawler Helper		0	2
Moali	2		
	13	20	36

Table 8. Five year activity work plan

Task	Responsible officer	Timing	Activities	Requirements	Indicators
1.1 Zoning	DFO	first year	· GPS survey · mapping · dispersion of maps to relevant stakeholders	GPS, mapping by RIMS	Zoning map, description and prescriptions agreed with stakeholders
1.2 Boundary demarcation	DFO, ACF,RO, BO	second year	· GPS survey · planning and placing markers, fences and buoys	GPS, mapping by RIMS	Boundary map, shapefile and markers and buoys established in the field
1.3 Solving land issues	DFO	immediately	· consultation and agreement with DC	cancelation of lease of "Char Mahid"	Agreements approved by Union Parishad
2.1 Forest plantation	DFO, BO	annually	· planting according to annual work plan	plants, logistics	ha of plantation realized
2.2 Control of dogs	DFO, BO	annually	· purchase of equipment, training, implementation	blowpipe, medicines, skills	number of dogs eliminated
2.3 Control of livestock	DFO, (ACF), BO	continuously	· include in zoning · fencing eastern side forest on main island · enforcement	effective patrolling	number of livestock found in the forest
2.4 Surveillance	(ACF), RO	entire 5-year planning period	· patrolling · monitoring	field equipment	number of patrols, regular coverage of NP
3.1 Conservation awareness	WNCC/NWC, RO, BO	entire planning period	· education at schools · awareness workshops with stakeholders · bill boards	training materials, training programmes	number of awareness sessions, number of stakeholder categories covered
3. 2 Establishment co-management	(ACF), RO, CREL	entire planning period	· Arranging of technical support · Motivation · Establishment CMOs · Development benefit sharing mechanism	NGO support for mobilisation of community (CREL)	establishment of CMO structures
3.3 Sustainable resource utilization	ACF	year 1 and 2 development; entire planning period implementation	· Establish resource user groups · Develop and implement improved and sustainable resource utilization systems	support of CREL	number of groups formed, livestock numbers, crop production, area of fisheries sanctuaries, fish production
3.4 Alternative Income Gene-rating Activities	Not by BFD, but supported by	entire planning period	· Identification of beneficiaries	CREL and NGO support	number of individuals and groups involved,

Task	Responsible officer	Timing	Activities	Requirements	Indicators
	CREL and NGOs		· Capacity building · Develop AIGAs		trainings delivered, successful AIGAs
3.5 Promotion conservation based enterprises	DFO	entire planning period	· Arrangements/MoUs with enterprises · Marketing support	investments, market linkages	number of enterprises
4.1 Ecotourism development	SRCWP, DFO	to be started ASAP	· Tourism development plan integrated in zoning plan	consultations	PA management plan and tourism development plan ready
4.2 Facilities development	SRCWP, DFO	entire planning period	· Construction of hides · nature trail development	eco-friendly designs	call for tenders, realized structures
4.3 Quality management accommodation, facilities and operations	SRCWP, DFO	entire planning period	· Environmental management plans · Code of conduct operators · Norms for sound · Garbage management · Monitoring	Rules, regulations, plans	waste, disturbances from tourism
4.4 Tourist communication and awareness	SRCWP, WNCC	entire planning period	· Marketing plan and communication materials · Awareness packages preparation · Awareness packages distribution	Training, awareness materials	Number of awareness events, awareness monitoring
5.1 Improving transport	DFO	first year	· Purchase of 4 motor cycles, 6 bicycles · Allocation/construction of one more trawler	Budget, tenders	Approved budget, completed tenders
5.2 Communication improvement	DFO	first year	· negotiate with mobile provider · Acquire hardware	collaboration with mobile providers	network extended
5.3 Realizing office facilities and accommodation	SRCWP	first year	· Construction of (a) 1 Park office and dormitory · (b) Guesthouse and observation facility	nature friendly design, clearance from World Bank	various steps of design, approval and tendering
5.4 Removal of old buildings from Namar Char beat office and Satapul	DFO, RO	first year	· Demolishing buildings · Clearing of land	approval for removal	Cleared land delivered
5.4 Procurement equipment	DFO	first year	· 2 GPS, 2 waterproof binoculars, 2 waterproof cameras, 1 laptop, 8 rechargeable torches, 1 steel	tender	Delivery and operationalization

Task	Responsible officer	Timing	Activities	Requirements	Indicators
			armouries for equipment, tranquilizer blowpipes		
5.5 Improving staff performance	SRCWP, WNCC/ NWC	ongoing	Training: · management planning · PA surveillance · field skills · wildlife	Training of Trainers	Number of trainings, trainees, application of skills (e.g. management plans made)
6. Smart patrolling	WNCC	first year	· assess feasibility of the introduction of MIST · design · training · implementation	· assignment of study to staff or expert · depending on result feasibility study	advice, implementation plan if advise is positive
7. Research and information management	This task should be mainly delegated to universities and research institutes	entire planning period	· facilitate research projects · acquire, store, analyse and apply acquired knowledge for adaptive management	engagement of research institutes	reports and publications

8 Monitoring, review, safeguards and research

8.1 Implementation safeguards

Implementation safeguards are mechanisms to deal with environmental and social impacts resulting from management interventions inside and around protected areas. The mechanism includes (1) screening and scoping to identify possible impacts, (2) impact assessment, (3) design and implementation of mitigation and impact monitoring. The Bangladesh environmental legislation as well as regulations of most international donors, including World Bank, ADB and UNDP require environmental and social impact management to be included in project planning and implementation (BFD 2013a, BFD 2013b, GoB 2011).

The mechanism is elaborated in an Environmental Management Plan (EMP) which serves as detailed guidance for environmental and social impact management in terms of mitigation measures and monitoring. An Environmental Management Plan (EMP) is a plan of scheduled actions that follows directly from a completed Environmental Assessment of a project and it includes an environmental mitigation plan and environmental monitoring plan.

BFD is responsible to carry out screening of interventions to keep record of essential information for proper environmental and social impact management and an Environmental Monitoring Framework (EMF) serves as the guideline for designated staff to monitor the environmental and social safeguards compliance of interventions initiated under their implementation responsibility. Safeguards are as far as possible included in interventions and activities covered in chapters 8 and 9 of the management plan, but as most interventions indicated are to be developed in the future, tasks related to environmental and social impact management need to be included and reviewed in annual operational plans.

8.2 Purpose of management plan monitoring

The purpose of monitoring is to assess the effectiveness and efficiency of the activities and the achievement of the management objectives. Monitoring results may be used to adapt the strategies to improve the management performance. The monitoring and evaluation plan provides for the annual review of operational plans, a five year work plan and an overall review period of the management plan of 5 years.

Monitoring involves the measurement of agreed indicators indicating changes at various levels: (a) management context (including threats), (b) activity performance, (c) results achievement, (d) outcome and (e) at impact level.

8.3 Biological monitoring

Occurrence and abundance of animal species are important indicators for biological monitoring, particularly of birds (Aziz et al. 2004) and mammals, but also other vertebrates or invertebrates may be used as indicator species. Biological monitoring is important to assess the impact of threats and to determine the effectiveness of management measures. Biological monitoring is usually done by carrying out wildlife surveys focussing specific taxonomic groups at regular intervals (Feeroz and Deodatus 2003, Van Lavieren, 1983).

(7) Bird survey

Fixed width strip surveys are appropriate to establish abundance and density of birds in mangroves and cultivated area. In this method the observer(s) slowly walk (ca. 1.5 km/hr) on a relatively straight line through the area and count the objects from both sides. The observation-range varies depending on the visibility of the area studied. In Nijhum Dwip mangrove forest an observation range of 25 m is taken on both sides. In open area wider strips may be taken. The initial location of the bird observed is always considered, because it might move away after watching the observer(s). If any bird is sighted beyond the pre-decided observation-range, or if the object is coming from the back (in order to avoid duplication), the observation is not recorded. The survey should be conducted in early mornings and late afternoons. Each strip transect count is actually the total count of an area of the strip (length of the strip [L] times width of the strip [w] which is equal to twice the observation-range). Population density D is estimated by D = n/2wL.

Water bird numbers are assessed by total counts of foraging birds in defined areas at low tide and counting of roosting birds at high tide both at least once a year during winter. The Asian Water bird Census[18] has developed a standardized methodology for this and this is applied usually every year in coastal areas of Bangladesh including Nijhum Dwip NP (Appendix 12, page 106).

(8) Mammals and other terrestrial animal survey

Variable width transect surveys are appropriate to determine the abundance and density of mammals. In this method the observer(s) slowly and silently walk (ca. 1.5 km/hr) on a straight line through the area and count animals from both sides. When an animal or a group of animals are sighted from a position along the transect, the sighting distance (also called "radial distance") should be recorded (D), being the distance from the observer to the animal (S) at the moment of detection. The animal density is determined by dividing the total number of observed animals of one species, divided by the area covered by observation which is calculated by multiplying the distance covered by the observers (length of the transect) multiplied by the average sighting distance multiplied by two (as animals have been sighted on both sides of the transect).

[18] http://south-asia.wetlands.org/WhatWeDo/AsianWaterbirdCensus/tabid/2892/Default.aspx

Indirect survey methods are more convenient to assess relative abundance of animals which are difficult to observe, due to low densities, dense habitat or hidden way of life. For this purpose, indices of presence (defecations, scent marks, ...) are counted inside plots 10 by 20 m) and/or animal tracks are recorded crossing the long sides of the same plot. This method is particularly appropriate for carnivores, small mammals and large reptiles.

(9) Vegetation cover survey

Changes of forest cover can be monitored by comparing remote sensing data of different years, or by recording vegetation class boundaries with a GPS. These approaches only show increase and decrease of forest cover, but not changes in vegetation structure and floristic composition. For the latter, structure and floristic composition, more detailed vegetation recording and analysis is required based on vegetation assessment in plots as laid out below.

A standardized method is as follows. For each sample plot (20 x 10 m), data are collected on the vertical vegetation structure and floristic composition using a relevee sheet. Stratum and species cover is determined by visual assessment. Unidentified species is sampled for identification in the Bangladesh National Herbarium. Soil is classified according to Moore and Chapman (1986). For inundation the following levels are distinguished: permanent, daily, 2-weekly, seasonally and never. A detailed description of the method is given in Feeroz & Deodatus 2003.

Vegetation succession monitoring is done by repeating the above procedure at regular intervals (usually one to five years) in fixed sample plots which are marked on the ground. This fixed quadrate method should be done yearly at least four places inside the forest on the main island after the implementation of rigorous measures to stop entry of livestock in the forest, in order to evaluate the effect on the vegetation development.

8.4 Environmental monitoring

Monitoring of environmental threats is important and modern technology is making environmental monitoring easier every day. Crucial variables to measure regularly in Nijhum Dwip are rainfall, temperature, salinity and erosion. These variables are easy to measure by field staff, and in case of erosion with GIS analysis by RIMS.

Water quality can be measured when pollution is suspected. However, water quality analysis requires an equipped laboratory and a water quality monitoring plan prepared by specialists to determine which indicators are the most appropriate in relation to the potential upstream sources. Usually additional costs are involved.

8.5 Management monitoring

Management motoring is the monitoring of the implementation and results of protection related activities as described in chapter 8. Management monitoring is an important element of reporting of the site manager (s) (Range Officer) to the District Officer (DFO). Indicators for management monitoring are:

- patrolling (when, participating staff, area/distance covered),
- arrests (date, place, offence, conviction),
- confiscations (date, place, item, conviction),
- awareness events, training delivery (when, target group, message/skill),
- revenue collection (when, resource, revenue collected),
- consultations (when, target group, purpose),
- services rendered (e.g. afforestation/reforestation support, wildlife-human conflict management).

8.6 Smart patrolling

With technical support from CEGIS, BFD has developed in the Sundarban Reserved Forest a GIS/GPS based system for the systematic collection of patrolling data (Anon. 2013). The system is has been named "MIST" following a similar system developed for Uganda National Parks which has become a model for patrol information collection in many countries.

Since Nijhum Dwip can be considered as a more vast protected area, the introduction of this system should be considered. Introduction requires however investments for equipment and training. A feasibility study is therefore required (see also section 7.2.5, page 60).

8.7 Management Effectiveness Tracking

BFD has decided to introduce the Protected Area Management Tracking Tool (MTT) in Bangladesh.

For tracking and increasing the effectiveness of the protected area management a number of tools have been developed to assess management practices. It is clear that the existence of a wide range of situations and needs require different methods of assessment. The World Commission on Protected Areas (WCPA) has therefore developed a 'framework' for this assessment (www.biodiv.org/decisions).The WCPA Framework aims to provide overall guidance in the development of assessment systems and to encourage standards for assessment and reporting (Dudley 2007).

According to the WCPA Framework, good protected area management follows a process that has six distinct stages, or elements: it starts with the understanding of the context of existing values and threats, progresses through planning, and allocation of resources

(inputs), and as a consequence of management actions (processes), eventually produces products and services (outputs), that result in impacts or outcomes (Dudley 2007).

The Management Effectiveness Tracking Tool is one of a series of management effectiveness assessment tools built around the WCPA Framework, which range from the WWF Rapid Assessment and Prioritization Methodology used to identify key protected areas at threat within a protected area system to detailed monitoring systems such as that developed by the Enhancing our Heritage project for UNESCO natural World Heritage sites. Having this range of tools in place will aid the many countries who are signatories to the Convention on Biological Diversity (CBD) in fulfilling their commitments. In particular at the 7th CBD Conference of the Parties in 2004, 188 member countries agreed a Programme of Work on Protected Areas (www.biodiv.org/decisions), one of the most ambitious environmental strategies in history. As part of the programme Nations have committed to develop assessment systems and report on the effectiveness of 30 per cent of their protected areas by 2010 (Dudley et. al. 2005).

8.8 Management plan review

The review cycle for the management plan is based on existing practices regarding forest management planning in Bangladesh (Balmforth 1988) and experiences in other countries (Thomas and Middleton 2003). Management of the park will be organised through an Annual Operational Plan (to be prepared annually), which is based on a 5-year workplan (Part II). The entire management plan (Parts I and II) will be reviewed every ten years.

8.9 Monitoring and review planning

A schedule for monitoring and evaluation planning is presented in Table 9, page 74.

8.10 Research

Research at Nijhum Dwip is the task of research institutes such as universities and institutes for fundamental and applied research. Relevant research themes for the conservation of the island are:

(1) Research on the utilisation and habitat quality of the marine and coastal zones around the island by migratory birds;

(2) Distribution and habitat utilisation of cetaceans;

(3) Sea turtle habitat utilization and breeding;

(4) Population dynamics of the deer population;

(5) Mangrove dynamics and deer browsing;

(6) The influence of the location of fresh water ponds on the dispersal and utilisation of habitat by wild and domestic herbivores;

(7) Assessment of the economic values of ecosystem services of the island including carbon fixation and climate change mitigation and resilience;

(8) Quantification of impacts of resource utilisation and sustainable resource use options;

(9) Feasibility of the introduction of Nipa (*Nypa fruticans*) as an exploitable resource.

Table 9. Monitoring and review plan

Task	Responsible officer	Timing	Activities	Requirements	Indicators
1.1 Bird survey	WNCC	annually	field survey		
1.1 Survey of terrestrial animals	WNCC	annually	field survey		bird abundance
1.3. Vegetation cover survey	Beat officer, RIMS	annually	fixed quadrate Remote Sensing		animal abundance
2. Management monitoring	Beat officer	3-monthly	logbook keeping reporting		patrolling, arrests, confiscations, awareness events, training delivery, revenue collection, consultations, services rendered
3. Smart patrolling	Beat officer	daily	data collection uploading analysis		see MIST framework
4. Management Effectiveness Tracking	DFO ?	5 year cycle	data collection and recording		see MTT framework
5. Review 5-year work plan	WNCC, DFO	every five years	covering chapters 8 and 9		updated five year work plan
6. Review management plan	WNCC, DFO	every ten years	covering chapters 1 - 7		updated management plan

9 Cost estimates of implementation

The estimation of total costs for staff and other recurrent costs are Tk 5,604,000 per year (Table 10, page 75). The total costs for works and goods related to activities (investment costs) are Tk 52,379,312 over a period of five years (Table 11, page 75).

Table 10. Recurrent costs

a. Cost item	b. Units	c. Number	d. unit cost (Tk)	e. Total cost per year	f. Covered by projects or FD budgets
ACF	Persons	1	25,000	300,000	FD (GOB)
Forest ranger	Persons	1	20,000	240,000	FD (GOB)
Deputy ranger	Persons	2	15,000	360,000	FD (GOB)
Forester	Persons	4	12,000	576,000	FD (GOB)
Forest guard	Persons	12	10,000	1,440,000	FD (GOB)
Boat man	Persons	8	10,000	960,000	FD (GOB)
Trawler Driver	Persons	2	10,000	240,000	FD (GOB)
Speedboat Driver	Persons	2	15,000	360,000	FD (GOB)
Cook	Persons	2	12,000	288,000	FD (GOB)
Allowances	Person-tours	2 x 10	10,000	200,000	Project
Fuel	Litre octane	4000	100	400,000	NDNPDP + FD (GOB)
Batteries	--	4			FD (GOB)
Trawler Helper	Persons	2	10,000	240,000	FD (GOB)
Total per year				5,604,000	

Table 11. Activity costs

a. Task	b. Activities	c. Works and goods	d. Units, unit cost (Tk)	e. Total cost per 5 year (Tk)	f. Covered by projects, project name
1.1 Zoning	· GPS survey and consultation · mapping · dispersion of maps to relevant stakeholders	· GPS survey costs · Maps printing (RIMS)	· LS	100,000	NDNPDP
1.2 Boundary demarcation	· planning · construction and purchase · establishment	· logistics, transport · buoys for app. 50 km marine boundary	· LS · Buoys at 95,000 · Anchor and steel chain at	100,000 1,425,000	NDNPDP[19] providing 1 Lac for Survey & Boundary Demarcation. NDNPDP has

[19] The Nijhum Dwip National Park Development Project (NDNPDP) is a "Window II" project under SRCWP

a. Task	b. Activities	c. Works and goods	d. Units, unit cost (Tk)	e. Total cost per 5 year (Tk)	f. Covered by projects, project name
		comprising all islands · CC markers for app. 15 km forest boundary	25,000 · CC markers at Tk 100,000 /km	375,000 -- 1,500,000	estimated cost for 8 km CC Markers while remaining 7 km CC makers to be covered from other sources.
1.3 Solving land issues	· consultation and agreement with DC · including cancelation of lease of "Char Mahid"	· 5 meetings	· meeting cost 5,000	25,000	Fund is needed to cover the expenses.
2.1 Forest plantation	· planting	· number of saplings[20], logistics	· 200 ha/yr at 37,055 /ha	7,411,000	NDNPDP
2.2 Control of dogs	· darting and killing of dogs by WNCC	· blowpipe, or tranquilizer gun · medicines · logistics, transport	· LS	50,000	NDNPDP
2.3 Control of livestock	· establish livestock grazing zones · fix and enforce grazing stocking rates · enforcement	· meetings with livestock owners to establish agreement on pasture utilization · fencing	· 5 meeting at 10,000 per meeting · 600,000/km for 14 km	50,000 8,400,000	
2.4 Surveillance	· patrolling · monitoring	· 20 torches	· 20 torches at 2,000	40,000	BFD recurrent budget
3.1 Conservation awareness	· education at schools · awareness workshops with stakeholders · bill boards	· training materials · billboards · logistics, transport	· schools: LS 100,000 for 1000 scholars · 2 workshop at 50,000 each · 10 bill boards at 10,000.00 each	300,000	Funding sources to be identified
3. 2 Establishment co-management	· Arranging technical support, stakeholder motivation, establishment CMOs, development benefit sharing	· 12 annual meetings	· 12 meetings at 10,000 each	120,000	Support by CREL

[20] 1000 ha mangrove plantation type would be accomplished in 5 years (200 ha/year) requiring requiring 5,000,000 saplings (1,000,000 per year). Although 4,444 saplings /ha is planted, 5,000 are raised in prospect of filling up/replacing failed plants. Only indigenous species planted.

a. Task	b. Activities	c. Works and goods	d. Units, unit cost (Tk)	e. Total cost per 5 year (Tk)	f. Covered by projects, project name
	mechanism				
3.3 Sustainable resource utilization	· Establish resource user groups · Develop and implement improved and sustainable resource utilization systems	· mobilization, process support	·	P.M.	CREL, NGOs
3.4 Alternative Income Gene-rating Activities	· Identification of beneficiaries · Capacity building · Develop AIGAs	· mobilization, process support	·	P.M.	CREL, NGOs
3.5 Promotion conservation based enterprises	· Arrangements/MoUs with individuals and enterprises (sustainable NTFP and tourism) · Licensing nature guides · Marketing support	· meetings with entrepreneurs	· meeting costs	P.M.	CREL, NGOs
4.1 Ecotourism development	· Tourism development plan integrated in zoning plan	· consultations	· zoning covered under 1.1	P.M.	SRCWP/TA NDNPDP partly
4.2 Facilities development	· Construction of hides · nature trail development · all eco-friendly designs	· nature trail (Mokhtaria ghat-Dubai khal) 3000m · nature trail (Namar bazar - Chatakhali) 4000m · 2 animal observation hides? · 2 new (eco) foot bridges near guest house, and eastern branch of Chatakhali	· nature trails 500,000 /km. · wooden bridge 300,000 · observation hides 282,000	3,500,000 600,000 282,000	NDNPDP provides 3 km nature trail (Mokhtaria-Dubai) and observation hides. Funds for 4 km trail and 2 bridges required
4.3 Quality management accommoda-tion, facilities and operations	· Environmental management plans · Code of conduct operators	· Maintenance costs · Garbage bins · Garbage collection system (incinerator,	· 20 CC garbage bins at 5,000 each · Monitoring cost per month: TK.	100,000 60,000	20 garbage bins covered by NDNPDP Fund for the monitoring cost is needed.

a. Task	b. Activities	c. Works and goods	d. Units, unit cost (Tk)	e. Total cost per 5 year (Tk)	f. Covered by projects, project name
	· Norms for sound · Garbage management · Monitoring	decomposer)	5.000.00 · collector, decomposer, incinerator LS 150,000	150,000	
4.4 Tourist communica-tion and awareness	· Marketing plan and communication materials · Awareness packages preparation · Awareness packages distribution	· Training, · awareness materials	· LS 200,000	200,000	Training to be provided by SRCWP
5.1 Improving transport	· draft design and specifications · budget allocation procurement, maintenance and operation · preparation tender · floating tender, selection and contracting · monitoring construction of trawler · acceptance of equipments	· 4 motor cycles · 6 bicycles · 1 trawler	· motor cycle: 110,000 · bicycle: 12,000 · trawler: 500,000	440,000 72,000 5,00,000	
5.2 Commu-nication impro-vement	· acquire mobile phones	· 4 mobile phone	· 4 mobile at 20,000 each	80,000	
5.3.1 Realizing office facilities and accommo-dation and Removal of old buildings from Namar Char beat office and Satapul	· draft design and specifications · budget allocation procurement, maintenance and operation · preparation tender · floating tender, selection and contracting · monitoring construction · acceptance	· 1 Park office and dormitory · 1 Guesthouse · 1 observation facility Demolishing buildings · Clearing of land	· TK. 02 Lac for land development · buildings 12,711,312	200,000 12,711,312	NDNPDP covers Park Office and Guest House Land development for buildings not covered
5.4 Procurement	· specifications · budget allocation	· 2 GPS · 2 waterproof	· 2 camera at · 20,000 each	40,000	NNPDP will support the GPS and

a. Task	b. Activities	c. Works and goods	d. Units, unit cost (Tk)	e. Total cost per 5 year (Tk)	f. Covered by projects, project name
equipment	procurement · preparation tender · floating tender, selection · acceptance	binoculars · 2 waterproof cameras · 1 laptop · 8 rechargeable torches · 1 steel armouries for equipment	· 1 laptop at 60,000 · 8 torches at 2,500 · armouries at 30,000 · GPS at 35,000	60,000 20,000 30,000 70,000	Waterproof binoculars but other items not covered
5.5 Communication and supplies	· draft specifications · budget allocation procurement, maintenance and operation · preparation tender · floating tender, selection and contracting · monitoring establishment · acceptance of equipments	· 2 generators · 2 solar units 100W · 2 rain water harvesting units	· 2 generator at 100,000 each · 2 RWHU at 20,000 each	200,000 40,000	
5.6 Improving staff performance	· Training · management planning · PA surveillance · wildlife	· --	· --	P.M.	by SRCWP
6. Smart patrolling	· assess feasibility of the introduction of MIST · design · training · implementation	· assignment of study to staff or expert · depending on result feasibility study	· L.S. 500,000	5,00,000	
7. Research and information management	· facilitate research projects · acquire, store, analyse and apply acquired knowledge for adaptive management	· Engagement of research institutes	· LS	2,000,000	Research institutions

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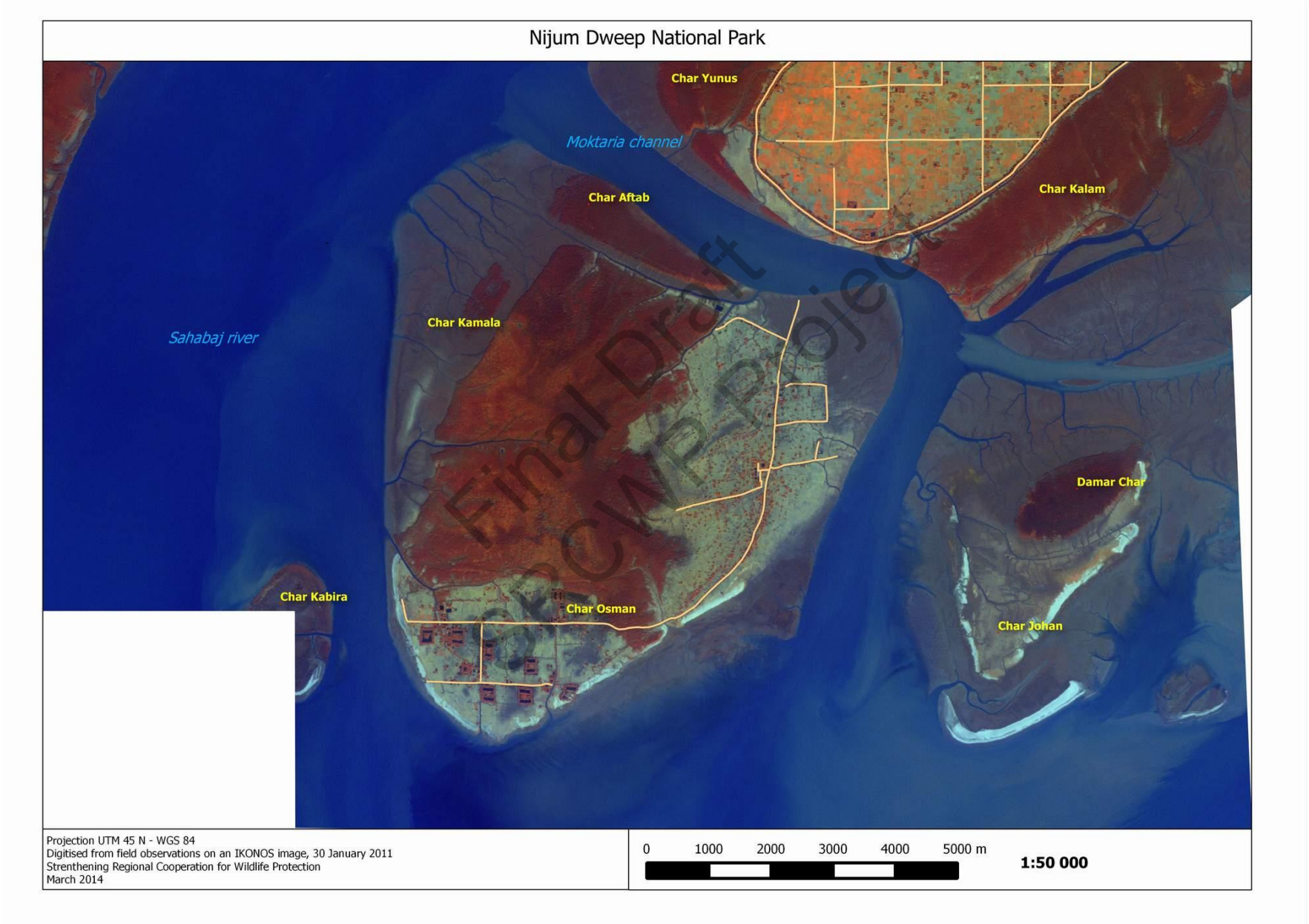
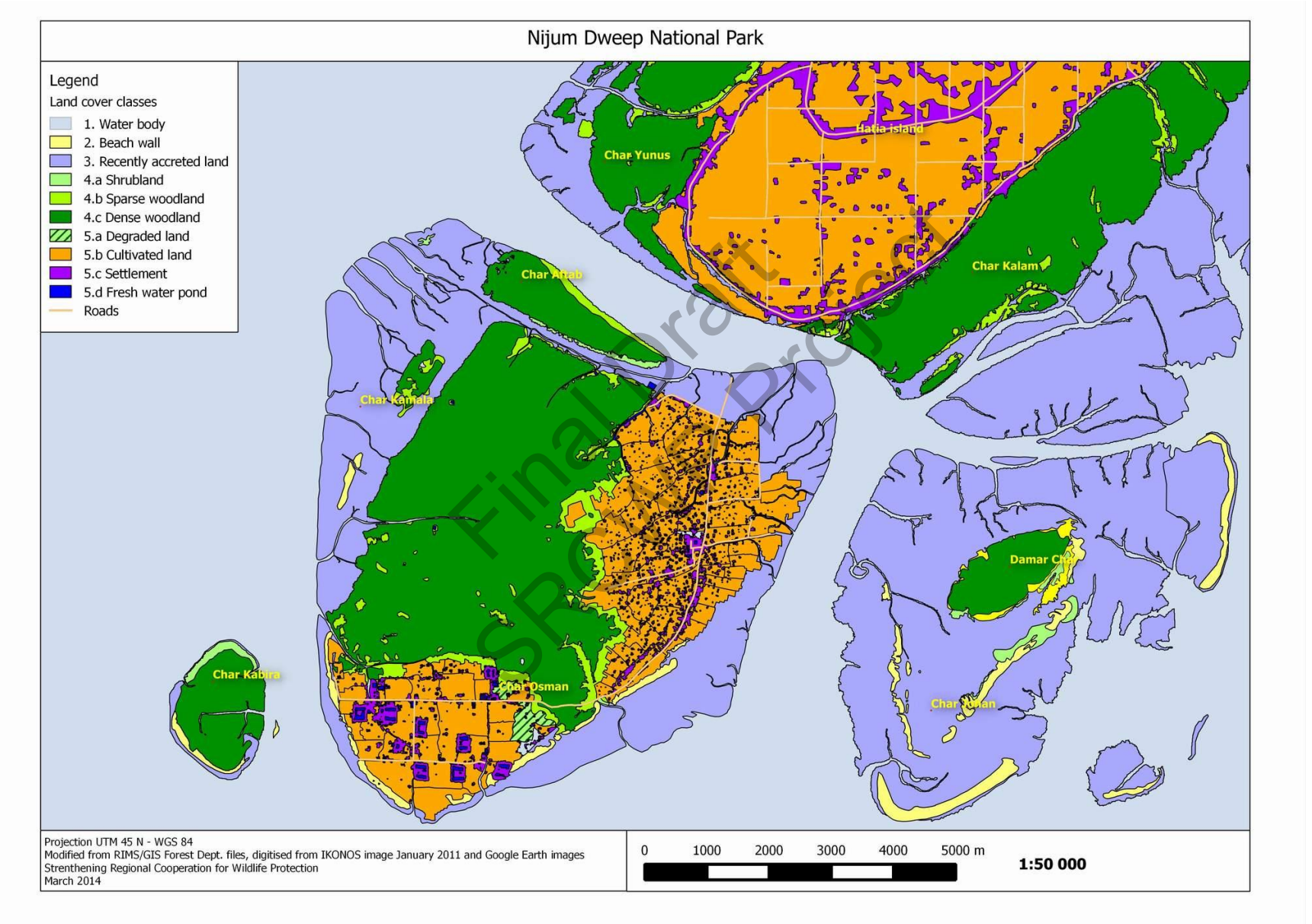
Appendices

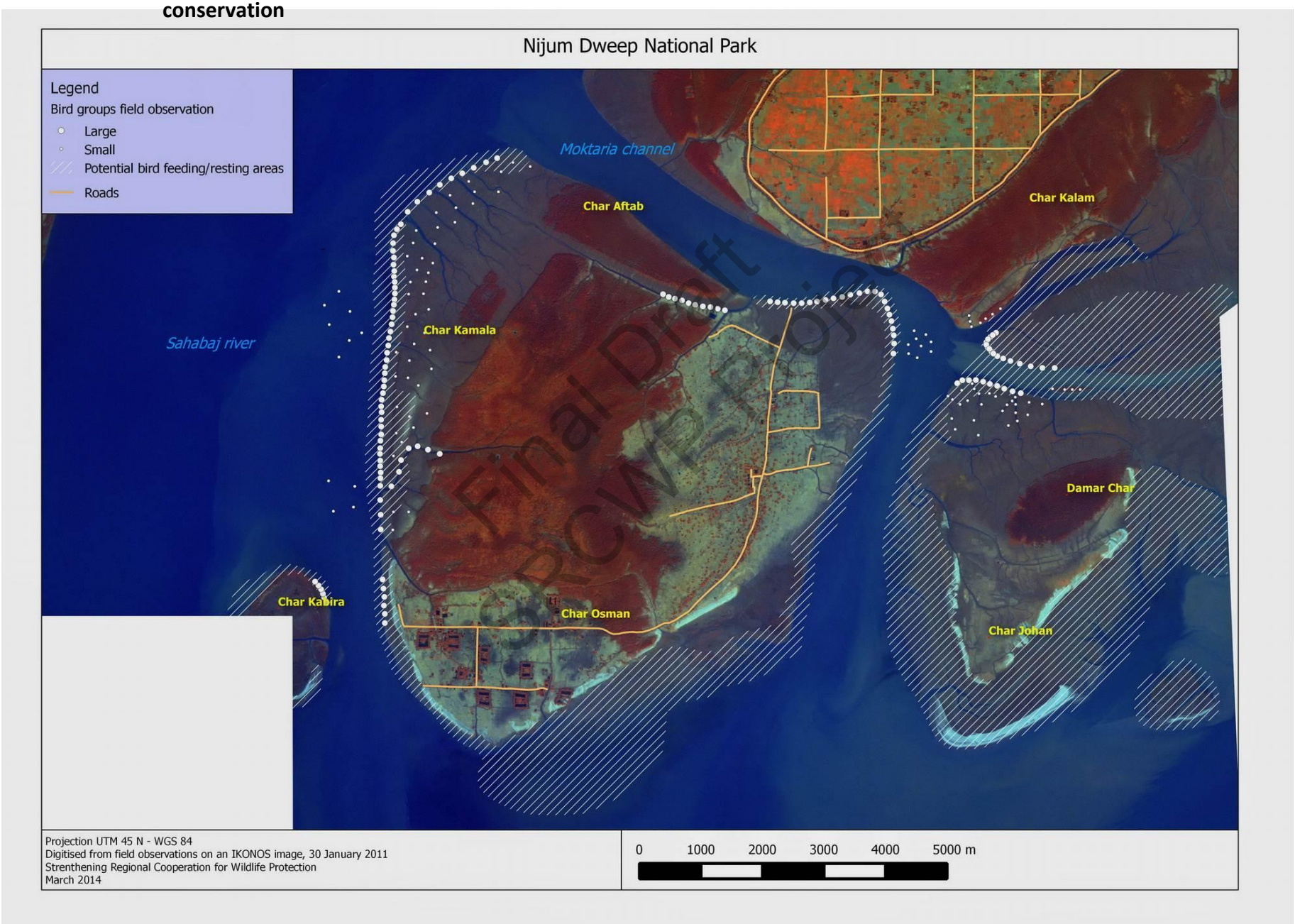
Appendix 1. Satellite map of Nijhum Dwip National Park



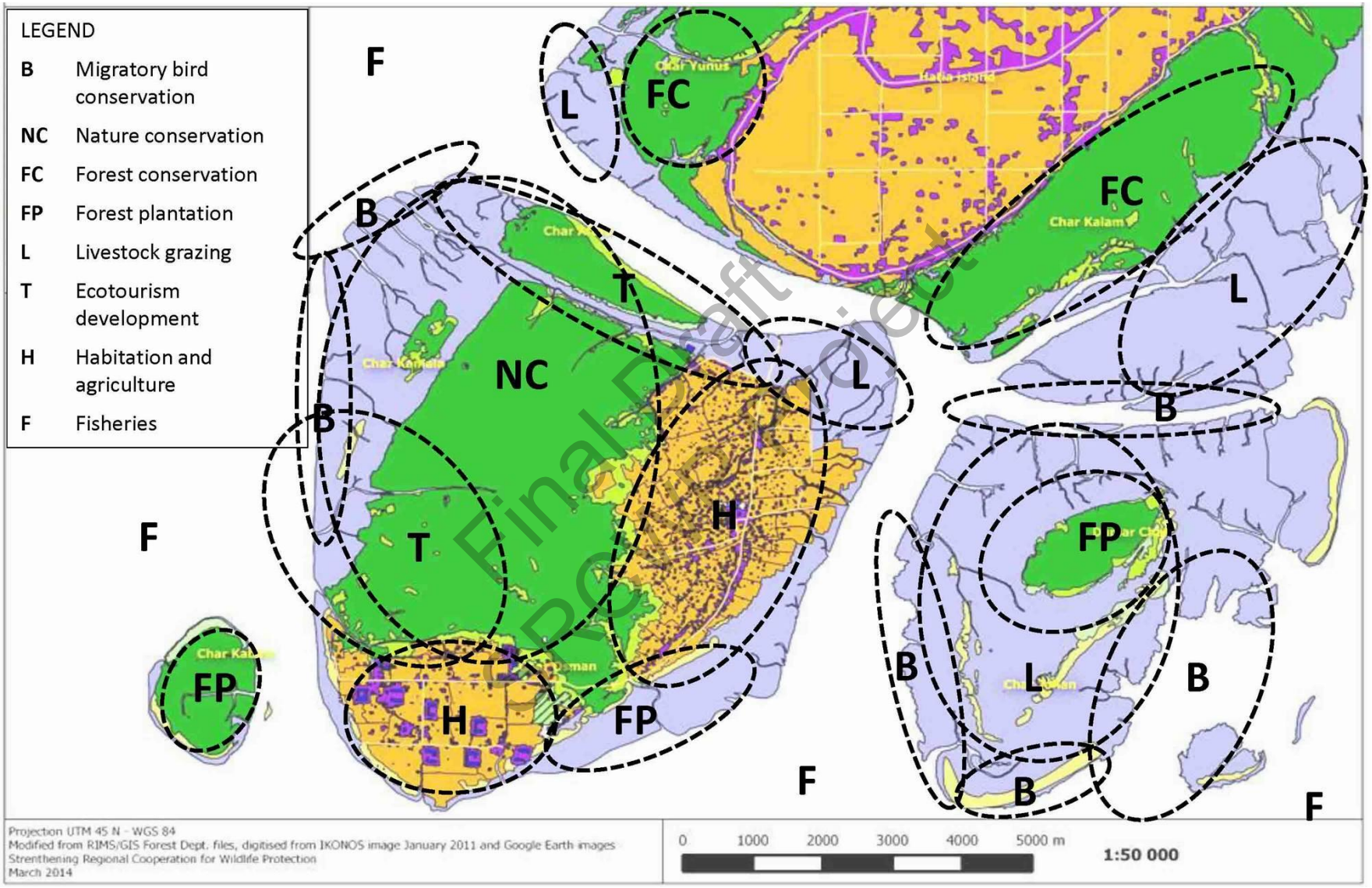
Appendix 2. Landcover map (preliminary version) of Nijhum Dwip



Appendix 3. Locations of observed migratory birds during surveys in February 2014 and potential areas to consider for bird conservation



Appendix 4. Proposed areas to consider for zoning in Nijhum Dwip National Park (management matrix: Table 6, page 55)



Appendix 5. Plant species observed during surveys in November 2013 and February 2014.

			Land cover class of occurrence						
Scientific Name	Local Name	Plant type	1. Water body	2. Recently accreted land	3. Beach wall	4a, b. Shrub and open woodland	4c. Dense woodland	5b. Cultivated land	5.c Human settlement
Acacia moniliformis	Akashmoni	Tree							√
Acanthus ilicifolius	Hargoza	Shrub					√		
Adhatoda vasica	Bashak	Bush							√
Adhatoda vasica	Bashak	Herb	?						
Alastonia scholaris	Satim	Tree							√
Albizia lebbeck	Sherishty Koroi	Tree							√
Albizia lucidia	Sheild korei	Tree						√	√
Albizzia richardiana	Belati koroi	Tree							√
Amaranthus gangeticus	Kachu	Herbs						√	
Andrographis paniculata	Kalomag	Herb				√			
Anona squamosa	Ata fal	Tree							√
Anthrocephalus	Kadamgas	Tree							√
Aphanamixis polystachya	Royna	Tree							√
Ardisia solanacea	Banjam	Tree							√
Artocarpus heterophyllus	Katal gas	Tree							√
Artocarpuslachucha	Dehua	Tree							√
Averrhoea carambola	Kamranga	Tree							√
Avicennia officinales	Bain	Tree					√		
Bambusa spp.	Basgas	Herb							√
Bombax ceiba	Shemul Tulagas	Tree							√
Borassus flabellifer	Tal	Tree							√
Bruguiera gymnorrhiza	Kankra	Tree					√		
Calotropis giagantea	Akanda	Shrub				√			
Carica papaya	Papa	Shrub						√	
Cassia alata	Dadmortan	Shrub							√
Cassia fistula	Badarlati	Tree							√
Centella asiatica	Thankuni	Herb				√			
Ceriops decandra	Goran	Tree					√		
Citrus grandis	Batabi Lebu	Shrub							√
Clerodendrum inerme	Sitka	Shrub							√
Clinogyne dichotoma	Murta/Mostak	Shrub		√					
Cocos nucifera	Narical	Tree							√
Cucurbita maxima	Gourd	Herb						√	
Cuscuta reflexa	Sornalata	Epiphyte							√
Cynodon spp.	Durba	Herb				√			
Delbergia sissoo	Shesu	Tree							√
Delonix regia	Krishnochura	Tree							√
Derris trifoliata	Kali lata/Gila lata	Herb					√		
Diospyros peregrina	Gab gas	Tree							√
Dutura metel	Dutura	Herb				√			
Eichhornia sp.	Kachoripana	Herb	√						
Enhydra sp.	Halencha	Herb	√						
Eriochloa procera	Nol gash	Herb			√				
Erythrina variegata	Mander	Tree							√

			Land cover class of occurrence						
Scientific Name	Local Name	Plant type	1. Water body	2. Recently accreted land	3. Beach wall	4a, b. Shrub and open woodland	4c. Dense woodland	5b. Cultivated land	5.c Human settlement
Eugenia fruticosa	Ban Jam, Jam gas	Tree							√
Excoecaria agallocha	Gewa	Tree					√		
Ficus bengalensis	Bhat	Shrub							√
Ficus heterophylla	Bala Dumur	Shrub							√
Ficus racemosa	Bara dumor	Shrub							√
Hibiscus rosa-sinensis	Jaba	Shrub							√
Hymenodictyon excelsum	Bhui Kadam	Tree							√
Ipomoea maxima	Bankalmi	Herb		√					
Ipomoea spp.	Kalmilata	Bush			√				
Justicia oreophyla	Basokpata	Bush							√
lagenaria vulgaris	laou	Herb						√	
Lemna sp.	Khudipana	Herb	√						
Litchi cinensis	Lechi gas	Tree							√
Lumnitzera racemosa	Kirpa/Kripa	Shrub					√		
Mangifera indica	Am gas	Tree							√
Melia azandirachta	Nimgas	Tree							√
Mentha sp.	Haysa	Herb						√	
Mikania cordata	Assamlata	Herb				√			
Mimusops elengi	Bakul	Tree							√
Musa sapientum	Kala gas	Shurb							√
Nymphaea nouchali	Shapla	Herb	√						
Ocimum sanctum	Tulshi	Herb				√			
Ocimun americanum	Ban tulsi	Herb				√		√	
Oxalis corniculata	Amrul	Herb				√			
Pandanus foetidus	Kewakata	Shrub					√		
Phoenix paludosa	Hantal	Shrub					√		
Phragmites karka	Nol Kagra	Herb			√				
Phyllanthus emblica	Amloki	Tree							√
Pistia sp.	Topapana	Herb	√						
Psidium guajava	Payera	Tree							√
Samanea saman	Raintree Koroi	Tree							√
Sarcolobus globosus	Bowali lota	Herb					√		
Smilax zeylanica	Bara kumarialata	Herb				√			
Sonneratia apetala	Keora	Tree					√		
Streblus aspera	Herba	Tree							√
Swietenia macrophylla	Bara Mehigini	Tree							√
Swietenia mahagoni	Mahagani	Tree							√
Syzygium cumini	Jam gas	Tree							√
Tamarindus indica	Tetul	Tree							√
Tamarix troupii	Banjau	Tree			√				
Temarix indica	Nonajhao	Tree			√				
Terminalia arjuna	Arjun	Tree							√
Terminalia arjuna	Arjungas	Tree							√
Vanda roxburghii	Rashna	Epiphyte					√		√
Wolffia spp.	Guripana	Herb	√						
Zizyphus mauritiana	Baroi	Tree							√

Appendix 6. Forest plantation at Nijhum Dwip island and Char Yunus since 1975

Year of raising Plantation	Location	Area planted (ha)	Encroached plantation (ha)	Failed plantation (ha)	River erosion (ha)	Existing plantation (ha)
1972-73	Nijhum Dwip	12	0	0	0	12
1973-74	Nijhum Dwip	91	0	0	0	91
1974-75	Nijhum Dwip	77	0	0	0	77
1975-76	Nijhum Dwip	202	0	0	0	202
1976-77	Nijhum Dwip	405	243	0	81	81
1977-78	Nijhum Dwip	435	314	0	0	121
1978-79	Nijhum Dwip	283	40	0	0	243
1979-80	Nijhum Dwip	486	81	0	0	405
1980-81	Nijhum Dwip	263	219	0	0	45
1981-82	Nijhum Dwip	162	0	0	0	162
1982-83	Nijhum Dwip	101	101	0	0	0
1983-84	Nijhum Dwip	61	61	0	0	0
1984-85	Nijhum Dwip	81	81	0	0	0
1985-86	Nijhum Dwip	40	40	0	0	0
1986-87	Nijhum Dwip	32	32	0	0	0
1887-88	Nijhum Dwip	105	40	0	0	65
2000-01	Nijhum Dwip	250	200	0	0	50
2002-03	Nijhum Dwip	100	0	100	0	0
2006-07	Nijhum Dwip	800	0	740	0	60
2006-07	Jhau	125	0	125	0	0
2006-07	Kul-Boroi	51	0	0	0	51
2008-09	Nijhum Dwip	300	0	0	0	300
2009-10	Nijhum Dwip	100	0	0	30	76
2010-11	Nijhum Dwip	270	0	0	0	270
2011-12	Nijhum Dwip	100	0	0	0	100
2012-13	Nijhum Dwip	100	0	965	0	100
Total		5,031	1,452	1,929	111	2,509
1975-76	Char Yunus	81	0	0	0	81
1976-77	Char Yunus	304	0	0	107	196
1977-78	Char Yunus	334	0	0	259	75
1978-79	Char Yunus	121	0	0	59	63
1979-80	Char Yunus	40	0	0	40	0
1980-81	Char Yunus	20	0	0	20	0
1998-99	Char Yunus	253	0	0	0	253
1999-2000	Char Yunus	200	0	0	0	200
2000-01	Char Yunus	10	0	0	6	4
2002-03	Char Yunus	100	0	0	0	100
2003-04	Char Yunus	300	0	0	40	259
2004-05	Char Yunus	101	0	0	0	101
2005-06	Char Yunus	152	0	0	0	152
2006-07	Char Yunus	202	0	0	61	81
2008-09	Char Yunus	202	0	0	0	202
2012-13	Char Yunus	100	0	0	0	100
Total		2,521	0	0	593	1,867

Appendix 7. Areal cover of plant species recorded in sample plots of 20x10 m

		Plot 1	Plot 2	Plot 3	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13
Location		Chor Komola	Chor kalam	Dhamar chor	Dubay khal	Chor Komola	Chor kalam	Dhamar chor	Chor Komola	Shapla dubi	Dhamar chor	Chor kalam	Chor Komola
Date		14/01/2014	15/02/2014	15/02/2014	16/02/2014	14/02/2014	15/02/2014	15/02/2014	16/02/2014	14/02/2014	15/02/2014	15/02/2014	16/02/2014
Time		12:45	11:30	2:15	1:25	12:49	10:47	13:50	12:43	14:45	14:15	10:15am	13:30
GPS-N		22˚03349′	22˚05.061′	22˚03..392′	22˚04.346′	22˚03.408′	24˚07.298′	22˚03.669′	22˚04.717′	22˚02.962′	22˚03.615′	22˚04.965′	22˚04.530′
GPS-E		90˚54.794′	91˚03.456′	91˚04.337′	91˚00.442′	90˚59.889′	90˚25.188′	91˚04.483′	90˚59.616′	91˚00.269′	91˚04.513′	91˚03.438′	91˚59.978′
Soil		Silty clay	Clay	Clay	Clay	Sandy clay	Sandy clay	Sandy clay	Sandy clay	Silty clay	Loam	Sandy clay	Silty clay
Inundation		Seasonal	Seasonal	Seasonal	Seasonal	Un	Un	Un	Un	Seasonal	Frequently	Seasonal	Frequently
Last inundation		3 month	4 month	3 month	Un	Apr-13	Mar-13	Un	Apr-13	01-Oct	3 month	2 month	Dec-13
Bare(%)		65%	90%	75%	85%	60%	82%	95%	50%	85%	65%	90%	85%
Herbs(%)		0%	0%	2%	2%	30%	8%	4%	30%	0%	1%	1%	1%
Shrubs(%) <2m		0%	1%	5%	30%	1%	2%	0%	5%	1%	15%	25%	3%
Trees(%)		35%	35%	25%	10%	9%	8%	1%	15%	42%	80%	70%	40%
Local name	***Scientific name***												
Kali lata	*Derris trifoliata*		1%		1%						2%	20%	1%
Monkata	*Randia dumetorum*											10%	
Keora	*Sonneratia apetala*	9%	70%	20%	10%	10%	25%	35%	50%	30%	45%	45%	20%
Gewa	*Excoecaria agallocha*		35%	1%	30%	2%	50%		10%	3%			1%
Har Kata	*Acanthus ilicifolius*			5%	1%								
Durbba Grass	*Cynodon dactylon*				1%								
Baen	*Avicennia officinales*	30%				35%					10%	70%	5%
Gogoi Kata	*Urena lobata*	1%	1%	1%	1%								
Hargoza	*Acanthus ilicifolius*										15%	10%	
Kakra	*Bruguiera gymnorrhiza*									7%			
Gaj kata	*Dalbergia spinosa*												1%
Tejpata	*Cinnamomum tamala*										2%	10%	1%
Nona gau	*Temarix indica*									5%	10%		
Garua lata	*Mikania cordata*											1%	
Helencha	*Alternanthera philoxeroides*											1%	
Kelakachu/Kerali	*Cryptocoryne retrospiralis*			1%									

Appendix 8. Vertebrate wildlife species observed during surveys in November 2013 and February 2014.

Amphibia					Land cover class of occurrence						
Species Name	**English Name**	**Local Name**	Obseved in November 2013	Observed in February 2014	1. Water body	2. Recently accreted land	3. Beach wall	4a, b. Shrub and open woodland	4c. Dense woodland	5b. Cultivated land	5.c Human settlement
Duttaphrynus melanostictus	Common Toad	Kuno Bang	√	√					√		
Euphlyctis cyanophlyctis	Skipper Frog	Mali Bang	√	√	√						
Euphlyctis hexadactylus	Green Frog	Sabuj Bang	√			√					
Hoplobactrachus tigerinus	Bull Frog	Sona Bang	√	√				√			√

Reptilia					Land cover class of occurrence						
Species Name	**English Name**	**Local Name**	Obseved in November 2013	Observed in February 2014	1. Water body	2. Recently accreted land	3. Beach wall	4a, b. Shrub and open woodland	4c. Dense woodland	5b. Cultivated land	5.c Human settlement
C. versicolor	Common garden lizard	Raktachosa/ Girgiti	√	√				√	√		
Cerberus rynchops	Dogfaced water snake	Maicha shap	√				√				
Hemidactylus flaviviridis	Yellow-bellied house gecko	Goda tiktiki	√	√							√
Hemidactylus. frenatus	Common house lizard	Haroil tiktiki	√	√							√
Lissemys punctata	Spotted flapshell turtle	Shundi kasirn	√								
Mabuya carinata	Keeled grass skink	Anzoni	√	√	√	√					
Pangshura tectum	Indian roofed turtle	Kori kaitta	√								
Varanus bengalensis	Bengal monitor	Kalo gui shap	√				√				
Xenochrophis piscator	Checkered keelback	Dhora shap	√	√	√						

Mammalia					**Land cover class of occurrence**						
Species Name	**English Name**	**Local Name**	Obseved in November 2013	Observed in February 2014	1. Water body	2. Recently accreted land	3. Beach wall	4a, b. Shrub and open woodland	4c. Dense woodland	5b. Cultivated land	5.c Human settlement
Axis axis	Spotted Deer	Chitra Harin	√	√		√			√		
Herpestes auropunctatus	Small Indian Mongoose	Choto Benji, Nakul	√						√		
Lutra lutra	Eurasian Otter*	Ud Biral, Bhodor	√	√			√				
Pipistrellus coromandra	Indian Pipistrelle	Chamchika	√	√					√		
Pteropus giganteus	Indian Flying Fox		√	√					√		
Rattus rattus	House Rat	Idur	√	√				√	√		
Bandicota bengalensis	Rat	Idur	√	√					√		
Canis aureus	Golden Jackal, Asiatic Jackal	Shiyal	√	√					√		√

Aves					**Land cover class of occurrence**						
Species Name	English Name	Local Name	November 2013	February 2014	Water bodies	Mud flat	Beach wall	Sparsely vegetated land	Mangrove forest	Cultivated land	Human settlement
Ardeola grayii	Indian pond heron	Deshi kanibok	√	√	√	√	√	√	√	√	√
Bubulcus ibis	Cattle egret	Go boga	√	√		√			√	√	√
Casmerudias albus	Great egret	Boro boga	√	√	√	√			√		
Egretta garzetta	Little egret	Chotoboga	√	√	√	√	√	√	√	√	√
Egretta intermedia	Yellow-billed egret	Majhla boga, korche bok	√	√	√	√					
Nycticorax nycticorax	Black-crowned night heron	Nishi bok	√	√					√		√
Ardea cinerea	Grey Heron	Dhusor Bok		√	√	√					
Anas strepera	Gadwall	Gadwal	√		√						
Anaus penelope	Eurasian wigeon	Wigeon hash	√	√	√	√					
Anus acuta	Northern pintail	Utturey lenjahash	√		√	√					
Anus clypeata	Northern shoveler	Utturey khunte hash	√	√	√	√					
Tadorna tadorna	Common Shelduck	Pati Chokhachokhi		√	√	√					
Tadorna ferrugenia	Ruddy Shelduck	Chokhachokhi		√	√	√					
Aythya fuligula	Tufted duck	Hash	√		√						
Aythya nyroca	Ferruginous pochard	Lalshir hash	√	√	√	√					
Dendrocygna bicolour	Fulvous whistling duck	Raj shorali	√	√	√						
Dendrocygna javanica	Lesser whistling duck	Pati shorali	√	√	√						
Falco subbuteo	Eurasian hobby	Baz pakhi	√	√			√		√		
Halia sturindus	Brahmany kite	Bhubon chil	√	√	√	√	√	√	√	√	√

Aves					**Land cover class of occurrence**						
Species Name	English Name	Local Name	November 2013	February 2014	Water bodies	Mud flat	Beach wall	Sparsely vegetated land	Mangrove forest	Cultivated land	Human settlement
Milvus migrans	Black kite	Chil	√	√				√	√	√	√
Haliaeetus leucogaster	White-bellied sea eagle	Sada pet eagle	√	√	√				√		
Pandion haliaetus	Osprey	Machmural		√		√					
Phalacrocorax niger	Little cormorant	Choto pankouri	√	√	√	√	√	√	√		√
Threskiornis melanocephalus	Black-headed ibis	Kalamatha Kastechora		√		√					
Vanellus indicus	Red-wattled lapwing	Lal-lotika hot-ti-ti	√	√		√			√		
Vanellus cinereus	Grey-headed lapwing	Metematha Titi		√		√					
Larusbrunni cephalus	Brown-headed gull	Khoiramatha Gangchil	√	√	√						
Larus ridibundus	Black-headed gull	Kalamatha Gangchil		√	√						
Larus ichthyaetus	Pallas's gull	Palasi Gangchil		√	√						
Sterna aurantia	River tern	Nodia panchil	√		√	√					
Sterna hirundo	Common Tern	Pati Panchil		√	√						
Sterna bengalensis	Lesser crested tern	Chotojhuti panchil	√		√	√					
Pluvialis squatarola	Grey plover	Mete Jiria		√		√					
Pluvialis fuva	Pacific golden plover	Proshanto shonajiria	√	√		√					
Charadrius mongolus	Lesser sand plover	Choto dhuljiria		√		√					
Charadrius leschenaultii	Greater sand plover	Boro dhuljiria		√		√					
Limosa limosa	Black-tailed godwit	Kalo lej lombathuti	√	√		√					
Numenius arquata	Eurasian curlew	Eureshio Gulinda	√	√	√	√	√				
Numenius phaeopus	Whimbrel	Choto Gulinda	√	√	√	√	√				
Ricurvirostra avosetta	Pied avocet	Pakra Ultothuti		√	√						
Rynchops albicollis	Indian Skimmer	Deshi Gangchosha		√	√						
Actitis hypoleucos	Common sandpiper	Pati batan, chapakhi	√	√	√	√	√		√		√
Tring stagnatilis	Marsh sandpiper	Bali batan	√	√	√	√					
Tringa glareola	Wood sandpiper	Bon batan	√	√	√	√	√				√
Tringa nebularia	Common greenshank	Pati shabujpa	√	√	√	√	√				
Tringa totanus	Common redshank	Pati lalpa	√	√	√	√					
Calidris minuta	Little Stint	Choto jorali		√		√					
Amaurornis phoenicurus	White-breasted Water hen	Dholabuk Dahuk		√					√		
Dendrocittava gabunda	Rufous treepie	Khoira harichacha, hari chacha	√	√	√				√		√
Centropus sinensis	Greater coucal	Boro kana koka	√							√	√
Eudynamys scolopacea	Asian koel	Kokil	√	√							√
Columba livia	Rock Pigeon	Gola paira, jalali kabutor	√	√				√	√	√	√
Streptopelia chinensis	Spotted dove	Tila ghughu	√	√			√	√	√	√	√

Aves					**Land cover class of occurrence**						
Species Name	English Name	Local Name	November 2013	February 2014	Water bodies	Mud flat	Beach wall	Sparsely vegetated land	Mangrove forest	Cultivated land	Human settlement
Streptopelia decaocto	Eurasian collared dove	Lal rajghughu	√	√		√		√		√	√
Streptopelia tranquebarica	Red turtle dove	Eurashio konthighughu	√					√			
Dendrocopos macei	Fulvous-breasted woodpecker	Batabi katkurali	√	√				√	√	√	√
Dendrocopos canicapillus	Grey-capped Pygmy woodpecker	Mete matha katkurali		√					√		
Dinopium bengalensis	Black-rumped flameback	Kalokomor kaththukra	√	√					√		√
Tyto alba	Barn owl	Lokkhi pecha	√								√
Merops orientalis	Green bee-eater	Shabuj shuichora	√	√				√	√	√	√
Merops philippinus	Blue-tailed bee-eater	Neel-lej shuichora	√	√			√	√	√	√	√
Merops leschenaulti	Chestnut-headed Bee-eater	Khoiramatha shuichora		√					√		√
Psittacula krameri	Rose-ringed parakeet	Shobuj tia	√	√				√	√	√	√
Alcedo atthis	Common kingfisher	Pati machranga	√	√	√	√	√	√	√	√	√
Halcyon pileata	Black-capped kingfisher	Kalatupi machranga	√	√	√	√		√	√		√
Todiramphus chloris	Collared kingfisher	Dholaghar machranga	√	√	√	√	√	√	√		√
Halcyon smyrnensis	White-throated kingfisher	Dholagoloa machranga	√	√	√	√	√	√	√	√	√
Upupa epops	Eurasian hoopoe	Pati hoodhood	√	√			√	√	√	√	√
Caprimulgus macrurus	Large-tailed Nightjar	Lenja Ratchora		√					√		
Cypsiurus balasiensis	Asian palm swift	Asiotalbatashi , nakkati	√	√	√		√	√	√	√	√
Sturnus contra	Pied starling	Pakra shalik, gubrashalik, gu shalik	√	√				√	√	√	√
Sturnus malabaricus	Chestnut-tailed starling	Khoiralej kathshalik, deshi pawei	√	√						√	√
Acridotheres fuscus	Jungle myna	Jhuti sahlik	√	√					√	√	√
Acridotheres tristis	Common myna	Bhat shalik	√	√					√	√	√
Corvus macrorhynchos	Jungle crow	Dar kak, danr kak	√	√	√			√	√	√	√
Corvus splendens	House crow	Pati kak	√	√	√	√	√	√	√	√	√
Dicrurus macrocercus	Black drongo	Kala fingey	√	√			√	√	√	√	√
Oriolus xanthornus	Black-hooded oriole	Kalamatha benebou	√	√				√	√	√	√
Oriolus chinensis	Black-naped oriole	Kalaghar benebou		√							√
Artamus fuscus	Ashy wood swallow	Metey bonababil, latora	√	√					√	√	√
Coracina macei	Large Cuckooshrike	Boro kabashi		√					√		
Phylloscopus trochiloides	Greenish warbler	Soboje futki	√								√
Phylloscopus fuscatus	Dusky Warbler	Kalchey futki		√					√		

Aves					**Land cover class of occurrence**						
Species Name	English Name	Local Name	November 2013	February 2014	Water bodies	Mud flat	Beach wall	Sparsely vegetated land	Mangrove forest	Cultivated land	Human settlement
Rhipidura albicollis	White-throated fantail	Dholagola chatighurani	√	√					√		√
Monticula solitarius	Blue rock thrush	Nilchepenga	√								√
Ficedula albicilla	Taiga flycatcher	Taiga chutki		√				√	√	√	√
Lanius schach	Long-tail shrike	Lombaleji koshai	√	√			√	√	√	√	√
Lanius cristatus	Brown Shrike	Khoira latora		√						√	√
Pycnonotus cafer	Red-vented bulbul	Bangla bulbul, bulbuli	√	√			√	√	√	√	√
Leptocoma zeylonica	Purple-rumped sunbird	Begunikomor moutushi	√	√							√
Ficedula hyperythra	Snowy-browed Flycatcher	Setabru chutki		√					√		
Copsychus saularis	Oriental magpie robin	Doel, udoidoel	√	√	√		√	√	√	√	√
Parus major	Great tit	Boro tit	√	√					√		√
Hirundo rustica	Barn swallow	Metho ababil	√	√	√	√	√	√	√	√	√
Hypothymis azurea	Black-naped monarch	Kalagharrajon	√								√
Dendronanthus indicus	Forest wagtail	Bon khonjon	√								√
Motacilla alba	White wagtail	Dhola khonjon	√	√		√	√	√	√	√	√
Motacilla cinerea	Grey wagtail	Metey khonjon	√	√		√	√		√	√	√
Motacilla flava	Western yellow wagtail	Poschima hodey khonjon	√	√		√			√	√	√
Orthotomus sutorius	Common tailorbird	Pati tuntuni	√	√							√
Passer domesticus	House sparrow	Patichorui	√	√			√	√	√	√	√
Ploceus philippinus	Baya weaver	Deshi babui	√	√					√	√	√
Lonchura punctulata	Scaly-breasred munia	Tilamunia	√							√	

Appendix 9. Conservation status of vertebrate species in Nijhum Dwip NP (Anon. 2000. Deniel, 1983, Khan 2010)

Abbreviations: LC = Least Concern, VC= Very Common, C=Common, FC=Fairly Common, F=Few, NO=Not Threatened, NT = Near Threatened, EN=Endangered, U=Uncertain and R=Rare

Amphibian Species	English Name	Local Name	Relative Abundance	Local status	Global status
Duttaphrynus melanostictus	Common toad	Kuno Bang	VC	NO	-
Euphlyctis cyanophlyctis	Skipper frog	Mali Bang	FC	NO	-
Euphlyctis hexadactylus	Green frog	Sabuj Bang	F	EN	-
Hoplobactrachus tigerinus	Indian bull frog	Sona Bang	C	NO	-

Reptilian species	English Name	Local Name	Relative Abundance	Local status	Global status
Pangshura tectum	Indian roofed turtle	Kori kaitta	FC	NO	-
Lissemys punctata	Spotted flapshell turtle	Shundi kasirn	C	VU	-
Calotes versicolor	Common garden lizard	Raktachosa	C	NO	-
Hemidactylus flaviviridis	Yellow bellied house lizard	Goda Tiktiki	C	NO	-
H. frenatus	Common house lizard	Haroil Tiktiki	FC	NO	-
H. brookii	House lizard	Tiktiki	FC	NO	--
Mabuya carinata	Keeled grass skink	Anzoni	FC	NO	-
Varanus bengalensis	Bengal monitor	Kalo Gui Shap	FC	VU	-
Xenochrophis piscator	Checkered keelback watersnake	Dhora Shap	C	NO	-
Amphiesma stolata	Stripped keelback	Dora shap	FC	NO	_
Cerberus rynchops	Dogfaced water snake	Jalbora shap	FC	VU	-
Enhydrina schistosa	Hook-nosed sea snake	Barshi nak samudrik shap	C	NO	

Mammal species	English Name	Local Name	Relative Abundance	Local status	Global status
Axis axis	Spotted deer	Chitra Harin	VC		LC
Herpestes auropunctatus	Small Indian mongoose	Choto Benji, Nakul	F		DD
Lutra lutra	Eurasian otter*	Ud Biral, Bhodor	F		NT
Pipistrellus coromandra	Indian pipistrelle	Chamchika	C		LC
Pteropus giganteus	Indian flying fox		VC		LC
Rattus rattus	House rat	Idur	VC		LC
Bandicota bengalensis	Lesser bandicoot rat	Idur	C		LC
Canis aureus	Golden jackal, asiatic jackal	Shiyal	C		LC

Avian species	English Name	Local Name	Relative Abundance	Local status	Global status
Ardeola grayii	Indian pond heron	Deshi kanibok	VC	NO	LC
Ardea cinerea	Grey heron	Dhusor bok	R	NO	LC
Ardea alba	Great white egret	Boro boga	R	NO	LC
Bubulcus ibis	Cattle egret	Go boga	FC	NO	LC
Egretta garzetta	Little egret	Chotoboga	F	NO	LC

Avian species	English Name	Local Name	Relative Abundance	Local status	Global status
Egretta intermedia	Yellow-billed egret	Majhla boga, korche bok	R	NO	LC
Nycticorax nycticorax	Black-crowned night heron	Nishi bok	FC	NO	LC
Anas strepera	Gadwall	Gadwal	M FC	-	LC
Anaus penelope	Eurasian wigeon	Wigeon hash	M FC	-	-
Anus acuta	Northern pintail	Utturey lenjahash	M C	-	-
Anus clypeata	Northern shoveler	Utturey khunte hash	M C	-	-
Tadorna tadorna	Common shelduck	Pati chokhachokhi	M C	-	LC
Tadorna ferrugenia	Ruddy shelduck	Chokhachokhi	M F	-	-
Aythya fuligula	Tufted duck	Hash	M FC	-	LC
Aythya nyroca	Ferruginous pochard	Lalshir hash	R C	NO	NT
Dendrocygna bicolor	Fulvous whistling duck	Raj shorali	R F	NO	LC
Dendrocygna javanica	Lesser whistling duck	Pati shorali	R C	NO	LC
Falco subbuteo	Eurasian hobby	Baz pakhi	R F	DD	LC
Halistur indus	Brahmany kite	Bhubon chil	R F	NO	-
Milvus migrans	Black kite	Chil	R FC	NO	LC
Haliaeetus leucogaster	White-bellied sea eagle	Sada pet eagle	R UC	EN	LC
Pandion haliaetus	Osprey	Machmural	M UC	-	LC
Phalacrocorax niger	Little cormorant	Choto pankouri	R FC	NO	LC
Threskiornis melanocephalus	Black-headed ibis	Kalamatha kastechora	R FC	DD	NT
Vanellus indicus	Red-wattled lapwing	Lal-lotika hot-ti-ti	R F	NO	LC
Vanellus cinereus	Grey-headed lapwing	Metematha titi	M F	-	LC
Larusbrunni cephalus	Brown-headed gull	Khoiramatha gangchil	M F	-	-
Larus ridibundus	Black-headed gull	Kalamatha gangchil	M F	-	LC
Larus ichthyaetus	Pallas's gull	Palasi gangchil	M F	-	LC
Sterna aurantia	River tern	Nodia panchil	M C	-	NT
Sterna hirundo	Common tern	Pati panchil	M C	-	LC
Sterna bengalensis	Lesser crested tern	Chotojhuti panchil	M C	-	LC
Pluvialis squatarola	Grey plover	Mete jiria	M C	-	LC
Pluvialis dominicus	Pacific golden plover	Proshanto shonajiria	M C	-	LC
Charadrius mongolus	Lesser sand plover	Choto dhuljiria	M C	-	LC
Charadrius dubius	Little ringed plover	Choto dhuljiria	M VC	-	LC
Charadrius leschenaultii	Greater sandplover	Boro dhuljiria	M FC	-	LC
Numenius arquata	Eurasian curlew	Eureshio gulinda	M F	-	NT
Numenius phaeopus	Whimbrel	Choto gulinda	M F	-	LC
Ricurvirostra avosetta	Pied avocet	Pakra ultothuti	M F	-	-
Rynchops albicollis	Indian skimmer	Deshi gangchosha	M FC	-	VU
Limosa limosa	Black-tailed godwit	Kalo lej lombathuti	M FC	-	NT
Actitis hypoleucos	Common sandpiper	Pati batan, chapakhi	M VC	-	LC
Tringa stagnatilis	Marsh sandpiper	Bali batan	M C	-	LC
Tringa glareola	Wood sandpiper	Bon batan	M F	-	LC
Tringa nebularia	Common greenshank	Pati shabujpa	M C	-	LC
Tringa totanus	Common redshank	Pati lalpa	M C	-	LC
Calidris minuta	Little stint	Choto jorali	M VC	-	LC
Amaurornis phoenicurus	White-breasted waterhen	Dholabuk dahuk	F	NO	LC
Dendrocitta vagabunda	Rufous treepie	Khoira harichacha, hari chacha	F	NO	LC
Centropus sinensis	Greater coucal	Boro kana koka	R	NO	LC
Eudynamys scolopacea	Asian koel	Kokil	F	NO	LC
Columba livia	Rock pigeon	Gola paira, jalali kabutor	C	NO	LC
Streptopelia chinensis	Spotted dove	Tila ghughu	C	NO	LC
Streptopelia decaocto	Eurasian collared dove	Lal rajghughu	F	NO	LC
Streptopelia tranquebarica	Red turtle dove	Eurashio konthighughu	F	NO	LC
Dendrocopos macei	Fulvous-breasted woodpecker	Batabi katkurali	F	NO	LC
Dendrocopos canicapillus	Grey-capped pygmy	Mete matha katkurali	R	NO	LC

Avian species	English Name	Local Name	Relative Abundance	Local status	Global status
	woodpecker				
Dinopium bengalensis	Black-rumped flameback	Kalokomor kaththukra	F	NO	LC
Tyto alba	Barn owl	Lokkhi pecha	R	NO	LC
Merops orientalis	Green bee-eater	Shabuj shuichora	FC	NO	LC
Merops philippinus	Blue-tailed bee-eater	Neel-lej shuichora	F	NO	LC
Merops leschenaulti	Chestnut-headed bee-eater	Khoiramatha shuichora	FC	NO	LC
Psittacula krameri	Rose-ringed parakeet	Shobuj tia	FC	NO	LC
Upupa epops	Eurasian hoopoe	Pati hoodhood	UC	NO	LC
Caprimulgus macrurus	Large-tailed nightjar	Lenja ratchora	F	NO	LC
Cypsiurus balasiensis	Asian palm swift	Asiotalbatashi, nakkati	FC	NO	LC
Alcedo atthis	Common kingfisher	Pati machranga	FC	NO	LC
Halcyon pileata	Black-capped kingfisher	Kalatupi machranga	F	NO	LC
Todiramphus chloris	Collared kingfisher	Dholaghar machranga	F	NO	LC
Halcyon smyrnensis	White-throated kingfisher	Dholagoloa machranga	F	NO	LC
Upupa epops	Eurasian hoopoe	Pati hoodhood	UC	NO	LC
Caprimulgus macrurus	Large-tailed nightjar	Lenja ratchora	F	NO	LC
Dendrocitta vagabunda	Rufous treepie	Khoira harichacha, hari chacha	F	NO	LC
Acridotheres fuscus	Jungle myna	Jhuti sahlik	C	NO	LC
Sturnus contra	Pied starling	Pakra shalik, gubrashalik, gu shalik	VC	NO	LC
Sturnus malabaricus	Chestnut-tailed starling	Khoiralej kathshalik, deshi pawei	F	NO	LC
Acridotheres tristis	Common myna	Bhat shalik	C	NO	LC
Corvus macrorhynchos	Jungle crow	Dar kak, danr kak	F	NO	LC
Corvus splendens	House crow	Pati kak	C	NO	LC
Dicrurus macrocercus	Black drongo	Kala fingey	VC	NO	LC
Oriolus xanthornus	Black-headed oriole	Kalamatha benebou	UC	NO	LC
Oriolus chinensis	Black-naped oriole	Kalaghar benebou	R	NO	LC
Coracina macei	Large cuckoo shrike	Boro kabashi	UC	NO	LC
Artamus fuscus	Ashy wood swallow	Metey bonababil, latora	F	NO	LC
Nectarinia zeylonica	Purple-rumped sunbird	Begunikomor moutushi	UC	NO	LC
Parus major	Great tit	Boro tit	UC	NO	LC
Copsychus saularis	Oriental magpie robin	Doel, udoidoel	FC	NO	LC
Ficedula hyperythra	Snowy-browed flycatcher	Setabru chutki	F	NO	LC
Ficedula albicilla	Taiga flycatcher	Taiga chutki	R	NO	LC
Rhipidura albicollis	White-throated fantail	Dholagola chatighurani	F	NO	LC
Orthotomus sutorius	Common tailor bird	Pati tuntuni	F	NO	LC
Phylloscopus trochiloides	Greenish warbler	Soboje futki	UC	NO	LC
Phylloscopus fuscatus	Dusky warbler	Kalchey futki	F	NO	LC
Monticula solitarius	Blue rock thrush	Nilchepenga	F	NO	LC
Hypothymis azurea	Black-naped monarch	Kalagharrajon	UC	NO	LC
Lanius schach	Long-tailed shrike	Lombaleji koshai	F	NO	LC
Lanius cristatus	Brown shrike	Khoira latora	M FC	-	LC
Hirundo rustica	Barn swallow	Metho ababil	F	NO	LC
Pycnonotus cafer	Red-vented bulbul	Bangla bulbul, bulbuli	C	NO	LC
Dendronanthus indicus	Forest wagtail	Bon khonjon	M FC	-	LC
Motacilla alba	White wagtail	Dhola khonjon	M F	-	LC
Motacilla cinerea	Grey wagtail	Metey khonjon	M F	-	LC
Motacilla flava	Western yellow wagtail	Poschima hodey khonjon	M F	-	-
Passer domesticus	House sparrow	Patichorui	VC	NO	LC
Ploceus philippinus	Baya weaver	Deshi babui	C	NO	LC
Lonchura punctulata	Scaly-breasred munia	Tilamunia	FC	NO	LC

Appendix 10. Bird species observed at Nijhum Dwip NP, including Southern Hatia and Domar Char in the period 2012 - 2014

(source: Samiul Mohsanin and Bangladesh bird club)
VC=very common, C=common, UC=uncommon, R=rare, (B)=observed before 2012

	Species Name	Scientific name	Local name	Resident/ Migrant	Abun-dance
1	Lesser Whistling Duck	*Dendrocygna javanica*	পাতি শরালি।	R	UC
2	Greylag Goose	*Anser anser*	মেটে রাজহাঁস।	M	UC
3	Bar-headed Goose	*Anser indicus*	দাগি রাজহাঁস।	M	UC
4	Ruddy Shelduck	*Tadorna ferrnginea*	খয়রা চকাচকি।	M	UC
5	Common Shelduck	*Tadorna tadorna*	পাতি চকাচকি।	M	UC
6	Northern Pintail	*Anas acuta*	উত্তুরে ল্যাঞ্জা হাঁস।	M	UC
7	Northern Shoveler	*Anas clypaeta*	উত্তুরে খুন্তে-হাঁস।	M	C
8	Eurasian Teal	*Anas crecca*	,পাতি তিলিহাঁস।	M	R
9	Eurasian Wigeon	*Anas penelope*	ইউরেশীয় সিঁথিহাঁস।	M	VC
10	Garganey	*Anas querquedula*	গিরিয়া হাঁস।	M	UC
11	Gadwall	*Anas strepera*	পিয়াং হাঁস।	M	C
12	Ferruginous Pochard	*Aythya nyroca*	মরচেরঙ ভুতিহাঁস।	M	UC
13	Eurasian Wryneck	*Jynx torquilla*	ইউরেশীয় ঘাড়ব্যথা।	M	R
14	Fulvous-breasted Woodpecker	*Dendrocopos macei*	বাতাবি কাঠকুড়ালি।	R	C
15	Rufous Woodpecker	*Celeus brachyurus*	খয়রা কাঠকুড়ালি।	R	R
16	Lesser Goldenback	*Dinopium benghalensis*	বাংলা কাঠঠোকরা।	R	C
17	Coppersmith Barbet	*Megalaima haemacephala*	সেকরা বসন্ত।	R	UC
18	Lineated Barbet	*Megalaima lineata*	দাগি বসন্ত।	R	R
19	Eurasian Hoopoe	*Upupa epops*	পাতি হুদহুদ।	M?	C
20	Indian Roller	*Coracias benghalensis*	বাংলা নীলকান্ত।	R	UC
21	Common Kingfisher	*Alcedo atthis*	পাতি মাছরাঙা।	R	VC
22	Stork-billed Kingfisher	*Pelargopsis capensis*	মেঘহও মাছরাঙা।	R	R
23	Black-capped Kingfisher	*Halcyon pileata*	কালাটুপি মাছরাঙা।	M	UC
24	White-throated Kingfisher	*Halcyon smyrnensis*	ধলাগলা মাছরাঙা।	R	VC
25	Collared Kingfisher	*Todiramphus chloris*	ধলাঘাড় মাছরাঙা।	R	UC
26	Pied Kingfisher	*Ceryle rudis*	পাকড়া মাছরাঙা।	R	C
27	Green Bee-eater	*Merops orientalis*	সবুজ সুইচোরা।	R	C
28	Jacobin Cuckoo	*Clamator jacobinus*	পাকড়া পাপিয়া।	M^s	UC
29	Common Hawk-Cuckoo	*Hierococcyx varius*	পাতি চোখগ্যালো।	R	UC
30	Plaintive Cuckoo	*Cacomantis merulinus*	করুণপাপিয়া।	M^s	C
31	Asian Koel	*Eudynamys scolopaceus*	এশীয় কোকিল।	R	C
32	Greater Coucal	*Centropus sinensis*	বড় কুবো।	R	C
33	Rose-ringed Parakeet	*Psittacula krameri*	সবুজ টিয়া।	R	C
34	Asian Palm Swift	*Cypsiurus balasiensis*	এশীয় তালবাতাসি।	R	VC
35	House Swift	*Apus affinis*	ঘর বাতাসি।	R	VC
36	Barn Owl	*Tyto alba*	লক্ষ্মী প্যাঁচা।	R	C
37	Spotted Owlet	*Athene brama*	খুদুলে প্যাঁচা।	R	C
38	Brown Hawk-Owl	*Ninox scutulata*	খয়রা শিকরেপ্যাঁচা।	R	UC
39	Large-tailed Nightjar	*Caprimulgus macrurus*	ল্যাঞ্জা রাতচরা।	R	UC
40	Common Pigeon	*Columba livia*	গোলা পায়রা।	R	C
41	Spotted Dove	*Streptopelia chinensis*	তিলা ঘুঘু।	R	VC
42	Eurasian Collared Dove	*Streptopelia decaocta*	ইউরেশীয় কন্ঠীঘুঘু।	R	VC
43	White-breasted Waterhen	*Amaurornsis phoenicurus*	ধলাবুক ডাহুক।	R	C
44	Pin-tailed Snipe	*Gallinago stenura*	ল্যাঞ্জা চ্যাগা।	M	UC
45	Common Snipe **(B)**	*Gallinago gallinago*		M	R
46	Bar-tailed Godwit	*Limosa lapponica*	দাগিলেজ জৌরালি।	M	C

	Species Name	Scientific name	Local name	Resident/ Migrant	Abun-dance
47	Black-tailed Godwit	*Limosa limosa*	কালালেজ জৌরালি ।	M	VC
48	Eurasian Curlew	*Numenius arquata*	ইউরেশীয় গুলিন্দা ।	M	VC
49	Whimbrel	*Numenius phaeopus*	নাটা গুলিন্দা ।	M	VC
50	Wood Sandpiper	*Tringa glareola*	বনবাটান ।	M	UC
51	Nordmann's Greenshank	*Tringa guttifer*	নর্ডম্যান সবুজপা ।	M	R
52	Common Greenshank	*Tringa nebularia*	পাতি সবুজপা ।	M	C
53	Green Sandpiper	*Tringa ochropus*	সবুজ বাটান ।	M	UC
54	Marsh Sandpiper	*Tringa stagnatilis*	বিল বাটান ।	M	UC
55	Common Redshank	*Tringa tetanus*	পাতি লালপা ।	M	C
56	Terek Sandpiper	*Xenus cinereus*	টেরেক বাটান ।	M	C
57	Common Sandpiper	*Actitis hypoleucos*	পাতি বাটান ।	M	VC
58	Ruddy Turnstone	*Arenaria interpres*	লাল নুড়িবাটান ।	M	C
59	Asian Dowitcher	*Limnodromus semipalmatus*	এশীয় ডউইচার ।	M	R
60	Sanderling	*Calidris alba*	স্যান্ডার্লিং ।	M	UC
61	Dunlin	*Calidris alpina*	ডানলিন ।	M	UC
62	Curlew Sandpiper	*Calidris ferruginea*	গুলিন্দা বাটান ।	M	C
63	Little Stint	*Calidris minuta*	ছোট চাপাখি ।	M	C
64	Red-necked Stint	*Calidris ruficollis*	লালঘাড় চাপাখি ।	M	C
65	Temminck's Stint	*Calidris temminckii*	টেমিঙ্কের চাপাখি ।	R	C
66	Red Knot **(B)**	*Calidris canutus*		M	R
67	Great Knot	*Calidris tenuirostris*	বড় নট ।	M	R
68	Spoon-billed Sandpiper ।	*Eurynorhynchus pygmeus*	চামচঠুঁটো বাটান	M	R
69	Broad-billed Sandpiper	*Limicola falcinellus*	মোটাঠুঁটো বাটান ।	M	UC
70	Ruff	*Philomachus pugnax*	গেওয়ালা বাটান ।	M	UC
71	Greater Painted Snipe	*Rostratula benghalensis*	বাংলা রাঙাচ্যাগা ।	R	R
72	Great Stone-curlew	*Esacus recurvirostris*	বড় মোটাহাঁটু ।	R	R
73	Eurasian Oystercatcher	*Haematopus ostralegus*	ইউরেশীয় ঝিনুকমার ।	M	R
74	Pied Avocet	*Recurvirostra avosetta*	পাকরা উল্টোঠুঁটি ।	M	UC
75	Pacific Golden Plover	*Pluvialis fulva*	প্রশান্ত সোনাজিরিয়া ।	M	C
76	Grey Plover	*Pluvialis squatarola*	মেটে জিরিয়া ।	M	C
77	Kentish Plover	*Charadrius alexandrinus*	কেন্টিশ জিরিয়া ।	M	C
78	Little Ringed Plover	*Charadrius dubius*	ছোট নথজিরিয়া ।	R	C
79	Greater Sand Plover	*Charadrius leschenaultii*	বড় ধুলজিরিয়া ।	M	UC
80	Lesser Sand Plover	*Charadrius mongolus*	ছোট ধুলজিরিয়া ।	M	VC
81	Grey-headed Lapwing	*Vanellus cinereus*	মেটেমাথা টিটি ।	M	UC
82	Red-wattled Lapwing	*Vanellus indicus*	লাল লতিকাটিটি/ হট টিটি ।	R	UC
83	Small Pratincole	*Glareola lactea*	ছোট বাবু বাটান ।	R	C
84	Oriental Pratincole	*Glareola maldivarum*	উদয়ী বাবু বাটান ।	M?	R
85	Indian Skimmer	*Rynchops albicollis*	দেশি গাঙচষা ।	M	C
86	Brown-headed	*GullLarus brunnicephalus*	খয়রামাথা গাঙচিল ।	M	VC
87	Heuglin's Gull	*Larus heuglini*	হিউগলিনের গাঙচিল ।	M	R
88	Great Black-headed Gull	*Larus ichthyaetus*	পালাসি গাঙচিল ।	M	UC
89	Common Black-headed Gull	*Larus ridibundus*	কালামাথা গাঙচিল ।	M	R
90	Gull-billed Tern	*Gelochelidon nilotica*	কালাঠোঁট পানচিল ।	R	C
91	Little Tern	*Sterna albifrons*	ছোট পানচিল ।	R	VC
92	River Tern	*Sterna aurantia*	নদীয়া পানচিল ।	R	C
93	Sandwich **(B)**	*Tern Sterna sandvicus*		M	R
94	Swift/Greater Crested Tern	*Sterna bergii*	বড় টিকিপানচিল ।	M	R
95	Caspian Tern	*Sterna caspia*	কাস্পিয়ান পানচিল ।	M	R
96	Common Tern	*Sterna hirundo*	পাতি পানচিল ।	M	UC
97	Whiskered Tern	*Chlidonias hybrida*	জুলফি পানচিল ।	M	UC
98	Osprey	*Pandion haliaetus*	মাছমুরাল ।	M	R
99	Oriental Honey-buzzard	*Pernis ptilorhynchus*	উদয়ী মধুবাজ ।	R	R

	Species Name	Scientific name	Local name	Resident/ Migrant	Abun-dance
100	Black Kite	*Milvus migrans*	ভুবনচিল ।	R	VC
101	Brahminy Kite	*Haliastur indus*	শঙ্খ চিল ।	R	VC
102	White-bellied Sea Eagle ।	*Haliaeetus leucogaster*	ধলাপেট সিন্ধুঈগল	R	C
103	Grey-headed Fish Eagle	*Ichthyophaga ichthyaetus*	মেটেমাথা কুরাঈগল ।	R	R
104	Shikra	*Accipiter badius*	পাতি শিকরে ।	R	R
105	Common Buzzard	*Buteo buteo*	পাতি তিসাবাজ ।	M	R
106	Greater Spotted Eagle	*Aquila clanga*	বড় গুটিঈগল ।	M	R
107	Peregrine Falcon	*Falco peregrinus*	পেরেগ্রিন শাহিন ।	M	UC
108	Common Kestrel	*Falco tinnunculus*	পাতি কেস্ট্রেল ।	M	UC
109	Merlin **(B)**	*Falco columbarius*		M/V?	R
110	Little Cormorant	*Phalacrocorax niger*	ছোট পানকৌড়ি ।	R	C
111	Little Egret	*Egretta garzetta*	ছোট বগা ।	R	VC
112	Yellow-billed Egret	*Egretta intermedia*	মাঝলা বগা ।	R	C
113	Grey Heron	*Ardea cinerea*	ধুপনি বক ।	R	C
114	Purple Heron	*Ardea purpurea*	লালচে বক ।	R	R
115	Great Egret	*Casmerodius albus*	বড় বগা ।	R	C
116	Cattle Egret	*Bubulcus ibis*	গো বগা ।	R	VC
117	Indian Pond Heron	*Ardeola grayii*	দেশি কানিবক ।	R	VC
118	Striated Heron	*Butorides striata*	খুদে বক ।	R	UC
119	Black-crowned Night Heron	*Nycticorax nycticorax*	কালামাথা নিশিবক ।	R	C
120	Cinnamon Bittern	*Ixobrychus cinnamomeus*	খয়রা বগলা ।	R	R
121	Black-headed Ibis	*Threskiornis melanocephalus*	কালামাথা কাস্তেচরা ।	M	UC
122	Eurasian Spoonbill	*Platalea leucorodia*	ইউরেশীয় চামচঠুঁটি ।	M	R
123	Painted Stork	*Mycteria leucocephala*	রাঙা মানিকজোড় ।	M	R
124	Asian Openbill	*Anastomus oscitans*	এশিয় শামখোল ।	R	UC
125	Brown Shrike	*Lanius cristatus*	খয়রা লাটোরা ।	M	C
126	Long-tailed Shrike	*Lanius schach*	ল্যাঞ্জা লাটোরা ।	R	C
127	Rufous Treepie	*Dendrocitta vagabunda*	খয়রা হাঁড়িচাচা ।	R	C
128	Large-billed Crow	*Corvus macrorhynchos*	দাঁড় কাক ।	R	VC
129	House Crow	*Corvus splendens*	পাতি কাক ।	R	VC
130	Ashy Woodswallow	*Artamus fuscus*	মেটে বন আবাবিল ।	R	C
131	Black-naped Oriole	*Oriolus chinensis*	কালাঘাড় বেনেবউ ।	M	R
132	Eurasian Golden Oriole	*Oriolus oriolus*	ইউরেশীয় সোনাবউ ।	M	R
133	Black-hooded Oriole	*Oriolus xanthornus*	কালামাথা বেনেবউ ।	R	C
134	Black-headed Cuckooshrike	*Coracina melanoptera*	কালামাথা কাবাসি ।	R	UC
135	Small Minivet	*Pericrocotus cinnamomeus*	ছোট সাহেলি ।	R	C
136	White-throated Fantail	*Rhipidura albicollis*	ধলাগলা ছাতিঘুরুনি ।	R	VC
137	Black Drongo	*Dicrurus macrocercus*	কালা ফিঙে ।	R	VC
138	Black-naped Monarch	*Hypothymis azurea*	কালাঘাড় রাজন ।	R	C
139	Asian Paradise Flycatcher	*Terpsiphone paradisi*	এশীয় শাবুলবুলি ।	R	R
140	Common Iora	*Aegithina tiphia*	পাতি ফটিকজল ।	R	C
141	Common Woodshrike	*Tephrodornis pondicerianus*	পাতি বনলাটোরা ।	R	UC
142	Tickell's Thrush	*Turdus unicolor*	টিকেলের দামা ।	M	R
143	Taiga Flycatcher	*Ficedula albicilla*	তাইগা চুটকি ।	M	C
144	Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*	মেটেমাথা ক্যানারিচুটকি ।	M	C
145	Oriental Magpie Robin	*Copsychus saularis*	উদয়ী দোয়েল ।	M	VC
146	Black Redstart	*Phoenicurus ochruros*	কালা গির্দি ।	M	R
147	Pied Myna	*Sturnus contra*	পাকরা শালিক ।	R	VC
148	Chestnut-tailed Starling	*Sturnus malabaricus*	খয়রালেজ কাঠশালিক ।	R	C
149	Jungle Myna	*Acridotheres fuscus*	ঝুটি শালিক ।	R	C
150	Common Myna	*Acridotheres tristis*	ভাত শালিক ।	R	VC
151	Great Tit	*Parus major*	বড় তিত ।	R	C

	Species Name	Scientific name	Local name	Resident/ Migrant	Abun-dance
152	Barn Swallow	*Hirundo rustica*	পাতি আবাবিল ।	R	VC
153	Red-vented Bulbul	*Pycnonotus cafer*	বাংলা বুলবুল ।	R	VC
154	Plain Prina	*Prinia inornata*	নিরল প্রিনা ।	R	UC
155	Oriental White-eye	*Zosterops palpebrosus*	উদয়ী ধলাচোখ ।	R	C
156	Common Tailorbird	*Orthotomus sutorius*	পাতি টুনটুনি ।	R	VC
157	Blyth's Reed Warbler **(B)**	*Acrocephalus dumetorum*		M	R
158	Dusky Warbler	*Phylloscopus fuscatus*	কালচে ফুটকি ।	M	C
159	Yellow-browed Warbler	*Phylloscopus inornatus*	হলদেভ্রু ফুটকি ।	M	C
160	Greenish Warbler	*Phylloscopus trochiloides*	সবজে ফুটকি ।	M	C
161	Bengal Bush Lark	*Mirafra assamica*	বাংলা ঝাড়ভরত ।	R	VC
162	Pale-billed Flowerpecker	*Dicaeum erythrorhynchos*	মেটেঠোঁট ফুলঝুরি ।	R	UC
163	Purple-rumped Sunbird	*Leptocoma zeylonica*	বেগুনিকোমর মৌটুসি ।	R	C
164	Purple Sunbird	*Cinnyris asiaticus*	বেগুনি মৌটুসি ।	R	C
165	House Sparrow	*Passer domesticus*	পাতি চড়ুই ।	R	VC
166	White Wagtail	*Motacilla alba*	ধলা খঞ্জন ।	M	VC
167	Citrine Wagtail	*Motacilla citreola*	সিট্রিন খঞ্জন ।	M	VC
168	Western Yellow Wagtail	*Motacilla flava*	পশ্চিমা হলদেখঞ্জন ।	M	C
169	Paddyfield Pipit	*Anthus rufulus*	ধানি তুলিকা ।	R	UC
170	Richard's Pipit **(B)**	*Anthus richardi*		M	R
171	Baya Weaver	*Ploceus philippinus*	দেশি বাবুই ।	R	UC

Appendix 11. Variable width transect counts of mammals at Nijhum Dwip in February 2014

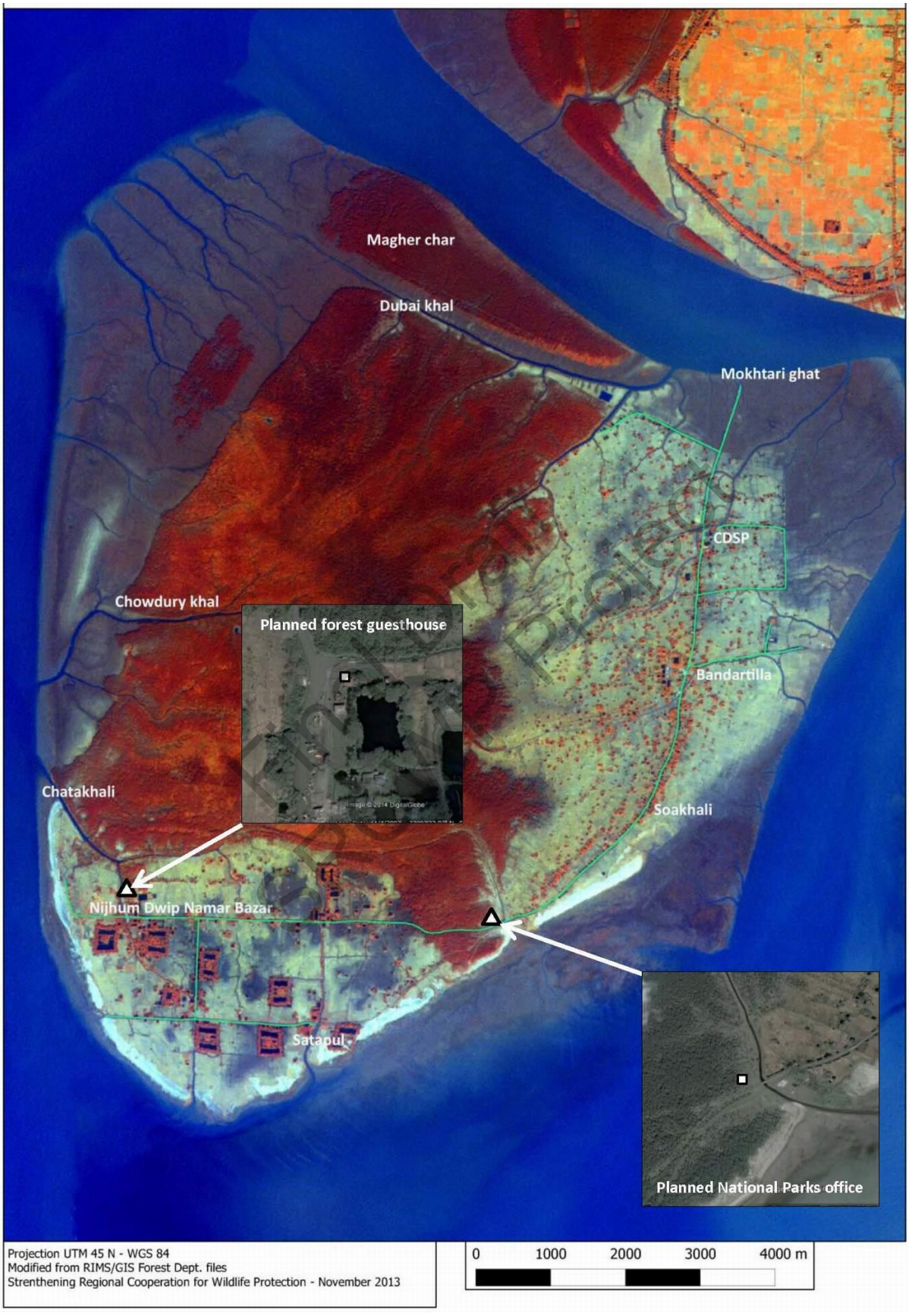
Transect no.	Observers	Date	Transect length (km)	Angle (degree)	Start N	Start E	End N	End E	Forest type	Species	Total N	Obser-vation distance
NDF01	Lokm	14/02/14	3.3	90	2202.985	9058.543	2202.411	9100.777	keora	cattle	7	80
NDF01	Lokm	14/02/14	3.3	90	2202.985	9058.543	2202.411	9100.777	keora	spotted deer	10	100
NDF01	Lokm	14/02/14	3.3	90	2202.985	9058.543	2202.411	9100.777	keora	spotted deer	5	100
NDF01	Lokm	14/02/14	3.3	90	2202.985	9058.543	2202.411	9100.777	keora	spotted deer	30	80
NDF02	Deo	14/02/14	3.3	90	2203.359	9058.759	2203.149	9100.649	keora	buffalo	9	60
NDF03	Shamsur	14/02/14	3.2	90, 105	2204.669	9059.409	2203.21	9100.646	keora	buffalo	6	20
NDF03	Shamsur	14/02/14	3.2	90, 105	2204.669	9059.409	2203.21	9100.646	keora	spotted deer	3	100
NDF04	Deo	16/02/14	3.1	225	2204.972	9101.136	2203.852	9059.807	keora	spotted deer	1	5
NDF04	Deo	16/02/14	3.1	225	2204.972	9101.136	2203.852	9059.807	keora	spotted deer	18	110
NDF05	Lokm	16/02/14	3.3	225	2205.204	9100.574	2203.879	9059.337	keora	golden jackal	2	150
NDF05	Lokm	16/02/14	3.3	225	2205.204	9100.574	2203.879	9059.337	keora	spotted deer	30	120
NDF05	Lokm	16/02/14	3.3	225	2205.204	9100.574	2203.879	9059.337	keora	spotted deer	5	120
NDF06	Shamsur	16/02/14	3.6	225	2203.315	9100.321	2203.846	9058.95	keora	spotted deer	21	100

Appendix 12. Nijhum Dwip NP mid-winter waterbird counts (AWC) 2006-2014 (mainly Domar Char and Muktaria Channel and NE Nijhum Dwip)

Species		2014	2013	2012	2011	2010	2009	2008	2007	2006
Cormorants & darter										
Little cormorant	*P. niger*	22	23	4	20	27	15	3		29
Herons & egrets										
Black-crowned night heron	*Nycticorax nycticorax*		2	3	1					1
Indian pond heron	*Ardeola grayii*		12	60	10	33		36		7
Stiated heron	*Butorides stiatus*							5		
Cattle egret	*Bubulcus ibis*	136	9	27				3		29
Little egret	*E. garzetta*	35	18	26	2	8	12	2		361
Intermediate egret	*E. intermedia*	21	10			17	38	54		
Great egret	*A. alba*	185	146	40	7	75	55	151		880
Purple heron	*Ardea purpurpurea*	2					2			
Grey heron	*A. cinerea*	4		2	5	1	1			4
Unidentified egrets										300
Ibis & spoonbill										
Black-headed ibis	*Threskiomis melanocephalus*	119	34	45	20	25	31	82		63
Eurasian spoonbill	*Platalea leucorodia*			15	2	2	11			16
Geese & ducks										
Greylag goose	*Anser anser*			6		30				
Bar-headed goose	*A. indicus*		208	56	120	390				304
Ruddy shelduck	*Tadorna ferruginea*	65	35		50	33	22			43
Common shelduck	*T. tadorna*	333	550	80	108	1085	1550	48		1630
Eurasian wigeon	*Anas penelope*	884	1700	1600	3000	885	11000	550		1797
Gadwall	*A. strepera*					65				116
Common teal	*A. crecca*		15							
Northern pintail	*A. acuta*		50				6			
Northern shoveler	*A. clypeata*	22	25		16	36				42
Unidentified ducks			100				228			
Rails										
White-breasted waterhen										1
Shorebirds										
Eurasian oystercatcher	*Haematopus ostralegus*		1							
Pied avocet	*Recurvirostra avosetta*	35	147	15	1	18	15			3
Great thick-knee	*Esacus recurvirostris*		1							
Little pratincole	*G. lactea*	4	2	100	30		12			
Red-wattled lapwing										2
Pacific golden plover	*Pluvialis fulva*	16	100	300	40	170				885
Grey plover	*P. squatarola*	37	4	79	1	22	2			205
Kentish plover	*C. alexandrinus*	43		50	1	12				10
Mongolian plover	*C. mongolus*	1800	500	1000	1	505				5520
Greater sand	*Plover C. leschenaultii*	170	15	22	14	10				
Little ringed plover	*C. dubius*	11		10		11				
Black-tailed godwit	*Limosa limosa*	225	370	79	60	280	103	270		347
Bar-tailed godwit	*L. lapponica*			4	15	16				
Whimbrel	*Numenius phaeopus*	54	25	18	5	9		25		25
Eurasian curlew	*N. arguata*	87	89	34	53	127	280			400
Redshank	*T. totanus*	153	32	60	38	173	5	100		216
Marsh sandpiper	*T. stagnatilis*	2		1		1	2			
Greenshank	*T. nebularia*	11	12	9	12	22		35		104

Species		**2014**	**2013**	**2012**	**2011**	**2010**	**2009**	**2008**	**2007**	**2006**
Nordmann's greenshank	*T. guttifer*		1		3	1				2
Green sandpiper	*T. ochropus*				7					1
Wood sandpiper	*T. glareola*			8		4				
Terek sandpiper	*Xenus cinereus*	6	33	1	18	5				197
Common sandpiper	*Actitis hypoleucos*		3		2					
Ruddy turnstone	*Arenaria interpres*			20		14				
Pintail snipe	*G. stenura*			2						
Common snipe										10
Asiatic dowitcher										11
Red knot										2
Great knot	*Calidris tenuirostris*				4					
Sanderling	*C. alba*					2				
Little stint c. Minuta/red-necked stint	*C. ruficollis*	70	3	250	150	16				230
Temminck's stint	*C. temminckii*	15			3	4				
Dunlin	*C. alpina*	7								
Curlew sandpiper	*C. ferruginea*		2	2	82	4				256
Spoon-billed sandpiper	*Eurynorhynchus pygmeus*				1					1
Broad-billed sandpiper	*Limicola falcinellus*	18	2	2	22	3				3
Unidentified shorebirds			400	400	500		250			
Heuglin's gull	*Larus heuglini*				2					
Brown-headed gull	*L. brunnicephalus*	3531	148	300	100	231	801	188		960
Black-headed gull	*L. ridibundus*		3			2				
Great black-headed gull	*Ichthyaetus ichthyaetus*	5	2		64	4	350			84
Whiskered tern	*Chlidonias hybridus*							2		12
Gull-billed tern	*Gelochelidon nilotica*	12	19		12	2		3		144
Caspian tern hydroponge caspia								2		2
Indian river tern	*Sterna aurantia*	5	5	4	20	7	20			3
Common tern	*S hirundo*		2							
Little tern	*S. albifrons*		50		1					2
Sandwich tern										1
Indian skimmer	*Rynchops albicollis*	1060	600	20		1600	2500	3200		875
Total birds		**9205**	**5508**	**4754**	**4623**	**5987**	**17311**	**4759**	na	**16136**
Total no. Of species		36	43	38	42	44	23	19		46

Appendix 13. Location of planned forest guesthouse and National Park Office



Appendix 14. Rules of Conduct for tourism in the Nijhum Dwip NP

The following elements to a code of conduct for the Nijhum Dwip NP based on the existing code of ethics for the Sundarban Reserved Forest (Chaves 2002). It is recommended that these guidelines become established legally and enforced, that each entry pass be considered as a contract between visitors and the Forest Department. Guidelines must be clearly posted in Bangla and English at all Forest Department stations and tourist areas, and be printed on the back side of entry passes.

Recommended Code of Conduct for Visitors:

- Be respectful of wildlife and other visitors - keep noise to a minimum. Audio systems and fireworks are prohibited in the Nijhum Dwip NP.
- Leave the night to the animals - keep night lighting to a minimum.
- Be alert and mindful for your own safety and that of others.
- Dress in dark clothes or garments that blend with the flora.
- Respect signs and remain in areas of public access only.
- Take only pictures, leave only footprints. Pack out all trash or dispose of trash in designated receptacles. Do not extract or collect plants and animals from the Nijhum Dwip NP.
- Keep animals wild - do not feed wild animals.
- No cooking or open fires in the Nijhum Dwip NP.

Recommended Code of Conduct for Tour Operators (additional to the Visitors' Code of Conduct):

- All tour operators visiting the Nijhum Dwip NP must be licensed by the Forest Department.
- Overnight mooring will only be allowed in designated areas.
- Tours must be conducted on designated circuits only.
- Tour operators will apply appropriate safety standards in their operations - boats not to exceed maximum carrying capacities, all boats must be equipped with sufficient life vests (one per passenger), a first aid kit, and a two-way radio.
- Tour operators must educate all participants on the SRF codes of conduct prior to tour initiation.
- No dumping of waste or sewage in Nijhum Dwip NP.