

Proposed Wind Parks in Mannar Area

A. Wind Power Development in Sri Lanka

1. Initial studies for the use of wind resources for power generation in Sri Lanka were conducted over 1992-1994, focusing on the southern coastal region. A 3 megawatt (MW) pilot wind power plant was built by Ceylon Electricity Board (CEB) near the southern town of Hambantota. The wind resource map of Sri Lanka prepared in 2003 identified more areas in the country with medium to high potential to use wind power to produce electricity. In the coastal areas, the Puttalam-Kalpitiya area, Mannar island and areas north of Mannar town were identified to have good wind potential. With the government's decision in 2008 to offer a cost-reflective tariff for the supply of wind power to the grid, a total of 90 MW of wind power capacity was built mainly in Puttalam-Kalpitiya area over 2009-2013. A few smaller wind power plants operate in other areas of the country. All these investments were made by the private sector, mostly with locally raised debt and equity finances. The resource allocation policy followed by the government so far was on a first-come, first-served basis. Prices offered for the supply of electricity and power purchase agreements (PPA) were standardized and non-negotiable.

2. There are two impediments to the rapid development of Sri Lanka's wind resources for power generation: (i) wind is an intermittent resource, and electricity production from wind requires to be carefully managed to ensure that undue power failures do not occur owing to sudden changes of wind flow, and (ii) the standardized prices offered to the private sector to supply wind power to the grid were considered to be excessive both by the international standards and when compared with the cost of producing electricity in Sri Lanka from other sources. The issue of intermittency and technical and economic problems arising from intermittency require the wind power capacity on the grid to be limited and a close operational control be exerted on wind power generators. The cost of generation from wind power can be reduced and the declining costs of wind power generating equipment in the international market be passed on to customers only by discontinuing the present procedure of offering standardized prices and by establishing a competitive bidding procedure.

3. In addition to the two impediments listed above, there are two shortcomings of the wind power development procedure presently followed in the Puttalam-Kalpitiya area that require correction: (i) the resource identification and infrastructure development is driven by the investors, and (iv) negligible participation of the community of the area in investment and limited benefits to them by way of regular benefits.

4. The procedure followed in the allocation of wind resources to the private developers was to allow the developers to propose wind power sites, to which the resource allocation and transmission connection would be provided by the relevant agencies, Sri Lanka Sustainable Energy Authority (SLSEA) and CEB. Other approvals, such as environmental approvals, would then be taken by each developer for their site, followed by investment approvals by the Board of Investment (BoI). This procedure has resulted in the wind resource in the Puttalam-Kalpitiya coastal belt to be developed rapidly, but in a manner that does not maximize harnessing the wind potential of the area. Each developer drawing their own transmission lines to reach CEB's interconnection point has caused a number of additional transmission lines being built at different times, inconveniencing the investors, regulatory agencies and land owners of the area. Construction of access roads to wind power sites too was done by each developer as and when he is ready for construction, again inconveniencing the authorities and the people living in the area.

B. Next Phase of Wind Power Development

5. In the next phase of wind power development in Sri Lanka, the government and Ministry of Power and Energy (MOPE) plan to overcome the two impediments and two shortcomings listed above by following a more systematic approach, as described below. The government intends to develop wind power generation in the Mannar district of the Northern Province in the future.

6. Based on the previous studies, the wind power potential in Mannar was studied in detail over 2011-2013 in an ADB-assisted wind resource assessment, which confirmed that Mannar has a high potential for wind power development.¹ Investment-grade wind resource information is now available for the Mannar region. Accordingly, the government, MOPE and CEB have initiated action to upgrade power transmission facilities from Mannar district to the main grid in preparation for the absorption of wind power to the grid. A new transmission line from Anuradhapura to Mannar town through Vavuniya is financed under ADB's on-going Clean Energy and Network Efficiency Improvement Project that is under implementation.² This transmission line will satisfy the growing demand for power in Mannar and surrounding areas and may also support delivering wind power back to the grid, once the wind resource is developed. The future wind power park development is not included for direct financing under the proposed Green Power Development and Energy Efficiency Improvement Investment Program. At the same time, the second tranche of the investment program may include infrastructure facilities (i.e., a transmission line and a pooling substation or other pooling arrangements) to support power evacuation from the future wind parks and connect the Mannar grid substation that is being constructed on the main island with the Mannar island.

7. The transmission line for evacuation of the generated power from the proposed wind parks may pass through the wetland area, located between the main island and Mannar island, that falls under the Ramsar Convention. The Ramsar Convention advocates for the wise use of wetlands and does not prohibit using wetland areas in the case of national interests.³ The proposed transmission line will effectively restore the old line that was passing through the area and was damaged during the past conflict. It will be restored using the same route of the old 33 kilovolt (kV) line that goes close and parallel to the old railway that was also destroyed during the past conflict and is being currently reconstructed by the government in the same area.

8. The government, MOPE and CEB were advised that for inclusion of such a subproject in the second tranche safeguard assessments fully complying with the requirements of ADB's Safeguard Policy Statement, 2009⁴ with regard to the transmission subproject, as well as an associated facility (i.e., the proposed wind parks), need to be prepared. Initial safeguard assessments for the subproject and the associated facility (see brief environmental and social summary sections on the associated wind parks below) were undertaken by CEB. The initial environmental assessment of the transmission subproject was supported by a team of consultants, including an ornithologist, a marine biologist, an ecologist, a hydrologist and a

¹ Under TA 7837-SRI: Clean Energy and Network Efficiency Improvement, ADB supported actual wind measurements and wind resource assessment at the proposed wind park site at Mannar.

² ADB. 2012. *Report and Recommendation of the President to the Board of Directors on Proposed Loans, Technical Assistance Grant, and Administration of Grant to the Democratic Socialist Republic of Sri Lanka for the Clean Energy and Network Efficiency Improvement Project*. Manila.

³ See the text of the Ramsar Convention on wetlands, as amended in 1982 and 1987, at http://www.ramsar.org/cda/en/ramsar-documents-texts-convention-on/main/ramsar/1-31-38%5E20671_4000_0__

⁴ 2009. ADB. *Safeguard Policy Statement*. Manila.

Geographic Information System specialist. CEB intends to further develop and complete the safeguard assessments for the transmission subproject and future wind parks. CEB has also initiated a bird migratory survey for the entire Mannar island to be carried out from January 2014 up to the end of 2015 for about a 2-year period to identify proper location of individual wind parks and avoid any adverse impact to bird migration.

9. A study to develop a master plan for wind power development in Mannar was commissioned by MOPE in 2013 with ADB's technical assistance.⁵ Accordingly, a comprehensive master plan was developed for wind power development in the Mannar district. Economic studies associated with the master plan study for Mannar have concluded that the cost of wind power generation can be substantially lower than the standardized prices presently offered to wind developers, if (a) the present 10 MW limit on the size of the power plant allowed to be developed by the private sector is increased, and, at the same time, (b) a competitive bidding procedure is followed to ensure the lowest possible price is achieved.

10. The two shortcomings in the existing process may be overcome by appointing a wind park developer, whose responsibilities will include a systematic design of wind parks, design and construction of infrastructure facilities in preparation for issuing of bidding documents, and to maintain the park throughout the duration of any power purchase agreement between wind park investors and CEB. Thus, under this concept, the wind park developer and wind power investors will be two different entities. To ensure that the benefits of wind power development will flow to the local community, land committed and land used for wind power development may be leased-out by the park developer in a manner that a regular income would flow to such owners. Potentially, one wind power block could be accorded a special status and designated as a block to which individuals, community organizations, institutions and small companies may invest, in a manner that a regular return on investment can be enjoyed by such smaller investors. A key responsibility of the wind park developer will be the planned development of the transmission network to deliver wind power to the main grid.

C. The Master Plan for Wind Power Development in Mannar

11. Results of the Master Plan study have recommended the establishment of a Wind Power Development Zone (WPDZ) in Mannar to facilitate all aspects of infrastructure development, investment and management of these developments. This recommendation and the wind park and block arrangements recommended by the Master Plan study have been accepted by MOPE.

12. **Wind Parks:** The master plan for wind power development in the WPDZ is shown in Figure 1. Accordingly, the wind resource areas in the Mannar district have been divided into 4 wind parks consisting of a total of 15 blocks.

13. **Capacity of Wind Parks and Blocks:** Each block has a designed capacity of 25 MW. Wind Parks 1, 2 and 3 will consist of 4 blocks each, amounting to a capacity of 100 MW in each park. There are only 3 blocks in Wind Park 4, with a total capacity of 75 MW. Accordingly, once fully developed over 2015-2025, the installed generating capacity of the Mannar WPDZ will be 375 MW. Wind Parks 1, 2 and 3 are on the Mannar island (linked to the mainland through a bridge at Mannar town), while Wind Park 4 is on the mainland, south of Mannar town. Total

⁵ A system stability study and a master plan along with a business model of the proposed wind park are being finalized with support of ADB's TA 8167-SRI (ADB. 2012. *Technical Assistance to the Democratic Socialist Republic of Sri Lanka for Capacity Building for Clean Power Development*. Manila, for \$900,000, approved on 18 September 2012, and financed on a grant basis by ADB's Technical Assistance Special Fund – [TASF-IV]).

generation capacity of the proposed wind parks is summarized in Table 1.

Table 1: Total generation capacity of the proposed wind parks in Mannar area

Wind Park No	Number of blocks	Power Generation Capacity allocated to each block (MW)	Total Generating Capacity of the Park (MW)
WP1	4	25	100
WP2	4	25	100
WP3	4	25	100
WP4	3	25	75
Total for WPDZ	15		375

WP = wind park, WPDZ = Wind Power Development Zone

Source: Asian Development Bank technical assistance report estimates.

14. **Development of Wind Parks:** Development of each wind park may be done by a special purpose company established by CEB (the Park Development Company or PDCo) with a majority shareholding. The role and responsibilities of the PDCo may be:

- (a) Acquisition/allocation of land and all the statutory clearances (such as environmental impact assessment [EIA], environmental licenses and other clearances and approvals) for establishing the wind park;
- (b) Provision of a secure and access controlled facilities within each wind park (access control, however, is expected to be limited to a small area within a park, whereas, most of the park will not be access-controlled);
- (c) Investing in marine delivery facilities, if any, for the use of wind power investors, and maintaining the facilities;
- (d) Development of access roads within the common area of each wind park and to each investor's project boundary, as required for transport of equipment;
- (e) Provisions of ancillary services such as security, landscaping of the common areas, road maintenance;
- (f) Maintaining the wind masts and data recording;
- (g) Overall site management with legal accountability of the wind park;
- (h) Ensuring that all developers develop within the blocks allocated to them, without infringing on the rights and resource of other existing and future investors;
- (i) Investing in infrastructure, upgrading transmission lines, road extensions;
- (j) Imposing service fees;
- (k) Implementing the grievance redress mechanism for social and environmental issues;
- (l) Statistical studies and publications; and
- (m) Optionally, provision of cranes for developers to use during wind turbine erection period and thereafter.

15. **Sri Lanka Sustainable Energy Authority (SLSEA):** In accordance with the SLSEA Act of 2007, the WPDZ may be declared a "resource area". As and when CEB issues a request for proposal (RFP) inviting bids for a block or several blocks, and when a successful bidder is announced for each block, SLSEA's project approval process will be activated in accordance with the provisions in SLSEA Act and the relevant regulations.

16. **CEB Transmission Licensee:** In accordance with the provisions of the Sri Lanka Electricity Act of 2009 and on the basis of grid absorption studies and economic studies, CEB

Transmission Licensee will be responsible for calling of bids from time to time, from prospective Wind Project Developers (WINCOs) for the establishment of wind power plants in each wind park or block, as the case may be. CEB Transmission Licensee will charge power transmission fees from WINCOs, which may include the upfront fees and service fees with agreed terms and conditions. A PPA will be signed between CEB and each WINCO.

17. **Investing in Wind Parks:** The role of each WINCO is to respond to requests for proposals issued by CEB and, if successful, build, own and operate (BOO) their individual wind power plants. Each WINCO will enter into a contract with the PDCo for the allotment of plots and guaranteed delivery of other infrastructure required for the successful commissioning of their wind power plant. Each WINCO may be responsible for:

- (a) Entering into a PPA with the CEB Transmission Licensee;
- (b) All the investment risks associated with the construction and operation of the wind power plant;
- (c) Legal accountability for the allotted land under their control under the PDCo;
- (d) Build and maintain all the facilities inside the wind power plant up to the Point of Supply to CEB; and
- (e) Delivery of power at agreed Point of Supply in accordance with the terms of PPA and the Grid Code.

18. **The Transmission Network:** The Master Plan study has evaluated several transmission options for Wind Parks 1, 2 and 3, and has conceptually recommended a transmission option (see Figure 2), in which:

- (a) Individual wind generator outputs will be stepped-up to 33 kV at the generator location, feeding a 33 kV wind block transmission line, which terminates at a Block Collector Substation (BCS) located within each block. It is assumed that each BCS will be located at the center of gravity of each block. Each BCS is only a switching and metering substation operating at 33 kV.
- (b) A 33 kV feeder will be built from each BCS to the corresponding Park Collector Substation (PCS). Each PCS is located in such a manner that transmission losses would be minimal. At each PCS, there will be 4x31.5 megavolt-ampere transformers, stepping-up the voltage to 132 kV.
- (c) A 132 kV feeder from each wind park to the Main Collector Substation (MCS) will serve the output of each wind park to the MCS. The optimal location of the MCS is shown in Figure 2. The MCS may only be a switching and metering substation, if the main transmission line to the Mannar grid substation would be at 132 kV. Otherwise, there will be step-up transformers 132/220 kV at the MCS, if the main transmission line would be at 220 kV.

Figure 1: Planned Wind Parks in Mannar Wind Power Development Zone

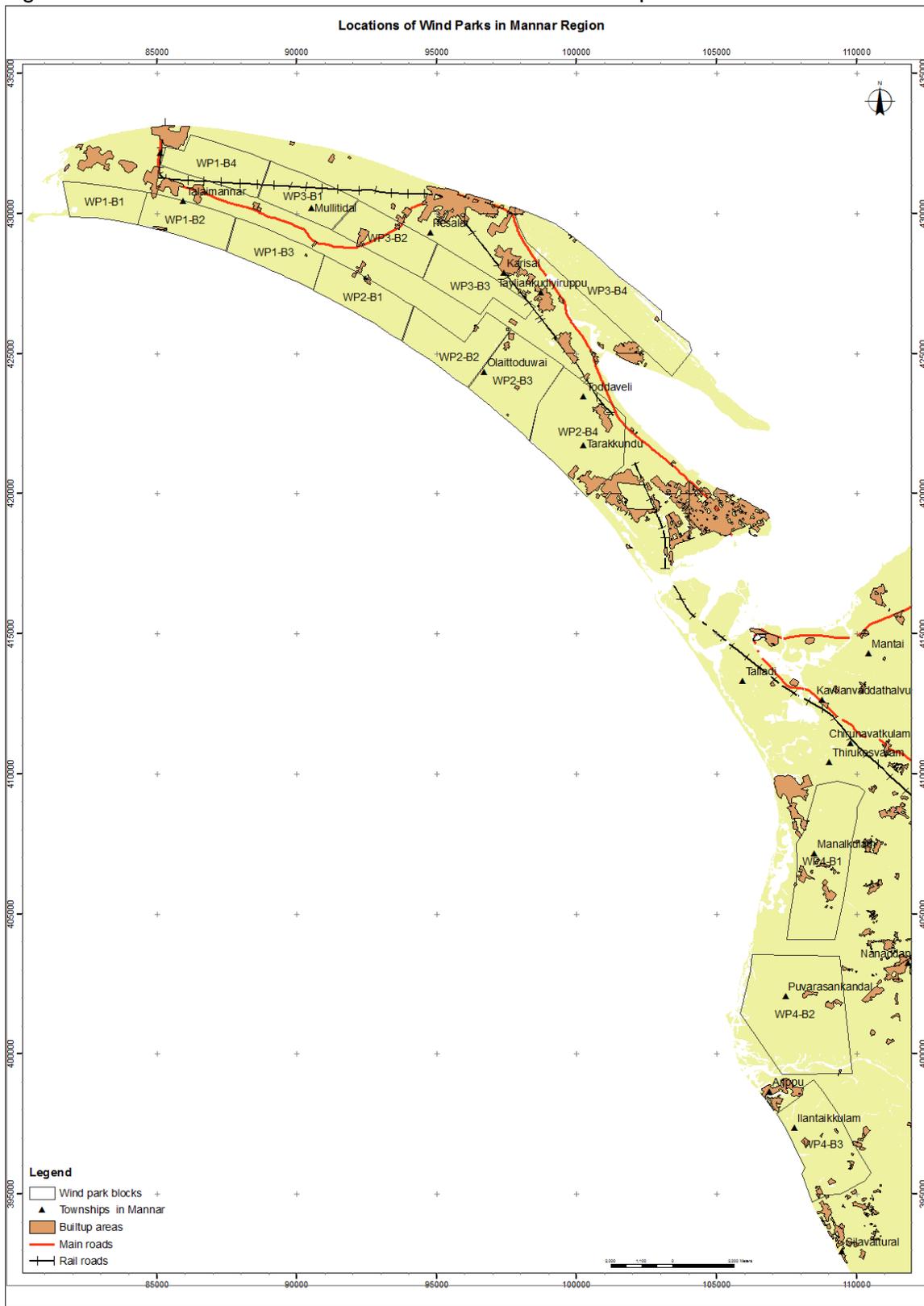
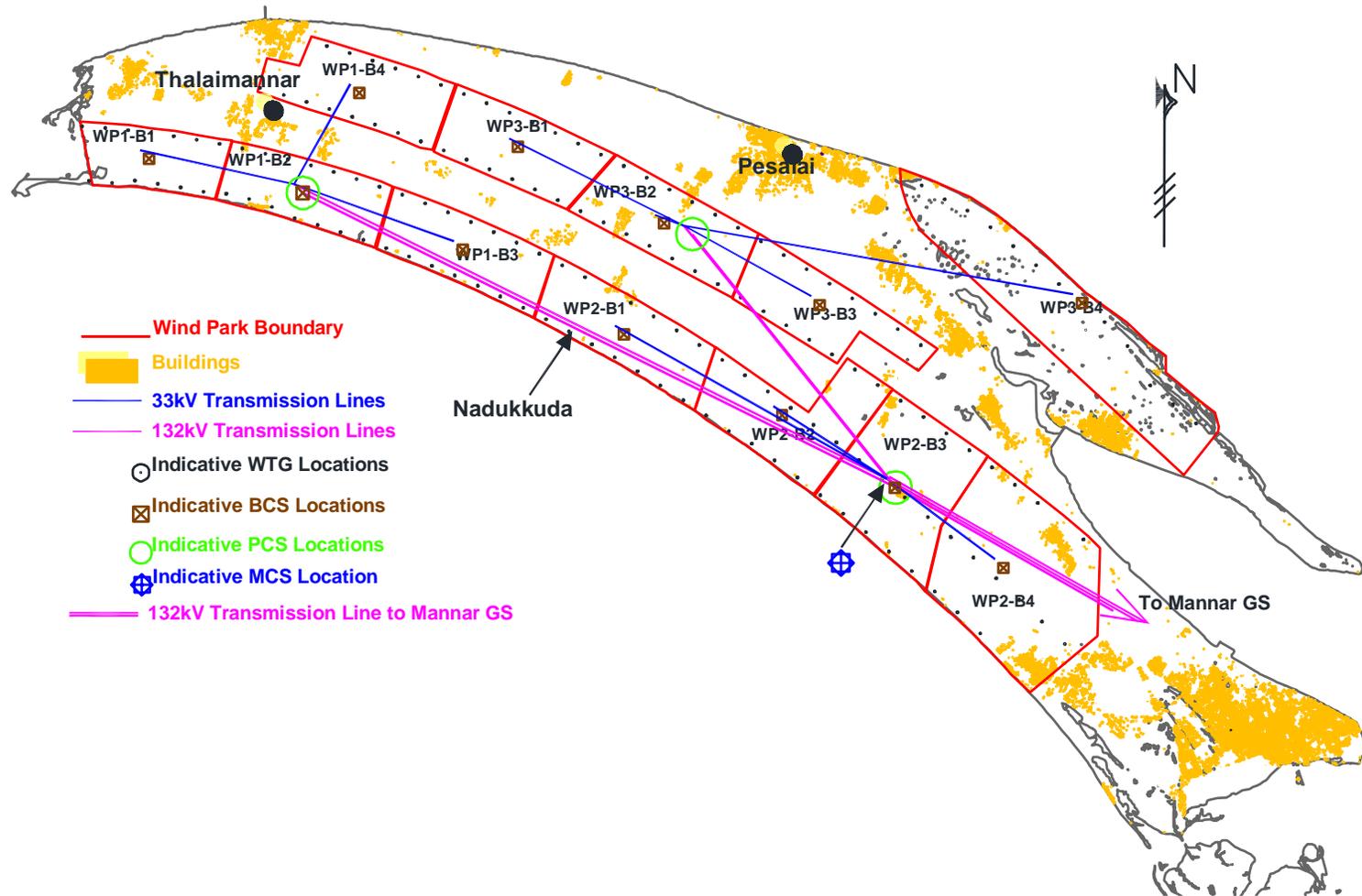


Figure 2: Conceptual Transmission Network for three Wind Parks in Mannar Island



Note: Transmission layout is conceptual, and line routes and substation locations are to be defined more accurately during the feasibility study.

D. Social Assessments of Wind Park Blocks in Mannar District

19. An initial social assessment has been concluded for 10 Wind Park Blocks (WPBs) in the Mannar district identified as suitable locations for wind resource development. This social assessment provided inputs to the regional master plan for wind resource development in the Mannar district, a national master plan for renewable energy development and to a Resettlement Plan to be developed by CEB for wind parks as an associated facility for the transmission interconnection subproject planned from the Mannar island to the main island.

20. Ten potential siting areas for wind parks were identified by a team implementing the master plan study, taking into account the resource availability, social and environmental constraints as well as several infrastructure limitations. The selected sites excluded home gardens, built up areas, wild life sanctuaries and forests, and other environmentally sensitive areas. The WPBs cut across parts of 22 Grama Niladhari Divisions (GNDs) in the three Divisional Secretariat Divisions (DSDs) of Mannar town, Nanattan and Musalai. The 22 GNDs embodies a total population of 25,784 people and 6,392 households, which altogether is 27 percent of the total population of the Mannar district. Of the households living within the ten WPBs, 78.5 percent lived in fishing communities while the rest 21.5 percent lived in communities that characterized mixed economic activities of both fishing and agriculture. A total of 988 mechanized boats and 422 non-mechanized boats operate from a number of fish landing sites spread across the 22 GNDs. Of the active labor force within the 22 GNDs, 39.5 percent is engaged in fishery, 23.4 percent in casual labor work, 9.1 percent in government or private sector jobs, 8.7 percent in agriculture and livestock farming, 6.8 percent in self-employment, 3.8 percent in foreign employment, and 8.5 percent in the manufacture of palmyrah products. The rate of unemployment stands at 7.1 percent, and 40.5 percent of the households receive food subsidy under the Samurdhi Program, the poverty alleviation program of the Government of Sri Lanka.

21. At the time of conducting the initial social assessment (September-October 2013), neither the exact locations for wind parks in the Mannar district nor their technical and engineering designs have been determined. Therefore, the social assessment was primarily focused on assessing the social feasibility of the proposed ten locations, socio-economic environment of those identified areas as well as potential impacts that wind parks could have on the adjacent communities and how the communities respond to the intended wind development projects and the ways, in which the communities could be involved in the project design and planning processes and in sharing its benefits.

22. A Rapid Social Appraisal (RSA) and several community consultations were conducted to identify the most conducive 'social space' available within each WPB for the installation of wind plant towers so that they avoid or minimize any adverse impacts on communities living within the WPBs and their social and economic activities. Based on an inventory of each WPB that recorded the geographical boundaries, geophysical features, settlement patterns, economic activities of the people, land ownership and land use patterns, common infrastructure and development activities and others, plots of land available within each WPB that were considered socially viable for the installation of wind power plants have been identified. The locations earmarked are those that exclude human settlements and their livelihood practices and other social activities. The rapid social appraisal also included a sample socio-economic survey to profile the socio-economic conditions of the households living within the WPBs.

23. The initial social assessment observed that the construction of wind power plants in the recommended locations would not lead to any physical or economic displacement of the present inhabitants in the WPBs because they excluded human settlements and their livelihood activities.

The patches of land recommended remain either vacant or covered with scrubs and belong to the state, the Catholic church, private businessmen and absentee landlords who live outside the WPBs or the district. Wind developers may negotiate with the respective owners to either purchase or lease the land without moving into involuntary land acquisition.

24. However, consultations and conducted focus group discussions with men and women in different communities located within the ten WPBs raised several issues related to the proposed wind parks as well as a demand for more information. The issues raised by community members evolved around wind plant technology, possible impacts on livelihoods, possible disturbances to community life, benefits to communities, community participation, and issues related to land, project implementing agencies and the communities' right to raise objections. A number of proposals and suggestions for further dialogue and information sharing were also presented by community members.

25. The initial social assessment did not lead to an assessment of resettlement and safeguards related issues as the exact locations for WPBs have not been determined at the time of conducting the assessment. The Master Plan for Wind Power Development in the Mannar district at the conclusion of its design in February 2014 earmarked boundaries of WPDZ, which encompasses four Wind Parks and fifteen Blocks (see Figure 1). However, the technical and engineering designs for the wind plants are yet to be developed.

26. A Social Safeguards Review should be commissioned by CEB as soon as the technical and engineering designs are in place and prior to project implementation with the objective of preparing a Resettlement Plan that addresses the following aspects:

- (a) An assessment of any land acquisitions and physical displacement of local communities;
- (b) An assessment of any economic displacements, either permanent or temporary;
- (c) An assessment of any restrictions to common property resources such as the fish landing sites, access roads to the beach, fisher camps, cattle grazing grounds and areas under palmyrah stands;
- (d) An assessment of any adverse impacts on indigenous populations;
- (e) A review of any alternate options considered to avoid or minimize adverse social and environmental impacts;
- (f) Safeguards to avoid, mitigate or minimize adverse impacts such as disturbances to community life, security and personal safety of local communities, particularly women and children;
- (g) An entitlement matrix and a budget that provides compensation at replacement cost to the affected persons and their income restoration;
- (h) A strategy to share project benefits with local communities;
- (i) A grievance redress mechanism;
- (j) Consultations with affected persons, general public and other stakeholders for information disclosure and consultation on proposed project design, eligibility criteria of affected households, and the safeguard measures to secure the rights and entitlements of the affected persons;
- (k) An institutional framework and a time frame for the implementation of the Resettlement Plan; and
- (l) A monitoring plan.

E. Environmental Assessment of Wind Park Blocks in Mannar District

27. An initial environmental assessment has been carried out in the blocks of land demarcated for the development of the proposed wind parks in the Mannar island and part of the mainland in the Mannar district. The objective of the study was to document the type of natural and man modified habitats, species composition and their distribution within the blocks of land. This provided baseline information on habitat types, species composition and conservation status of species, environmentally sensitive areas within the blocks, to address the environmental impacts and risks associated with the proposed wind park project interventions and integration of environmental considerations into the project decision making process.

28. Floristically the Mannar island and the mainland belongs to the 'Coastal and Marine belt' and 'Dry and Arid Lowlands' floristic regions of the country. The typical natural climax vegetation types found in these zones are marine, mangroves, salt marsh, sand dunes, strand vegetation and tropical dry-mixed evergreen forests (*Manilkara* and mixed community) tropical thorn forest, and scrublands.

29. Agro-ecologically this area classified as DL 3 and DL 4- low country dry zone with flat and slightly undulating terrain, and Red Yellow Latosol, Regosol, Grumusols, Solodized- Solonetz, and Solonchaks soils, as the typical soil types. The land use includes coconut plantations, stands of naturally occurring Thal (*Borassus flabellifer*) trees, home gardens and natural vegetation types such as shore vegetation, mangroves, salt marshes, and scrublands. Average annual rainfall is less than 1000 mm and average annual temperature is more than 27.5°C. The main habitat types can be recognized in Mannar are sea shore vegetation, thorn scrubland habitat, mangroves, salt marshes, and mud flats.

30. A total of 107 plant species, including two endemics, were recorded from the scrublands, mangroves, salt marshes and sea shore vegetation during the field survey carried out in 10 WPBs. Hundred plant species are indigenous to the area and five are exotics. All recorded flora species are not unique or restricted to the project area. Threatened plant species belonging to critically endangered (CR), endangered (EN) or vulnerable (VU) categories listed in the National Red List 2012 of Sri Lanka were not recorded from any of the WPBs in the Mannar district.

31. The Mannar island and the adjacent areas in the mainland are home to a considerably rich fauna, especially birds. Its various coastal habitats including the lagoons, mud flats and salt marshes are highly important as feeding grounds for many migrant birds that visit Sri Lanka during the winter migratory period. As the island is located in the migratory path of these birds it has an additional importance for them. The dry grass lands in the coastal areas are the home for one of Sri Lanka's critically endangered birds, Indian Courser (*Cursorius coromandelicus*). Mannar is also a home to the breeding resident birds usually restricted to the northern region of the country. Some of these species are Black Kite (*Milvus migrans*), Grey Francolin (*Francolinus pondicerianus*), Eurasian Collared Dove (*Streptopelia decaocto*), Long-tailed Shrike (*Lanius scach*), Spot-billed Duck (*Anas poecilorhyncha*) and Crab Plover (*Dromas ardeola*). Most of them are only found in the semi-arid zone of the north-western coastal line in which Mannar is also located. It also provides habitats for some migratory birds especially waders and ducks, which do not migrate to others areas of the country. The small sandy islands around the island of Mannar are the only location in Sri Lanka that sea birds like Sooty Tern (*Onychoprion fuscatus*) and Bridled Tern (*Onychoprion anaethetus*).

32. A reconnaissance survey was carried out to identify major habitats/vegetation formations in WPBs. A rapid survey was carried out in order to prepare a species inventory, to identify

possible environmental impacts due to the proposed future activities. This survey included the assessment of accessible field sampling points (FSP) within blocks to record the structure, physiognomy, dominant plant species and vegetation. Global Positioning System coordinates and digital photographs were taken to show the location and habitats of the field sampling point.

33. The suitable site for the wind park in Block 1 would be the area up to 1 kilometer (km) from the coast parallel to the coastline of 6.5 km. The coastal scrublands are found about 60 meters (m) from the beach along the entire block. These scrublands show a dense canopy and a very few Palmyra trees. Open scrublands without many Palmyra trees are found further inland within the 1 km belt from the coast. Therefore, the removal of Palmyra trees for the development purposes would be minimum along 1 km stretch from the coast in the entire block. The western part of Block 1 close to the sea is having environmentally sensitive habitats such as mangroves, salt marshes and mud flats. This area and archaeological sites would not be identified for the proposed development.

34. In Block 2 area up to 800 m to 1 km from the coast parallel to the coastline of 3.6 km would be suitable for wind parks. The coastal scrublands are found along the entire block close to the beach. The shrubs could be removed for the construction purposes leaving the Palmyra trees. Therefore, the removal of Palmyra trees would be minimum along the 800 m to 1 km stretch from the coast in the entire block. Environmentally sensitive habitats and archaeological sites are not found in this block.

35. The suitable site for the wind park in Block 3 would be the area up to 800 m to 1 km from the coast parallel to the coastline of 3.6 km. The coastal scrublands are found along the entire block close to the beach. Open scrublands without Palmyra trees are found towards inland. The shrubs could be removed for the construction purposes leaving the Palmyra trees. Environmentally sensitive habitats and archaeological sites are not found in this block. The existing road to Nadukuda would be an advantage to establish new access roads along the coast to the wind park sites in the east and west of the block extending towards Block 2.

36. The species composition in shore vegetation, open scrublands, coastal scrublands and Palmyra stands is similar to the habitats found in Blocks 1, 2 and 3. The suitable site for the wind park in Block 4 would be the area up to 1.5 km from the coast parallel to the coastline of 3.5 km. The coastal scrublands are found along the entire block. Open scrublands in Block 4 could be selected for the proposed wind power development. Environmentally sensitive habitats and archaeological sites are not found. The scrublands along the existing road to Periakarisal could be selected to establish wind farms. Also, the coastal belt beyond a new tourist hotel site towards the western part of the block could be identified for the new development.

37. The suitable site for the wind farm in Block 5 would be the area up to 1 km from the coast parallel to the coastline. The coastal scrublands are found along the entire block. Also, areas with open scrublands along the existing road to Erukkalampiddy could be selected for the proposed wind power development. Also, the coastal belt beyond Navy camp towards the western part of the block could be identified for the new development. Environmentally sensitive habitats and archaeological sites are not found in Block 5.

38. The only habitat type found in Block 6 is natural scrubland with Palmyra trees. This block will not reach the coastline, and therefore sea shore vegetation and coastal scrublands are absent. The southern boundary of the block is along A 14 road and the northern boundary is 0.5 to 1 km from the coastline. The density of vegetation is low towards inland, more open areas are found within the block compared to the other blocks demarcated in the island. The western corner

of the block is outside the Thalaimannar pier east village area. In Upputharavai area the vegetation cover is dense (Palmyra stands and scrublands) close to the coastline, which is outside the block. Clearing of scrublands, removal of Palmyra trees for the site preparation is minimal. Therefore, anticipated environmental and/or ecological impacts on natural environment are very low. Environmentally sensitive habitats and archaeological sites are not found in Block 6.

39. The landscape of Block 7 is dominated by coconut plantations in Erukkalampiddy west, north, east and coastal scrublands along the northern boundary of the block from Periakarisal to Usimukkanthurai. In addition, the habitats such as Palmyra stands, home gardens, sea shore vegetation, mangroves, salt marshes and mudflats are found towards the eastern tip of the block. Mangroves and salt marsh vegetation is found in the last 2 km of the tip, which adjoins the Vedithalativu-Thondaveli Sanctuary proposed by the Department of Wildlife Conservation. The southern boundary of Block 7, Erukkalampiddy south and central, adjoins the lagoon and this area would be a boundary of the proposed sanctuary. Therefore, a limited area is available for a wind park in the southern coastline of the block. The coastal scrublands in northern coastline from Periyakaraisal, Narapadu navy point towards the eastern tip of the block, Usimukkanthurai, about 11.5 km, would be available for development of wind parks.

40. Block 8 is situated in the mainland and its northern boundary is about 1 km south of Vankalai sanctuary. The length of the block is about 7.5 km along the coastline. The width is about 1.5 km towards inland. The habitats such as *Prosopis* dominated scrublands, mangroves, salt marshes and mud flats are found in the block. *Prosopis* scrublands are common between the main road to Nanandan and mangrove habitat. Lagoons, mangroves, salt marshes and mudflats are found towards the coast. The southern part of the block, Achchankulam consists of lagoons associated with Aravi Aru. Therefore, the suitable land for wind park would be the scrublands area dominated by *Prosopis*. Ecologically sensitive habitats such as lagoons, mangroves, salt marshes and mudflats occupy most of the block. The rest of the area is paddy fields and homesteads in Naruvilikulam. Therefore, available land for the wind park is limited compared to the WPBs in the Mannar island.

41. A network of lagoons associated with Aruvi aru river is found within the first 2.5 km from northern boundary of Block 9, between Achchankulam and Arippu. The natural habitats such as scrublands, and mangroves are found in the northern part of the block. The southern part consists of newly built housing schemes, paddy fields, villages such as Pandaraveli and Methaveli. A protected monument 'Doric House' ruins of the House of the first British Governor of Ceylon, Frederic North, and an old light house is situated adjoining the beach between Arippu and Silavathurai. As in Block 8, suitable lands for the wind parks are limited due to the ecologically sensitive areas and rapid development of the rest of the land in the block.

42. This is the extension of eastern boundary of Block 6 towards Pesalai by about 3-4 km between the Talaimannar road (A14) and the coastline. About 90% of the area is occupied by scrublands and Palmyra stands, except the area used for a housing scheme at Vettimukkalkudiyiruppu village situated about 0.5 km from the coast (4 km west of Pesalai). The landscape of the block is very much similar to Block 6. Clearing of scrublands and removal of Palmyra trees would not be required due to large areas without vegetation available in the block. Thus, anticipated adverse environmental or ecological impacts on natural environment are low.

43. Once the proposed locations of individual wind turbines are finalized within the wind park blocks, a survey on critical habitats and planning for biodiversity offsetting need to be carried out as required by ADB's Safeguard Policy Statement, 2009.