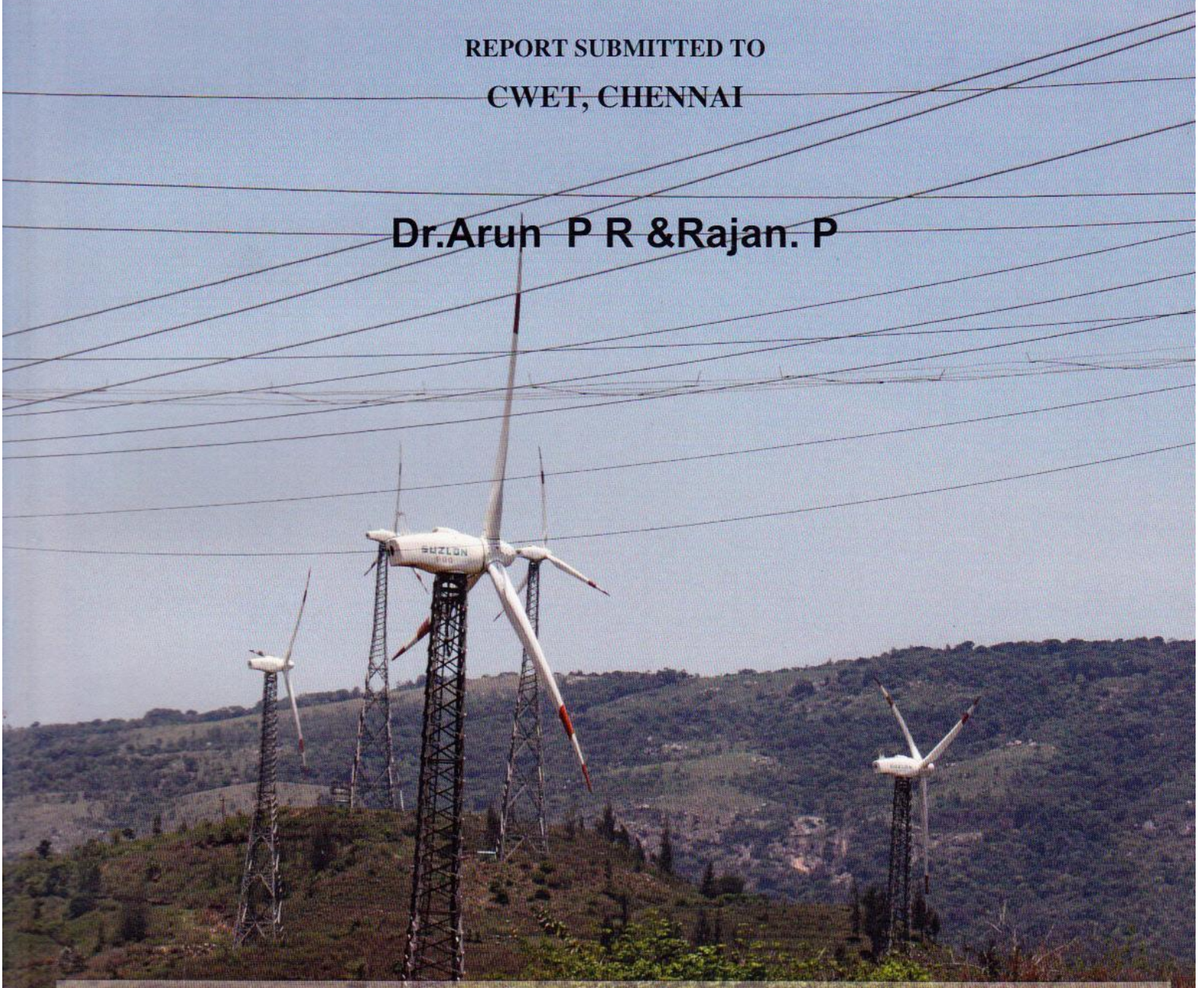
STUDY ON THE POTENTIAL ENVIRONMENTAL IMPACTS OF WIND FARM DEVELOPMENT IN AGALI, ATTAPPADI, KOTTATHARA AND NALLASINGAM AREAS OF PALAKKAD DISTRICT, KERALA

REPORT SUBMITTED TO

CWET, CHENNAI

Dr.Arun P R &Rajan. P



Sálim Ali Centre for Ornithology and Natural History (SACON)
Anaikatty, Coimbatore-641 108

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Contents

1 INTRODUCTION....1
2 ENVIRONMENTAL CONCERNS: A REVIEW....4
3 BACKGROUND....5
4 STUDY AREA....6
5 METHODS....8
6 RESULTS....9
6.1 Possible impacts on landscape and vegetation....10
7 CONCLUSION....11
8 BIBLIOGRAPHY....19

Figure 1. Installed capacity of Indian Power sectors as on 30-06-2012 2

Figure 2Renewable energy Scenario in India as on January 31, 2011 3

Figure 3. Location of the proposed area for the turbines.... 7

Figure 4. Closer view of the major locations proposed for the turbines (marked in red). 7

Figure 5. Natural vegetation types of Attapadi. Palakkad.... 8

Figure 6. Ficus trees in fruiting seen at some parts of the proposed turbine locations..10

Figure 7. Landscape and topography changes as seen around existing turbines....11

1 INTRODUCTION

The energy of blowing wind is an important source of renewable energy with significant potential in most parts of the world. The mounting costs and negative environmental impacts involved in the energy generation using conventional fuels (McLeish 2002) has made the wind energy a preferred important and fastest growing sector of the global energy industry (Pasqualetti*et al*. 2004). The conventional methods of power generation are known to cause varying degrees of negative environmental effects. Nuclear power plants causes thermal pollution in water-bodies and causes concern over radioactive waste disposal and its inherent risk potential for devastating impacts on environment in the events of leaks, accidents and natural calamities. Large hydro-electric facilities disrupt aquatic ecosystems and often submerge large areas of land, causing notable environmental concerns, including significant habitat loss for wild species and loss of agricultural lands apart from risks and safety concerns of the downstream areas of large dams. Meanwhile, the adverse effects of coal-fired Thermal power plants have caused the most concern among environmentalists, regulators and the general public. Coal's contribution to greenhouse gas emissions and air pollution has fuelled the need for increasingly explore non-conventional alternative sources for energy generation. Climate change can have major impacts on natural habitats, and the birds that are dependent upon them.

Around 8% of the total power generation in the country is contributed by renewable sector (Figure 1). Wind-generated electricity is renewable and generally considered environmentally clean, and recent technological advances and tax subsidies have made wind generation to compete with energy produced from fossil fuels and nuclear power (Gipe 1995; Redlinger *et al*. 2002). Harnessing wind energy is an affordable means of power generation that is pollution-free with relatively less-known environmental impacts. These advantages have led to a dramatic increase in its popularity in recent years and have resulted in the proliferation of wind farms around the world (Osborn *et al*. 2000).

In India, several wind farms are already operational and more are under development in those areas with wind resource is plentiful. Often, suitable areas occur in the offshore and coastal areas as well as along ridges and mountains in open agricultural areas and other open habitats. Unfortunately, many of these areas contain sensitive habitats especially for the avifauna, that could be under direct and indirect threats from the wind turbines, Hence it is important to duly evaluate the locations from the environmental point of view, before siting the wind energy projects.

The development of wind power in India began in the 1990s, and has significantly increased in the recent years. The worldwide installed capacity of wind power reached 197 GW by the end of 2010. China (44,733MW), US (40,180 MW), Germany (27,215 MW) and Spain (20,676 MW) are ahead of India, which is in fifth position. Wind power alone accounts for 6% of India's total installed power capacity, and is the major player in the country's renewable energy sector (Figure 1 & 2).

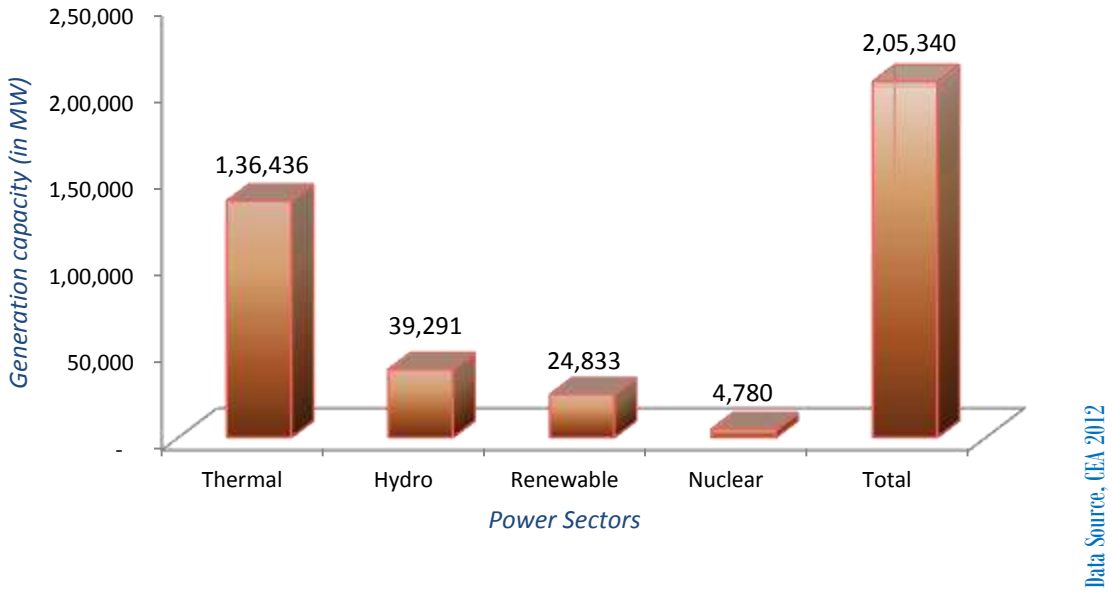

Figure 1. Installed capacity of Indian Power sectors as on 30-06-2012

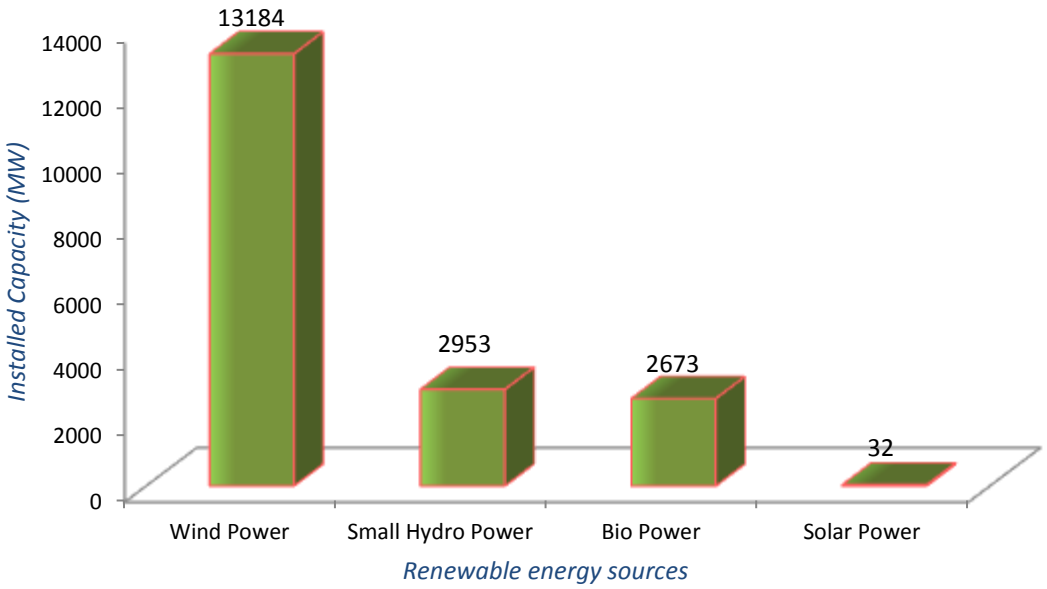

Figure 2Renewable energy Scenario in India as on January 31, 2011

2 Environmental Concerns: A review

The development of wind-energy is not without its share of impacts on the environment. Considering the current pace and scale of wind power development proposals, combined with the lack of understanding of their environmental impacts, it is often a cause for concern. Of late, concerns have been raised by the public and regulators regarding the potential environmental impact of these facilities and in particular their potential cost of Wind power sector on birds. This issue first became apparent in the late 1980s when birds of prey, especially Red-tailed Hawks, American Kestrels and Golden Eagles were first noticed to be killed by wind turbines and their associated power lines at Altamont Pass and Tehachapi Pass, in California. The high numbers of raptors killed at these sites have proven to be more of an anomaly than a typical situation. Nevertheless, these well-known examples continue to spark concerns among the public and other organizations and, more than anything else, have generated widespread fears that turbines are invariably fatal to birds.

Bird fatalities caused by human-made infrastructures (power lines, communication towers, wind turbines) are widely reported from around the world (Erickson *et al*. 2005; Manville 2009). Wind farms affect birds mainly through collision with turbines and associated power lines (Drewitt & Langston 2006; Lekuona & Ursua 2007; Thelander & Smallwood, 2007) or disturbance displacement (Drewitt & Langston, 2006). Observed impacts vary geographically due to varying topography, habitat, weather conditions, flyways, species diversity and species abundance (GAO 2005). Some recent studies suggest insignificant threats to wildlife from commercial wind-generated electricity relative to other anthropogenic structures (such as buildings and automobiles) and energy sources (NRC 2007; Sovacool 2009). However, potential cumulative impacts of current and future wind developments remain largely unknown. Considering that the number of wind turbines has more than doubled since 2005, and is expected to continue to increase in future years (WWEA 2009), there are concerns on environmental impacts, especially on birds, bats and their habitats.

Bird fatalities associated with wind turbines are more significant when endangered or protected species of higher conservation priorities are involved, due to their small,

fragmented and isolated populations. With a few important exceptions from Europe and America, studies so far has shown low numbers of bird fatalities at wind energy facilities elsewhere (Osborn et al. 2000; Erickson et al. 2001; Jain 2005). The impact of wind farms on birds and bats from the Indian context is very less studied with very little scientific literature available on this topic(Kumar *et al*. 2012). The observed mortality caused by wind energy facilities is regarded very low compared to other existing sources of human-caused avian mortality. Based on 15,000 American wind turbines in operation, and a mortality of 2.19 birds per turbine per year, Erickson *et al.* (2001) estimated that 33,000 birds are killed each year by wind turbines in the U.S.A.

While bats are able to detect the relatively slow and gradual pressure changes caused by approaching storms etc, they are reportedly unable to detect the sudden drops in pressure caused by a wind turbine. These sudden pressure changes can cause rapid expansion of the lungs of the bats leading to bursting of the fine capillaries in their lungs, and ultimately causing their death. This phenomenon is known as 'barotrauma' (Handwerk 2008). Several studies have reported negative impacts of wind turbines on bats. Bat fatalities at wind turbines were an unanticipated and unprecedented phenomenon. The most important problems are bat collision, *barotrauma*, loss of foraging habitat, barrier effect of commuting routes and emission of ultrasound by wind turbines. Wind turbines cause local changes in air pressure.

Earlier wind farm studies found that, in comparison to birds, bat collisions with wind towers appeared to be rare (Orloff & Flannery 1992; Howell 1997).The first reported mortality of bat species occurred at early generation wind turbines in Australia. Hall & Richards (1972) reported 22 White-striped Mastiff Bat *Tadarida australis* mortalities over a four-year studyperiod. Interest in impacts of wind energy development on bat species has increased in recent years (Arnett 2006; Fiedler *et al*. 2007).

3 Background

The present rapid study of one month duration was taken up by SACON for Centre for Wind Energy Technology (CWET), Chennai to look into the environmental impacts of the proposed wind farm development in Agali, Attappadi, Kottathara and Nallasingam

areas of Palakkad district, Kerala by NHPC as a part of the DPR. The scope of the present study was a rapid assessment of the impact potential on Birds, Bats and other aspects of Biodiversity if any from the proposed wind power project primarily from the available secondary information.

4 Study area

The proposed locations are situated in the Attappady region of Palakkad District among the Western Ghats. Attappadi area lies in the foothills of Nilgiris in the Mannarghat Forest Division of Kerala in the Western Ghats. Attappadi Reserve Forest is about 249 sq.km covering western-most part of the approximately 745 km^2 in Attappadi Block of Mannarkkad Taluka of Palakkad district of Kerala. The area has been cleared of natural vegetation in the past and mostly has settlements and cultivation on the hills.

The area is important in being close to the 'Palghat Gap', the only major discontinuity in the 1600 km long Western Ghats mountain range that is well known as one among the biodiversity hotspots of the world and harbour about 30% of the India's biodiversity (Rodgers and Panwar, 1988).

Attappadi is an extensive mountain valley and it is bordered in east by Coimbatore district, on the North by The Nilgiris, south by the Palghat taluk and on the west by Karimba-I and II, Pottassery-I and II, and Mannarghat revenue villages of Mannarghat taluk of Palghat District and Ernad taluk of Malappuram district. Also, Attappadi is an informal buffer zone adjoining the Silent valley National Park to the west.

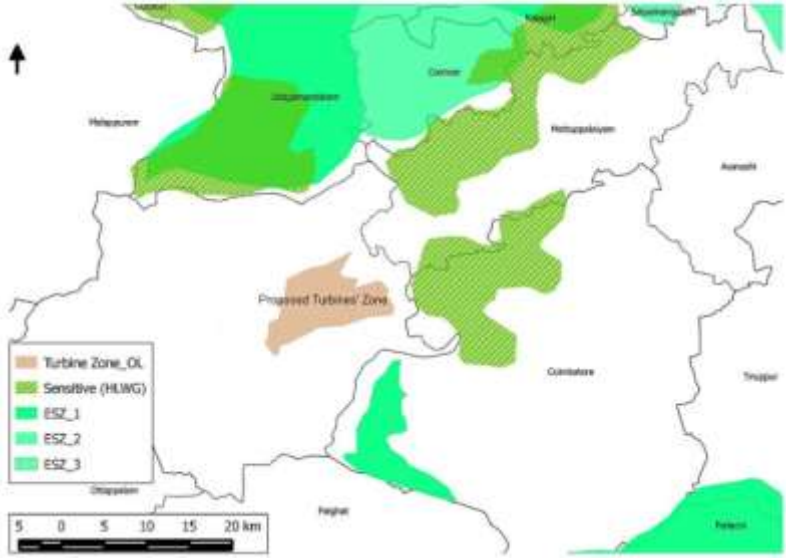

Figure 3. Location of the proposed area for the turbines
(Approximate location of Major proposed Eco sensitive (ESZ) areas of Western Ghats of Tamilnadu according to Gadgil & Kasturirangan reports are also shown as shaded areas).

Figure 4. Closer view of the major locations proposed for the turbines (marked in red)

Elevation ranges from 750 m to 1664 mat Malleswarm peak. The Bhavani river flows from the Northwest around the mountain. Attappadi Reserve Forest receives a high rainfall of 4700 mm moving eastward towards Agali the rainfall steadily decreases to a low of 900 mm. The vegetation of the study site was covered with varieties of natural

vegetation patches such as Shola forest, Evergreen forest, Semi-evergreen forest, Moist deciduous forest, Dry deciduous forest and Grassland. Majority of the places covered with Dry deciduous forest. However the proposed area for windmill area covered mainly with Evergreen, Moist Deciduous, Dry Deciduous, Grasslands and Shola forests.

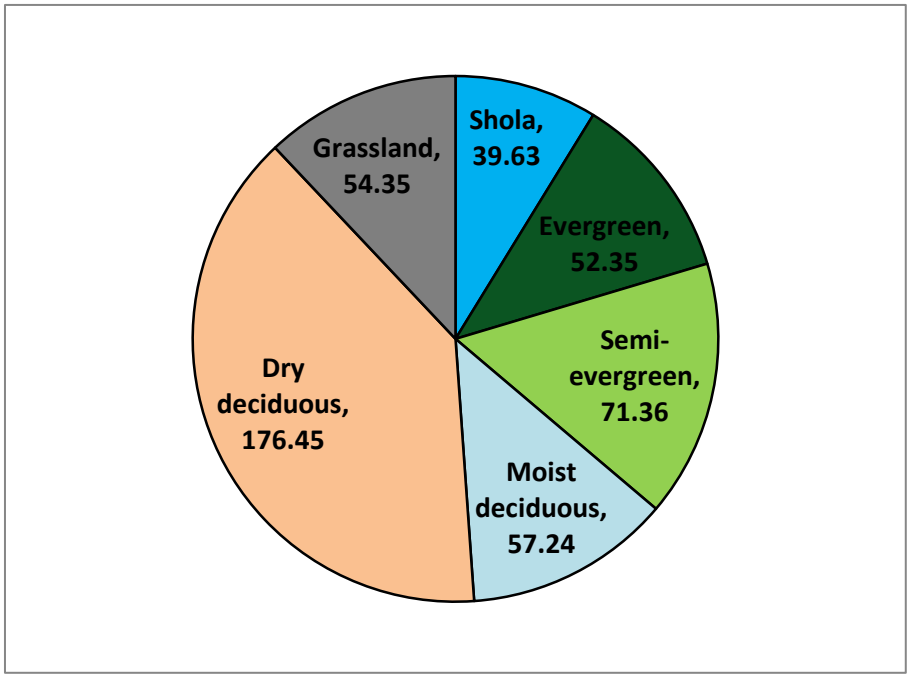

Figure 5. Natural vegetation types of Attapadi. Palakkad

(Source: Vijayan et al. 2008)

The broad location of the wind turbines being proposed in Agali, Attappadi, Kottathara and Nallasingam areas of Palakkad District is given in the Figure 3 & 4.

There are operational turbines already existing in the area.

5 Methods

A rapid survey of the proposed turbine sites of the Agali, Attappadi, Kottathara and Nallasingam areas of Palakkad district, Kerala was conducted along with CWET. This report is mainly based on available secondary information. Systematic primary data was not collected because of the short duration (one month) of this project. But

investigation surveys were conducted and opportunistic observations were recorded. In the past, SACON has worked in these areas. The "Biodiversity assessment of Attappadi" is a significant work (Vijayan. *et al*. 2008). However, many of the available works from this region consist of "grey literature", reports and other pieces of work that are not peer reviewed publications. The cited reports have been critically examined and used to make compiled list of species of the study site.

Compilation of available scientific information relevant to the present study has been done. One of the main areas of concern is the potential impact of wind farms on birds and bats. The Avifaunal information compiled is given in the Appendix 1. Potential avifaunal impact from collision mortality, displacement, barrier and deterrent effects and direct habitat loss from the farms will have to be evaluated case by case in detail may be at later stage by an year round study.

6 Results

The impact of wind turbines on birds and bats has been studied widely and showed evidence of bat and birds deaths from collisions with wind turbines and due to changes in air pressure around the rotating turbines as well as from habitat loss due to windmill construction work. In each windmill construction work, there are many secondary associated sources of impacts such as road construction, power evacuation lines, transformer placing, etc.

The Bird collision is mostly seasonal. Local as well as migratory birds are can get impacted due to their daily movements around the turbines. In Attappady area, there are many fruiting plants especially *Ficus spp* available. These fruiting trees attract birds from neighboring places. These movements also can cause the bird collision at wind turbines, hence locations close to such areas may be avoided while siting the turbines.

Figure 6. Ficus trees in fruiting seen at some parts of the proposed turbine locations (May cause an increased risk of bird movements in some of the turbine sites).

A total of about 152 species of birds were reported so far from Attappadi Hills which includes 15 endemic species out of 24 in Western Ghats (Vijayan *et al*.2008). According to Vijayan et al., (2008) Sholayoor areas have more bird diversity as compared to the Agali and Kottathara due to presence of intensive evergreen patches in Sholayoor area. Forest patches of Sholayoor area have more priority for conservation. Attappadi is considered as an informal buffer zone bordering the Silent valley National Park and chances of wildlife movements will be high due to patchily distributed forest around Attappadi. Nilgiri Wood-Pigeon *Columba elphinstonii* is a Vulnerable species globally threatened species reported from this area (sholayoor) importance to the area.

According to Drewitt and Langston (2006), the four main effects of windmills are collision, displacement due to disturbance, barrier effects and habitat loss. Collision risk depends on the bird species, numbers and behaviour, weather conditions and topography of the area. Research shows that, there are many impacts on windmill on bird populations such as bird mortality, changes in migration route, avoidance of bird activities from windmill area (Drewitt and Langston 2006).

6.1 Possible impacts on landscape and vegetation

Landscape changes are expected during the wind farm development. The impact would vary depending on the terrain and number of windmills. All wind mills in the proposed study site of Attappadi area are on undulating terrain. The scale of habitat destruction depend on the characteristics of the landscape and vegetation cover. Road construction, turbine construction, installation of electrical substations transmission lines, etc will be

changing the topography of the wind farm site. The roads required to establish connectivity among the turbine sites would cause notable environmental impacts. This could be minimized by avoiding natural vegetation and minimizing the length of the roads through proper holistic planning including existing turbines and connecting roads as well.

Figure 7. Landscape and topography changes as seen around existing turbines

There are existing operational turbines existing in these areas which are also being considered for evaluating the impacts if any in the local context. The compilation of this information is also under way to better understand and suggest management strategies if required for the proposed turbines. The detailed Map of the area with distance to closest sensitive areas such as protected areas is also under preparation.

7 Conclusion

Currently, the available information may not be sufficient enough to conclude on the exact magnitude and nature of impacts of wind farm on wildlife, however, the proposed areas of Agali, Attappadi, Kottathara and Nallasingam of Palakkad District are mostly revenue/ agricultural lands with no sensitive flora/ fauna/ wildlife habitat of conservation importance involved, only minimal impact is expected from the proposed project.

Although there are some reports (Telegraph 2014) there is very little information available on the bat collision with wind turbine and bat mortality from India. There are also apprehensions that the ultrasonic sound from the moving blades of wind turbines can interfere with movement of eco-locating bats. Preliminary results

from the SACON's ongoing research in Gujarat and Karnataka had indicated that there is no significant risk to the avifauna from the collision with wind turbines. However, wind power being a relatively new and emerging sector of power generation, long-term scientific studies to address the lacunae in our current scientific knowledge regarding the impact of wind farms on the environment are required for better management of the wind power sector in the future.

Appendix 1: List of birds reported from the area

Sl No.	Common Name	Scientific Name	Family	IUCN Status
1	Grey Francolin	*Francolinus pondicerianus*	Phasianidae	LC
2	Jungle Bush-quail	*Perdicula asiatica*	Phasianidae	LC
3	Red Spurfowl	*Galloperdix spadicea*	Phasianidae	LC
4	Grey Junglefowl	*Gallus sonneratii*	Phasianidae	LC
5	Indian Peafowl	*Pavo cristatus*	Phasianidae	LC
6	Little Grebe	*Tachybaptus ruficollis*	Podicipedidae	LC
7	Indian Pond-heron	*Ardeola grayii*	Ardeidae	LC
8	Cattle Egret	*Bubulcus ibis*	Ardeidae	LC
9	Little Egret	*Egretta garzetta*	Ardeidae	LC
10	Little Cormorant	*Phalacrocorax niger*	Phalacrocoracidae	LC
11	Common Kestrel	*Falco tinnunculus*	Falconidae	LC
12	Black-winged Kite	*Elanus caeruleus*	Accipitridae	LC
13	Black Kite	*Milvus migrans*	Accipitridae	LC
14	Brahminy Kite	*Haliastur indus*	Accipitridae	LC
15	Crested Serpent-eagle	*Spilornis cheela*	Accipitridae	LC
16	Montagu's Harrier	*Circus pygargus*	Accipitridae	LC
17	Shikra	*Accipiter badius*	Accipitridae	LC
18	Black Eagle	*Ictinaetus malayensis*	Accipitridae	LC
19	White-breasted Waterhen	*Amaurornis phoenicurus*	Rallidae	LC
20	Red-wattled Lapwing	*Vanellus indicus*	Charadriidae	LC
21	Rock Pigeon	*Columba livia*	Columbidae	LC
22	Laughing Dove	*Stigmatopelia senegalensis*	Columbidae	LC
23	Spotted Dove	*Stigmatopelia chinensis*	Columbidae	LC
24	Nilgiri Wood-pigeon	*Columba elphinstonii*	Columbidae	VU
25	Eurasian Collared-dove	*Streptopelia decaocto*	Columbidae	LC
26	Emerald Dove	*Chalcophaps indica*	Columbidae	LC
27	Pompadour Green-pigeon	*Treron pompadora*	Columbidae	LC
28	Yellow-footed Green-pigeon	*Treron phoenicopterus*	Columbidae	LC
29	Mountain Imperial-pigeon	*Ducula badia*	Columbidae	LC
30	Vernal Hanging-parrot	*Loriculus vernalis*	Psittacidae	LC

Sl No.	Common Name	Scientific Name	Family	IUCN Status
31	Rose-ringed Parakeet	*Psittacula krameri*	Psittacidae	LC
32	Plum-headed Parakeet	*Psittacula cyanocephala*	Psittacidae	LC
33	Malabar Parakeet	*Psittacula columboides*	Psittacidae	LC
34	Pied Cuckoo	*Clamator jacobinus*	Cuculidae	LC
35	Asian Koel	*Eudynamys scolopaceus*	Cuculidae	LC
36	Sirkeer Malkoha	*Phaenicophaeus leschenaultii*	Cuculidae	LC
37	Common Hawk-cuckoo	*Cuculus varius*	Cuculidae	LC
38	Blue-faced Malkoha	*Phaenicophaeus viridirostris*	Cuculidae	LC
39	Greater Coucal	*Centropus sinensis*	Cuculidae	LC
40	Oriental Scops-owl	*Otus sunia*	Strigidae	LC
41	Brown Fish-owl	*Ketupa zeylonensis*	Strigidae	LC
42	Spotted Owlet	*Athene brama*	Strigidae	LC
43	Grey Nightjar	*Caprimulgus indicus*	Caprimulgidae	LC
44	Indian Nightjar	*Caprimulgus asiaticus*	Caprimulgidae	LC
45	Little Swift	*Apus affinis*	Apodidae	LC
46	Malabar Trogon	*Harpactes fasciatus*	Trogonidae	LC
47	Indian Roller	*Coracias benghalensis*	Coraciidae	LC
48	White-throated Kingfisher	*Halcyon smyrnensis*	Alcedinidae	LC
49	Pied Kingfisher	*Ceryle rudis*	Alcedinidae	LC
50	Little Green Bee-eater	*Merops orientalis*	Meropidae	LC
51	Chestnut-headed Bee-eater	*Merops leschenaulti*	Meropidae	LC
52	Eurasian Hoopoe	*Upupa epops*	Upupidae	LC
53	Malabar Grey Hornbill	*Ocyceros griseus*	Bucerotidae	LC
54	Brown-headed Barbet	*Megalaima zeylanica*	Ramphastidae	LC
55	White-cheeked Barbet	*Megalaima viridis*	Ramphastidae	LC
56	Crimson-fronted Barbet	*Megalaima rubricapillus*	Ramphastidae	LC
57	Speckled Piculet	*Picumnus innominatus*	Picidae	LC
58	Brown-capped Woodpecker	*Dendrocopos nanus*	Picidae	LC
59	White-bellied Woodpecker	*Dryocopus javensis*	Picidae	LC
60	Yellow-crowned Woodpecker	*Dendrocopos mahrattensis*	Picidae	LC

Sl No.	Common Name	Scientific Name	Family	IUCN Status
61	Common Flameback	*Dinopium javanense*	Picidae	LC
62	Black-rumped Flameback	*Dinopium benghalense*	Picidae	LC
63	Rufous Woodpecker	*Celeus brachyurus*	Picidae	LC
64	Heart-spotted Woodpecker	*Hemicircus canente*	Picidae	LC
65	Indian Pitta	*Pitta brachyura*	Pittidae	LC
66	Common Iora	*Aegithina tiphia*	Aegithinidae	LC
67	Rosy Minivet	*Pericrocotus roseus*	Campephagidae	LC
68	Scarlet Minivet	*Pericrocotus flammeus*	Campephagidae	LC
69	Bar-winged Flycatcher-shrike	*Hemipus picatus*	Campephagidae	LC
70	Bay-backed Shrike	*Lanius vittatus*	Laniidae	LC
71	Long-tailed Shrike	*Lanius schach*	Laniidae	LC
72	Great Grey Shrike	*Lanius excubitor*	Laniidae	LC
73	Eurasian Golden Oriole	*Oriolus oriolus*	Oriolidae	LC
74	Black-naped Oriole	*Oriolus chinensis*	Oriolidae	LC
75	Fork-tailed Drongo	*Dicrurus adsimilis*	Dicruridae	LC
76	Ashy Drongo	*Dicrurus leucophaeus*	Dicruridae	LC
77	White-bellied Drongo	*Dicrurus caerulescens*	Dicruridae	LC
78	Bronzed Drongo	*Dicrurus aeneus*	Dicruridae	LC
79	Greater Racket-tailed Drongo	*Dicrurus paradiseus*	Dicruridae	LC
80	White-browed Fantail	*Rhipidura aureola*	Rhipiduridae	LC
81	Asian Paradise-flycatcher	*Terpsiphone paradisi*	Monarchidae	LC
82	Rufous Treepie	*Dendrocitta vagabunda*	Corvidae	LC
83	White-bellied Treepie	*Dendrocitta leucogastra*	Corvidae	LC
84	House Crow	*Corvus splendens*	Corvidae	LC
85	Large-billed Crow	*Corvus macrorhynchos*	Corvidae	LC
86	Great Tit	*Parus major*	Paridae	LC
87	Red-rumped Swallow	*Hirundo daurica*	Hirundinidae	LC
88	Plain Prinia	*Prinia inornata*	Cisticolidae	LC
89	Black-crested Bulbul	*Pycnonotus melanicterus*	Pycnonotidae	LC
90	Red-whiskered Bulbul	*Pycnonotus jocosus*	Pycnonotidae	LC

Sl No.	Common Name	Scientific Name	Family	IUCN Status
91	Red-vented Bulbul	*Pycnonotus cafer*	Pycnonotidae	LC
92	White-browed Bulbul	*Pycnonotus luteolus*	Pycnonotidae	LC
93	Yellow-browed Bulbul	*Iole indica*	Pycnonotidae	LC
94	Asian Black Bulbul	*Hypsipetes leucocephalus*	Pycnonotidae	LC
95	Common Tailorbird	*Orthotomus sutorius*	Sylviidae	LC
96	Blyth's Reed-warbler	*Acrocephalus dumetorum*	Sylviidae	LC
97	Tickell's Leaf-warbler	*Phylloscopus affinis*	Sylviidae	LC
98	Greenish Warbler	*Phylloscopus trochiloides*	Sylviidae	LC
99	Large-billed Leaf-warbler	*Phylloscopus magnirostris*	Sylviidae	LC
100	Puff-throated Babbler	*Pellorneum ruficeps*	Timaliidae	LC
101	White-browed Scimitar-babbler	*Pomatorhinus schisticeps*	Timaliidae	LC
102	Yellow-eyed Babbler	*Chrysomma sinense*	Timaliidae	LC
103	Common Babbler	*Turdoides caudata*	Timaliidae	LC
104	Rufous Babbler	*Turdoides subrufa*	Timaliidae	LC
105	Jungle Babbler	*Turdoides striata*	Timaliidae	LC
106	Wynaad Laughingthrush	*Garrulax delesserti*	Timaliidae	LC
107	Brown-cheeked Fulvetta	*Alcippe poioicephala*	Timaliidae	LC
108	Oriental White-eye	*Zosterops palpebrosus*	Zosteropidae	LC
109	Asian Fairy-bluebird	*Irena puella*	Irenidae	LC
110	Velvet-fronted Nuthatch	*Sitta frontalis*	Sittidae	LC
111	Hill Myna	*Gracula religiosa*	Sturnidae	LC
112	Common Myna	*Acridotheres tristis*	Sturnidae	LC
113	Jungle Myna	*Acridotheres fuscus*	Sturnidae	LC
114	Brahminy Starling	*Sturnus pagodarum*	Sturnidae	LC
115	Malabar Whistling-thrush	*Myophonus horsfieldii*	Turdidae	LC
116	Oriental Magpie-robin	*Copsychus saularis*	Muscicapidae	LC
117	Indian Robin	*Saxicoloides fulicatus*	Muscicapidae	LC
118	Pied Bushchat	*Saxicola caprata*	Muscicapidae	LC
119	Blue Rock-thrush	*Monticola solitarius*	Muscicapidae	LC
120	Asian Brown Flycatcher	*Muscicapa dauurica*	Muscicapidae	LC

Sl No.	Common Name	Scientific Name	Family	IUCN Status
121	Rusty-tailed Flycatcher	*Muscicapa ruficauda*	Muscicapidae	LC
122	Little Pied Flycatcher	*Ficedula westermanni*	Muscicapidae	LC
123	Slaty-blue Flycatcher	*Ficedula tricolor*	Muscicapidae	LC
124	Black-and-rufous Flycatcher	*Ficedula nigrorufa*	Muscicapidae	NT
125	White-bellied Blue-flycatcher	*Cyornis pallipes*	Muscicapidae	LC
126	Tickell's Blue-flycatcher	*Cyornis tickelliae*	Muscicapidae	LC
127	Grey-headed Canary-flycatcher	*Culicicapa ceylonensis*	Muscicapidae	LC
128	Blue-winged Leafbird	*Chloropsis cochinchinensis*	Chloropseidae	LC
129	Golden-fronted Leafbird	*Chloropsis aurifrons*	Chloropseidae	LC
130	Thick-billed Flowerpecker	*Dicaeum agile*	Dicaeidae	LC
131	Pale-billed Flowerpecker	*Dicaeum erythrorhynchos*	Dicaeidae	LC
132	Plain Flowerpecker	*Dicaeum concolor*	Dicaeidae	LC
133	Purple-rumped Sunbird	*Nectarinia zeylonica*	Nectariniidae	LC
134	Crimson-backed Sunbird	*Nectarinia minima*	Nectariniidae	LC
135	Long-billed Sunbird	*Nectarinia lotenia*	Nectariniidae	LC
136	House Sparrow	*Passer domesticus*	Passeridae	LC
137	White-throated Munia	*Lonchura malabarica*	Estrildidae	LC
138	Scaly-breasted Munia	*Lonchura punctulata*	Estrildidae	LC
139	Paddyfield Pipit	*Anthus rufulus*	Motacillidae	LC
140	Common Rosefinch	*Carpodacus erythrinus*	Fringillidae	LC

Plate I View of existing turbines and some of the birds recorded during the opportunistic observations

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