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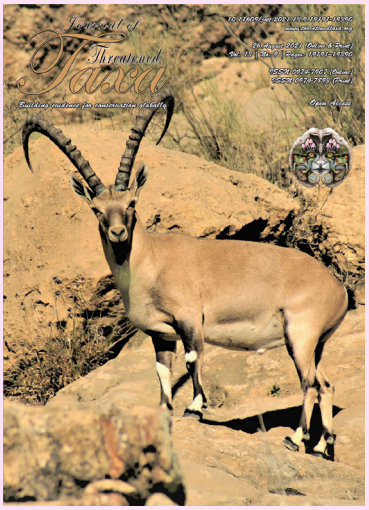

COMMUNICATION

BLACKBUCK *ANTILOPE CERVICAPRA* (MAMMALIA: CETARTIODACTYLA: BOVIDAE) ESTIMATES IN HUMAN-DOMINATED LANDSCAPE IN ALIGARH, UTTAR PRADESH, INDIA

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COMMUNICATION

Blackbuck *Antilope cervicapra* (Mammalia: Cetartiodactyla: Bovidae) estimates in human-dominated landscape in Aligarh, Uttar Pradesh, India

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Abstract: Information on the status of the Indian Blackbuck *Antilope cervicapra* is mostly available from protected areas (PA), although 80% of its population occurs outside PAs. We conducted surveys to assess the status, age structure, sex ratio, and conservation issues of Blackbuck in and around Aligarh between February and June 2014. A median of 672 individuals at 18 separate locations were recorded with a group size ranging 4–216 except for solitary individuals. The abundance of Blackbuck was maximum in Sikandra Rao (range: 154–216) followed by Andla (range: 47–65), and Pala-Sallu (range: 53–62). Sex ratio was skewed towards females (1:4.5) with yearling to female and fawn to female ratio of 7.8:100 and 6.7:100, respectively. The percentage of adult males of Blackbuck (12.8% adult males, 8.4% sub-adult males) as well as adult females (56.4% adult females, 11.9% sub-adult females) was higher than other age classes or groups in the population. The preliminary observations indicate that the increasing population of free-ranging feral dogs, degradation of forest patches, social forestry plantations, competition with livestock, and poaching pressure are the major conservation issues of Blackbuck in the area. The current information is expected to serve as baseline in assessing the population of Blackbuck in the future.

Keywords: Age structure, agricultural fields, conservation issues, grasslands, Indian Blackbuck, plantations, population status, scrublands, sex-ratio, surveys.

सार: भारतीय काला हिरण की आबादी की स्थिति के बारे में जानकारी अधिकतर संरक्षित क्षेत्र (पी. ए.) से उपलब्ध है, यद्यपि इसकी 80 % आबादी पी. ए. क्षेत्र के बाहर पायी जाती है। हमने फरवरी से जून 2014 के बीच अलीगढ़ और उसके आस-पास काला हिरण की स्थिति, आयु संरचना, लिंग अनुपात और संरक्षण के मुद्दों का आकलन करने के लिए सर्वेक्षण किया। 18 अलग-अलग स्थानों पर 672 काला हिरण पाए गए । एक समूह 4 - 216 के आकार के साथ दर्ज किया गया। सिकंदरा राव (श्रेणी: 154 -216) में काला हिरण की बहुतायत सबसे अधिक थी, उसके बाद अंडला (श्रेणी: 47-65), और पाला सल्लू (श्रेणी: 53-62) का स्थान था। लिंगानुपात काला हिरण मादा की ओर झुकाव था (1:4.5), इरलिंगज़ (Yearlings) और मादाओं व बच्चों (Fawns) और मादाओं के लिए अनुपात क्रमशः 7.8:100 और 6.7:100 था। काला हिरण के वयस्क नर (12.8% वयस्क नर, 8.4% उप -वयस्क नर) के साथ-साथ वयस्क मादा (56.4% वयस्क मादा, 11.9% उप -वयस्क मादा) का प्रतिशत आबादी में अन्य आयु वर्गों या समूहों की तुलना में अधिक था। प्रारंभिक टिप्पणी से संकेत मिलता है की मुक्त जंगली कुत्तों की बढ़ती आबादी, वन पैच का निम्नीकरण, सामाजिक वानिकी वृक्षारोपण, पशुधन के साथ प्रतिस्पर्धा और अवैध शिकार क्षेत्र में काला हिरण के प्रमुख संरक्षण मुद्दे हैं। भविष्य में काला हिरण की जनसँख्या का आकलन करने में वर्तमान जानकारी एक अहम् भूमिका प्रदान कर सकती है।

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Author contributions: MA: conceptualization, methodology, data collection, analysis and writing. JAK: conceptualization, methodology and supervision. SK: conceptualization, methodology, supervision, evaluation, editing and proof reading.

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INTRODUCTION

The Indian Blackbuck *Antilope cervicapra* Linnaeus, 1758, Schedule-I species in Indian Wildlife (Protection) Act, 1972, is native to the Indian sub-continent. It was listed as 'Near Threatened' in 2014 by IUCN, which has been downgraded to 'Least Concern' category in 2017 (IUCN SSC Antilope Specialist Group 2017). There are two sub-species of blackbuck; *A. c. cervicapra* and *A. c. rajputanae* (Prater 2005; Menon 2014). *A. c. cervicapra* is found roughly west and south of Delhi to Point Calimere, Tamil Nadu whereas *Antilope c. rajputanae* occurs in Gujarat and Rajasthan (Menon 2014). Blackbuck occur in a wide range of habitats ranging from semi-arid grasslands, scrublands to open forest with preference to open grassland (Isvaran 2005; Meena & Saran 2018). Rahmani (1991) has conducted country-wide survey of Blackbuck population and has mentioned the species to occur in 80–100 fragmented populations in India. However, the current distribution range of Blackbuck is shrinking due to conversion of grassland into agricultural fields and direct competition for food and space with livestock (Dabadghao & Shankarnarayan 1973; Singh & Joshi 1979; Jhala & Isvaran 2016).

In Uttar Pradesh, Blackbuck occur in some protected areas such as Kaimoor Wildlife Sanctuary, Ranipur Wildlife Sanctuary, Hastinapur Wildlife Sanctuary, Meja Forest Division (a proposed Blackbuck Conservation Reserve, 46 km southeast of Parayagraj in Uttar Pradesh) and also outside protected areas in Varanasi, Kanpur, Pilibhit, Lakhimpur Kheri, Shahjahanpur, Banda, Sitapur, Hardoi, Bijnor, Bahraich, Muzaffarnagar, Meerut, Aligarh, Bulandshahr, Ghaziabad, Etah, and Mathura districts (Ranjitsinh 1982, 1989; Rahmani 1991). But it has disappeared from some areas such as Katarniaghat Wildlife Sanctuary and Kishanpur Wildlife Sanctuary. Most of these areas outside protected areas where Blackbuck is distributed in Uttar Pradesh are densely populated with humans unlike its distribution range in peninsular India. Since then, no systematic survey was carried out and recent information on the status of Blackbuck is lacking hitherto.

Aligarh, an agricultural district in the western part of Uttar Pradesh lies between rivers Ganga and Yamuna (Khan 2017). *Prosopis juliflora* was planted in 'usar' land areas about 30–35 years ago to provide fuel-wood to the local villagers, which support a population of Blackbuck (Gautam 1991; Dubey 1993). Some recent information on Blackbuck from a few sites of Aligarh district is presented in this paper by conducting a survey on its status, age structure, group size, and sex ratio. The study also focuses on identifying various threats that are currently prevailing in the densely populated agricultural landscape in the district.

Study area

Aligarh district (latitude 27° 54' 1.3788" N, longitude 78^0 4' 20.2116" E) in western part of Uttar Pradesh falls in the Gangetic plain biogeographic zone of India (Image 1). Administratively, the district is divided into 12 blocks, namely: Atrauli, Bijauli, Gangheeri, Lodha, Javan, Dhanipur, Akrabad, Iglas, Gonda, Khair, Chandaus, and Tappal. It encompasses an area of about 3,747 km^2 between the rivers Ganga and Yamuna. The district is bounded by the river Ganga on the north-east and Yamuna on the north-west parts and thus has a highly fertile 'doab' commonly known as the Ganga-Yamuna doab. Topographically, the district harbours vast open alluvial plains. The district is covered with loamy, sandy, clay, and silty soil. The region experiences humid subtropical climate, where average temperature ranges 35–38 ^{0}C during the summer (March to May) but average temperature rises beyond 45^{0}C during May–June. The average temperature is about 10^{0}C during winter months (November–February), and it may even be lower than 10^{0}C during January. Aligarh receives an average annual rainfall of ~800mm during the monsoon months (mid-June to September). Pulses, wheat, rice, barley, millet, and maize are mainly cultivated in Aligarh. A major portion of the district is rural with patches of forest (1%), scrublands, and wetlands interspersed among cultivated areas (Khan 2017).

Since the natural forest is less than 1% in the district, most common trees occuring in plantations, tree groves and human settlements include *Prosopis juliflora*, *Acacia nilotica*, *Azadirachta indica*, and *Adina cordifolia* besides agricultural fields. There are a few 'usar' land pockets affected by salt and remnant grassland patches interspersed within the agricultural landscape, which are used by blackbuck besides the above-mentioned categories.

METHODS

A literature review on the earlier studies on blackbuck in this region was carried out (Gautam 1991; Rahmani 1991; Dubey 1993). In addition, forest department (FD) guards, watchers appointed by the FD and also the residents in 56 villages of Atrauli, Iglas, Khair, Aligarh, and Sikandra Rao blocks were interviewed in February 2014 regarding the occurrence of this species.

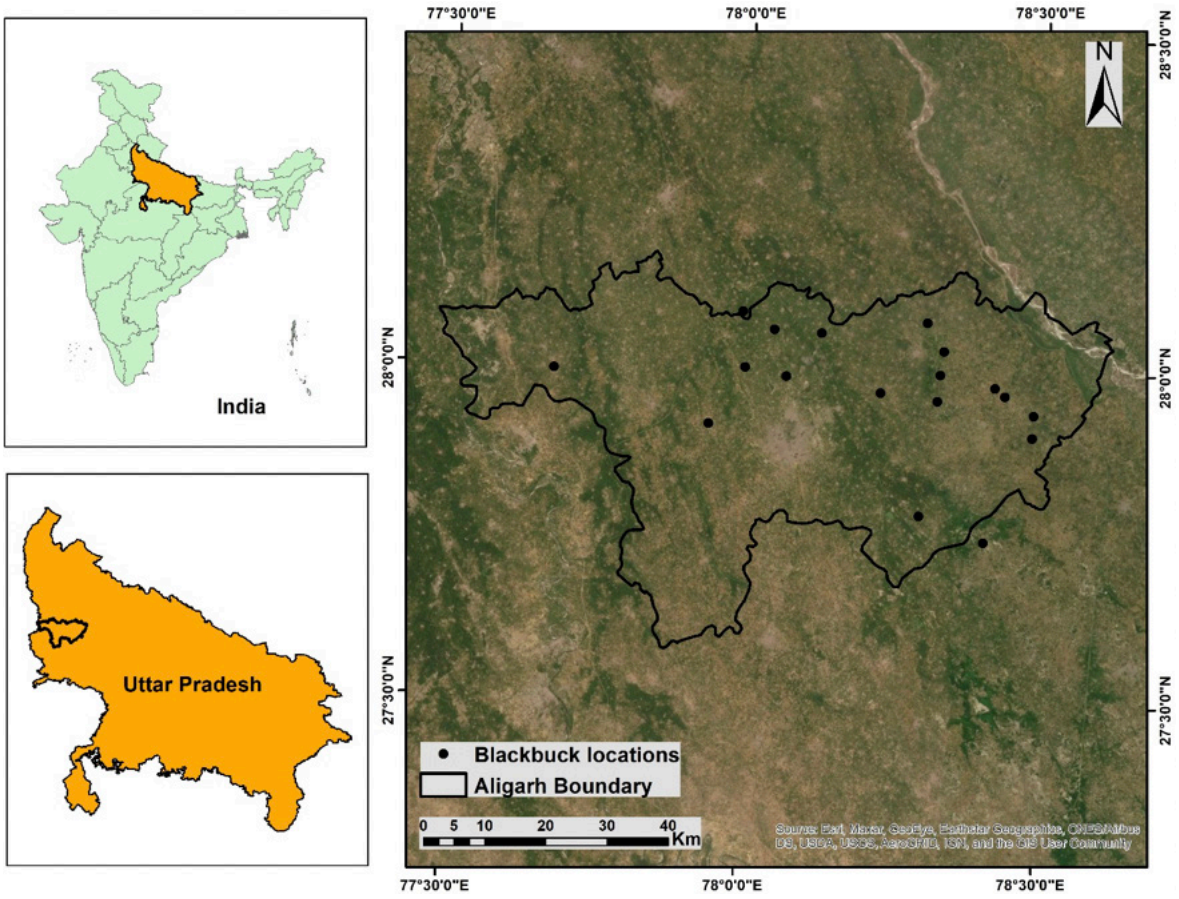

Image 1. Map of Study area in Aligarh, Uttar Pradesh.

The sites where the species was present were visited three times during March–June 2014. The observations were made from 0600 to 1000 h and 1600 to 1900 h when the Blackbucks are most active. Total or direct count method was employed to take a census of this species as it aggregates and inhabits relatively open areas (Sutherland 1996; Jethva & Jhala 2004). Data were collected block-wise in the selected 18 non-contiguous sites, among which six sites represented *Prosopis juliflora* plantations, seven agricultural fields, and five sites were located around human settlements. When sighted group size, sex, and age structure were recorded. The groups were considered as separate if (a) the herds were separated 2–3 km from each other and (b) the population was separated by some physical barrier such as water canal, which clearly classified them as separate groups (Image 2). The maximum home range of male Blackbucks recorded till date is 5.14 km^2 (Mahato & Raziuddin 2010). The maximum number of individuals of Blackbuck sighted at each site was considered as the maximum numbers in that area. The number of Blackbucks in a group or herd were categorized into: adult males and females (>2 years), sub-adult males and females (1–2 years), yearlings (<1 year), and fawn (>2 weeks) following Jhala (1991). Moreover, conservation threats such as the presence of dogs, degradation of resting sites, presence of livestock, and evidence of any poaching incidence were also recorded at each site.

RESULTS

We estimated a maximum of 764 and median of 672 and minimum of 476 individuals in 18 separate areas, with group size ranging from 4 to 216 individuals except for solitary ones (Table 1, Image 1, 2). We did not document any mixing of herds during three visits to the study sites. This may primarily be due to an extensive network of metalled and unmetalled roads and canals in the area interspersed with agricultural fields and human settlement (Image 2). Their presence was higher in sites with plantations than in sites with few or no plantations. Considering the median values of the estimates, Blackbuck were recorded in the highest numbers in

Table 1. Estimates of Blackbuck population at different sites in Aligarh District, Uttar Pradesh.

	Monitoring sites	Maximum	Minimum	Median
1	Sikandra Rao (Sahadatpur)	216	154	207
2	Andla	65	47	54
3	Pala-Sallu (Gabhana)	62	53	59
4	Neem Nadi-Bijauli Khas	61	13	52
5	Jarthari-Bhoolgadhi	49	0	30
6	Ghazipur	41	32	38
7	Rampur-Ladhwa	41	35	39
8	Tal Ka Nagla	41	33	39
9	Kakethal	35	22	29
10	Chandula- Sujanpur	33	23	32
11	Bajna-Nagra	31	11	22
12	Tewthoo-Gulapur	30	27	28
13	Tejpur-Rathana	17	4	12
14	Sindauli-Sheikpura	10	7	7
15	Junglegadi-Malikpura	11	5	7
16	Hursaina (Husaina)	9	7	7
17	Palla-Kashthali	8	3	8
18	Bijrauli-Palimuqeempur	4	0	2
	Total	**764**	**476**	**672**

plantations at Sahadatpur (n= 207) followed by Pala-Sallu (n= 59) and Andla (n= 54). The median age structure was 85 males, 424 females, 62 sub-adult males, 53 sub-adult females, 18 yearlings, and 30 fawns. A higher number were adults of both sexes (12.6% AM, 7.8% SAM) as well as females (63.09% AF, 9.22% SAF). Sex ratio was skewed towards females (1:4.5) and yearling to female and fawn to female ratios were 1:17 and 1:14 respectively in the population.

Presence of the Blue Bull *Boselaphus tragocamelus* and livestock in the same sites could lead to competition for food and space, the increasing population of free ranging feral dogs, degradation of forest patches, poaching pressure, crop damage by Blackbuck (Image 5) and equally so by Blue Bull are some of the challenges for the survival of Blackbuck in Aligarh (Table 2).

DISCUSSION

Studies on the status of Indian Blackbuck in Uttar Pradesh were first documented by Ranjitsinh (1982, 1989) who estimated 941 to 1,000 individuals. After almost a decade, Rahmani (1991) roughly estimated Blackbuck population to be about 1,100 individuals in

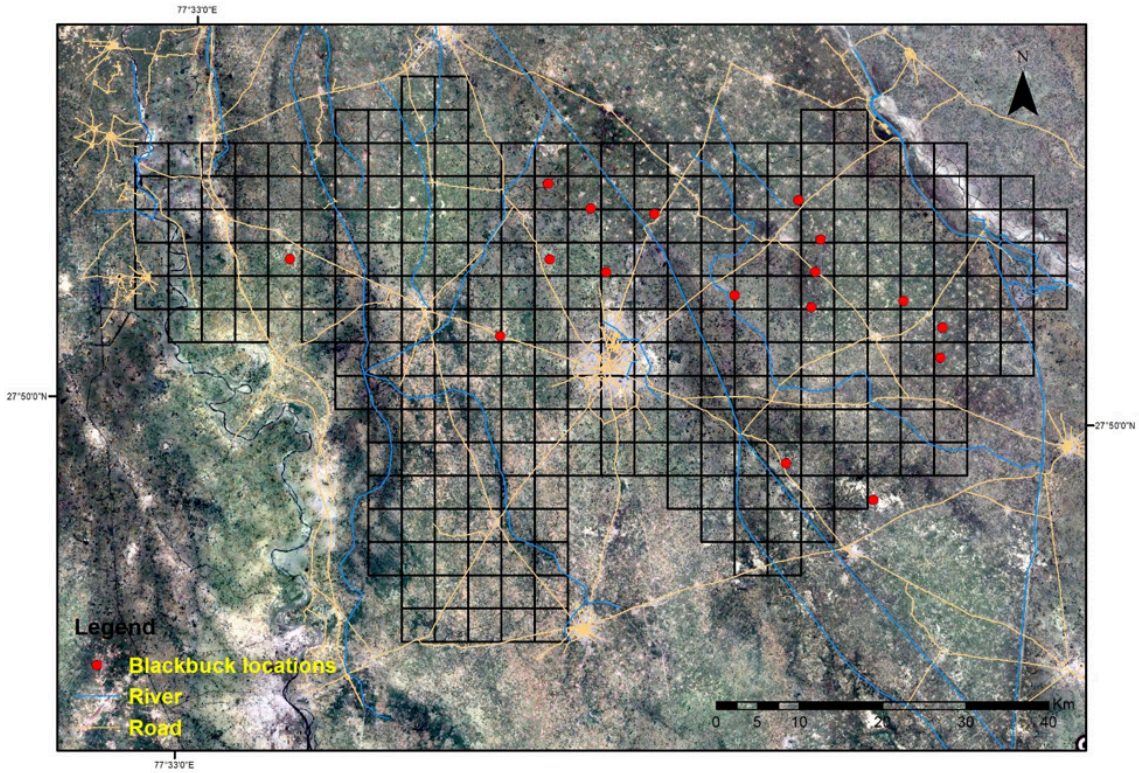

Image 2. Individual groups of Blackbuck (4 × 4 km²) in Aligarh, Uttar Pradesh.

Table 2. Threats to Blackbuck recorded at various sites of Aligarh, Uttar Pradesh

	Monitoring sites	Competition with		Free ranging feral dogs	Poaching	Wood extraction
		Blue Bull	Livestock			
1	Sikandrarao (Sahadatpur)	+	+	+	-	+
2	Andla	+	+	-	-	+
3	Palla-Sallu (Gabhana)	+	+	+	-	+
4	Neem Nadi-Bijauli Khas	+	-	-	-	-
5	Jarthari Bhoolgadhi	+	-	+	-	-
6	Ghazipur	+	+	+	-	+
7	Rampur-Ladhwa	-	-	-	-	-
8	Tal Ka Nagla	+	-	-	-	-
9	Kakethal	+	-	-	+	-
10	Chandaula- Sujanpur	+	-	-	-	-
11	Bajna-Nagra	-	-	-	-	-
12	Tewthoo-Gulapur	+	-	-	-	-
13	Tejpur-Rathana	-	-	-	-	-
14	Sindauli-Sheikhpura	-	-	-	-	-
15	Junglegadhi-Malikpura	+	+	+	+	+
16	Hursaina (Husaina)	+	+	+	-	+
17	Palla-Kashthali	+	+	-	+	+
18	Bijrauli-Palimuqeempur	-	-	-	-	-

Uttar Pradesh, including 420 individuals from Aligarh. Earlier an estimate of about 59 individuals of Blackbuck had been reported from Atrauli block of Aligarh (Dubey 1993). There were about 11 Blackbuck reported in 178 ha 'community forest' in Gursikaran village (Gautam 1991), which is now extirpated completely from the area. The increase in Blackbuck numbers in Aligarh district in comparison to the earlier estimate by Rahmani (1991) may be due to an increase in survey efforts and larger spatial coverage in this study.

The group size of Blackbuck ranged 2–207 individuals (Median value, Table 1) within the study area. Variation in abundance of Blackbuck within population has also been observed by previous studies including Isvaran (2007), Sagar & Antoney (2017), and Prashnath et al. (2016).

The variation in group size among sites could be attributed to habitat structure. Blackbuck is known to occur in large groups in open habitats and small groups in patchy environment (Isvaran 2007; Jhala & Isvaran 2016). Larger groups are usually formed in response to predation pressure. In open habitats, predation risk is reduced by forming large groups as compared to higher probability of large groups being detected in closed habitat. However, Aligarh is dominated by cultivated areas, thus providing open habitat all around

Image 3. Female herd of Blackbuck on cultivated land of Aligarh, Uttar Pradesh.

(Khan 2017). Natural predators are the Golden Jackal *Canis aureus* present in all the sites covered under this survey whereas the Indian Wolf *Canis lupus pallipes* was recorded from only one location, i.e., Ghazipur in Atrauli forest range. Local residents often mention Golden Jackal preying on fawns. However, there was no indication of predation by the Indian Wolf. Poaching of Blackbuck by local people is common in Malikpura, Kakethal, and Pala-Kashthali localities as reported by the ground staff of the FD.

Image 4. Fuel-wood (*Prosopis juliflora*) collection by villagers in Aligarh, Uttar Pradesh.

Image 5. Sorghum (*Sorghum bicolor*) crop damaged by Blackbuck in Aligarh, Uttar Pradesh.

Sikandra Rao with the largest *Prosopis* plantation (~100 ha) supports the largest number of Blackbuck. The sex ratio of Blackbuck was female biased in our study sites. Sex ratio of adult males to adult females was comparatively lower than in Point Calimere Wildlife Sanctuary, Tamil Nadu (Nair 1976), Andhra Pradesh (Prasad & Ramana 1990), Pipli Deer Park, Kurukshetra (Gupta & Bhardwaj 1990), M.C. Zoological Park, Chhatbir, Punjab (Vats & Bhardwaj 2009), Ganjam district and Balipadar-Bhetnoi Blackbuck Conservation Area, Odisha (Mahato et al. 2010; Murmu et al. 2013; Debata 2017), Sorsan grassland in Baran District and Tal Chappar Blackbuck Sanctuary, Rajasthan (Meena et al. 2017) and Lalpur Jheel, Haryana (Rai & Jyoti 2019). The female skewed sex ratio indicates that male mortality is higher.

The local people co-exist with Blackbuck and accept them as part of the agrarian system although they damage crops such as wheat, mustard, berseem, and chickpea (Image 3) . At present, people are tolerating and bearing the crop damages in these areas. However, the situation can worsen with the increase in abundance of Blackbuck (Chauhan & Singh 1990). There is no compensation given to locals against crop damage by Blackbuck and Blue Bull.

Competition with feral livestock and the Blue Bull is an important source of competition for limited forage. Cattle are discarded by the local people after they stop yielding milk and compete with Blackbuck for resources, mainly food and shelter. Free ranging feral dogs were often seen hunting Blackbuck frequently during the surveys. Control of free ranging feral dogs is needed to increase wild ungulate populations. Harvesting of fodder and fuelwood from plantations and other semi-natural habitat is an added cause of land degradation (Image 4) .

Forest cover as well as grassland areas are scanty in the study area and thus the only option for their survival is around such plantations and 'usar' land (patches of alkaline land) dispersed over the agricultural landscape. If there are no further changes and disturbances in the landscape, Blackbuck may continue to survive in viable numbers. Some of these sites may be protected as community reserves for protecting Blackbuck population of the area.

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