A comprehensive study of the potential ecological impact of windmill farms on wildlife with special emphasis to avifauna in Karnataka

Final Report

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Sálim Ali Centre for Ornithology and Natural History



A Centre of Excellence under the Ministry of Environment, Forest

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Coimbatore-641108, Tamil Nadu

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EXECUTIVE SUMMARY

Globally, wind power is considered to be a major source of energy for electricity production. Presently, in some countries, the electricity generation from wind power has reached 30 to 40% of their total annual energy production. Although wind energy is considered as clean energy, but installing the windmills and associated activities are noted to have negative impact on the environment. The encompassed biological diversity may be affected, since the wind farms require vast stretches of land and subsequent death of many faunal species upon collisions with rotor blades of windmills. After witnessing collision induced fatality of many birds in some of the countries like Belgium, Netherlands, Spain, and UK, this negative impact was recognized and considered as a crucial issue while selecting the location for a wind farm.

In India, by the March 2018, the total installed capacity of wind power was 34,207 MW in different states, i.e., Tamil Nadu, Gujarat, Maharashtra, Karnataka, Rajasthan, Andhra Pradesh, Madhya Pradesh, Telangana, and Kerala. Karnataka stands at the 4th place in India's wind power generation with an installed capacity of 4,673 MW. The plains of Karnataka (Bijapur, Belgaum, Dharwad, Gadag, Ballary, Chitradurga, Davanagere, Tumkur and Bagalkot Districts) have a high potential for windmill farms, wherein many windmill farms have been already established.

We conducted a study from June 2016 to May 2018 to understand the impact of windmills on birds and mammals with the following objectives 1. To assess the occurrence and abundance of wildlife in and around the selected and proposed windmills, 2. To map the location of existing or proposed windmill farms and to examine the vulnerability of wild animals from the windmills, 3. To study the collision and fatality rate of animals especially the birds, bats, primates and other arboreal species around windmills, 4. To study the impact of windmills on movement pattern, habitat selection and breeding biology of birds and terrestrial fauna especially the Blackbuck, 5. To assess the habitat characteristics of windmills sites, and 6. To suggest preventive and restorative strategies for addressing significant potential impact of proposed and existing windmill farms on wildlife and evolve mitigation measures to minimize the impact.

We selected three windmill sites (Jogimatti, Challkere, and VV Sagar) in Chitradurga district and three windmill sites in Gadag district (Kelur, Papanasi, and Kappadagudda) to study the bird diversity and collision of birds/bats with windmills. We selected two control sites (Jogimatti and VV Sagar) in Chitradurga district having similar habitat strucutre in the same hill system and within a kilometer from the nearest windmills. We selected 15 windmills each at VV Sagar and Jogimatti, 12 windmills at Challkere in Chitradurga district, 15 windmills each at Kappadagudda and Papanasi and 14 windmills at Kelur in Gadag district, and monitored them between September 2016 and October 2017 to estimate the fatality rate and bird diversity. Fixed-radius point count method was followed to estimate the bird abundance and richness both in windmill and control sites (N=15-point count stations each in VV Sagar and Jogimatti control sites). Fortnight surveys were carried out in each point count station. Fatality rate can be calculated by carcass search method in a fixed period of time for each windmill, which accounts the number of bird/bat death by colliding with windmills. Carcass searches were conducted once in a week for 30 minutes per windmill within a predefined distance of 120 m radius from the windmill base. To estimate the fatality rate, an essential component is the mean length of time for which the carcasses remain at the location before being removed by other animals. We conducted carcass removal study at 9, 10 and 5 windmills at VV Sagar, Kelur and Kappadagudda respectively. We calculated the average period for which the carcass remained on the site.

We mapped all the windmills in the state between November 2016 and October 2017. Of the 3127 windmills in 114 windmill sites in 14 districts, the one-time carcass search and point count for bird diversity was done for 1713 windmills.

Since the windmills in Karnataka are located away from the forests of Western Ghats, none of the distribution range of large squirrels and endemic primates overlapped with the windmill sites. However, the sites overlapped with the distribution range of mammal species such as Indian Grey Wolf and antelopes. Thus, we selected Kappadagudda hills to study the occurrence and distribution pattern of mammals by using camera trap technique. The study was conducted between January and May 2018. The study site was overlaid with two square kilometre grid cells, and we selected 69 grid cells of the total 94 grid cells for sampling for mammals. In each grid cells, we placed the five passive infrared camera traps for three days. We collected ecological and anthropogenic variables for each grid cell. We built set of models to find the influence of covariates on occupancy for each select species using their detection history from cameras traps and covariates.

We reviewed the existing literature on flora of the study sites, and prepared the plant species for restoration of the disturbed habitat of windmill sites.

We recorded 208 (196 bird species during the present study +12 bird species compiled from secondary literature) and 189 bird species of birds from Chitradurga (three hill ranges - VV Sagar, Jogimatti and Challkere hills and four wetlands) and Gadag districts respectively (from two hill ranges-Kappadagudda and Kelur, one agriculture fields-Papanasi and four wetlands) which represents nearly 36 - 40% of Karnataka's bird diversity (524 species). The mean abundance of birds in different foraging guild at 'control' and 'windmill sites' represented high abundance of frugivorous, insectivorous and nectarivores at control sites than windmill sites. We recorded 19 and 10 species of diurnal raptors including four globally threatened species (two Endangered and two Near-Threatened) from windmill and control sites respectively. This may be attributed to the habitat heterogeneity, resource availability and the geomorphological features of the hill systems in Chitradurga and Gadag.

The spatial sampling of other windmill sites showed highest bird species richness in Gadag (47 species) and Chitradurga (44 species) districts, followed by Belgaum (42 species), Ballary and Davanagere (33 species). The bird species richness was very low in four districts *viz.*, Tumkur, Raichur, Koppal, and Bagalkot. The bird species diversity in the sampled sites was almost similar, but Gadag (3.124) and Ballary (3.027) district had high diversity value than other districts. The density of birds at windmill sites varied between 2.41 in Bagalkot and 10.83 in Koppal. The maximum bird density was recorded in Koppal district (10.83) followed by Hassan (7.24), Raichur (7.18), and Shimoga (6.59).

A total of 144 and 124 days were spent for carcass searches in Chitradurga and Gadag districts (86 windmills) respectively, and recorded four bird and six bat carcasses. The estimated mean annual bird/bat fatality rate per windmill was 0.23/ windmill/year.

We found 43 carcasses of birds/bats during the carcass search in one-time sampling of 1713 windmills in 14 districts. Of which, nine were of birds and 34 were of bats. Amongst birds, Common Kestrel had the maximum collision (five collisions). In Gadag, we recorded 34 carcasses of Egyptian Free-tailed Bat (*Tadarida aegyptiaca*), and all of them had injured body. Maximum fatalities were recorded during October and February.

Our review suggests that the observed fatality for birds/ bats in the current study was less than Satara in Maharashtra (1.90) and Jhangi in Gujarat (0.38). Globally, the fatality rate estimated for different windmill sites ranged from zero in the cornfield of Friedrich – Wilhelm-Lubke-Koog to 2/windmill/year in Zeebrugge, Belgium. Although, the observed

fatality rate in the windmill sites in the current study is comparatively lower, but cannot be ignored.

One-time bird surveys were conducted at 22 proposed windmill sites. The estimated bird species richness ranged between 7 and 24, and only four sites had \geq 15 species richness. We prepared the profile of existing windmills, forest types, extent of forest, and bird species richness and important birds for each proposed sites that may help while planning the installing of windmills in future.

The camera trapping study at Kappadagudda reveals that at least 17 species of mammals inhabits the hill system. The occupancy of Four-horned Antelopes was relatively more in the new windmill sites than in the old windmill sites. Relative less recordings of Blackbuck, Chinkara and Goledn Jackal both in old and new windmill sites was an important observation for further plan of actions.