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Adaptations in avian nesting behavior in relation to indigenous trees and housing structures in Punjab

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Abstract

The present study was carried out to know about the avian nesting behavior in relation to indigenous trees/shrubs/housing structures in two villages, viz; village Rampur Chhana (location I) and village Dargapur (location II) from April 2016 to March 2017. Selection of nesting sites, different nesting patterns and usage of different nesting materials of 15 bird species were recorded in both the selected locations. It was recorded that nesting site preferences of different bird species varied in relation to cultivated crops/ trees/shrubs/ornamental plants/ housing structures and nest predation at both the selected locations. Ten bird species were further found to utilize unusual materials such as plastic pieces, animal hair, pieces of cloth, toffee wrappers, wires, threads, safety pins and pieces of bangles in their nests. This study has generated information on avian nesting behavior in relation to indigenous trees/shrubs and other anthropogenic factors which could suggest measures to conserve avian fauna in farmlands.

Keywords: Avian species, anthropogenic material, nest sites, nesting material, nesting pattern

1. Introduction

Nest has been defined as a structure which is required for the egg laying, their protection and survival of young ones [1]. Choice of nest site is influenced by various factors like food supply, risk of predation and nest ecomparasities which can affect survival of young ones [2,3,4]. In birds, habitat selection for breeding may be affected by type and structure of vegetation, availability of food and nest site and chances of predation [5, 6]. Different nesting materials are used by different birds like larger birds preferred larger twigs and smaller birds used finer material [7]. Site for nest building depends upon breeding season of bird, food and water resources and availability of suitable nest sites [8]. Choosing of nest site depends upon the sites which provide good environment for the survival and reproduction of birds. Birds made important decision to architect nests that help to provide survival to young ones in the unfavorable conditions. So, the avian species build perfect nest through natural selection and species-specific nests [9]. Habitat loss had direct effect on loss of nesting features needed by breeding birds which lead to change of their nesting features or adaptation [10]. Alteration of land use cause disappearance of habitat of particular species and which becomes main reason for declining number of biodiversity [11, 12]. Nest predation is the reason for the failure of nesting among passerines [6]. Urbanization cause changes in the type and availability of nesting sites [13, 14]. Human disturbance affected the nesting behavior of birds by their habitat loss, changing housing structures and by introduction of exotic species replacing local endemics [15]. Predation, desertion and human disturbance were the reasons for nest failure [16]. Vegetation was the important factor to got shelter and to made nests [17]. Bird nests were influenced by urbanization in many ways [18- 20]. High level of urbanization led to more use of anthropogenic material by birds for nest construction [21]. Anthropogenic material in nests might be hazardous to bird's survival and breeding success [22, 23]. Collias and Collias [7] and Hansell [24] provide the information related to general descriptions of bird nest construction. Little information was there about the material used by avian species [25-27]. Many bird species fill their nests and cavities with considerable amount of nesting material [28]. The studies on nesting pattern and nesting behavior of different bird species are required to protect/conservate bird fauna as well as indigenous vegetation in farmlands of Punjab.

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2. Materials and Methods

2.1 Study area

The study of nesting pattern and nesting behavior was carried out in two villages i.e village Rampur Chhana (District Sangrur) and village Dargapur (District Patiala), Punjab. Rampur Chhana (Location I) lies at latitude of 30°27'33" N and longitude of 76°03'00" E and Dargapur (Location II) lies at latitude of 30°32'55" N and longitude of 76°13'29" E. The study was conducted from April 2016 to March 2017. Birds were identified according to keys of Ali (2002). Observations were made on weekly basis and during data collection each and every tree as well as the edges, corners of the walls and roofs were carefully scanned. The status of the nest, i.e. whether active or not, was determined by examining its contents at regular intervals with the help of a binocular (8×42X Nikon). The observations for nesting activities included number of nests, type of nests, tree or houses selected as nesting sites, nesting material utilized and its surroundings. Tree names were visually noted. Other parameters like tree height and nest height were estimated through Ravi altimeter.

2.2 Statistical analysis

T-test was used to find significant variation among the nest heights of bird species at both the selected villages.

2.3 Results and Discussion

During the study, a total of 15 species were found nesting at location I and at location II (Table 1). At location I, there were noticed 13 bird species nesting which belonged to four orders, thirteen avian species were found nesting at location II which belonged to four orders. There was recorded nesting of 11 bird species common to location I and II. Most dominated order was Passeriformes (eight and seven bird species at location I and II respectively), followed by Columbiformes (two species each at location I and II), Psittaciformes (one species at both studied locations), Ciconiiformes (one species at location I), Apodiformes (one species at location II). Seven different kinds of nesting patterns, viz; cavity nesters (three bird species), platform nesters (four bird species), cup nesters (one bird species), pendent nesters (two bird species), shallow scrape (one bird species), dome shaped (two bird species) and mud nesters (two bird species) were noted (Table 2). Nesting site preference of bird species varied at both the studied locations. Preference of nesting sites seemed to depend on cultivated crops, type of indigenous trees/shrubs/building structures and nest predation. At location I, four, five, eight, seven, five, nine, nine, one, nine, six, five, one and two nests of Asian Pied Starling, Baya Weaver Bird, Blue Rock Pigeon, Common Myna, House Crow, House Sparrow, Cattle Egret, Purple Sunbird, Red-vented Bulbul, Eurasian-Collared Dove, Rose-ringed Parakeet, Spotted Munia and Red-wattled Lapwing were recorded respectively. At location II, four, four, eight, seven, one, five, eleven, three, ten, five, six, one and one nests of Asian Pied Starling, Baya Weaver Bird, Blue Rock Pigeon, Common Myna, Wire-tailed Swallow, House Crow, House Sparrow, Common Swift, Red-vented Bulbul, Eurasian-Collared Dove, Rose-ringed Parakeet, Spotted Munia and Red-wattled Lapwing were recorded respectively. In the present study there was found no significant variation among the nest heights of both the selected locations. Ali had mentioned similar type of observations and discussed about breeding habits of 30 species having five different nesting types [29]. Similar finding on avian nesting had been reported Reddy; nesting of 26 avian species which belonged to 15 orders was described. He further stated the details of nests of

White-rumped Munia (13 nests) followed by Red-vented Bulbul (9 nests) [30].

Table 1: List of bird species observed nesting in selected villages

| S. No. | Bird Species | Scientific name |
|--------|------------------------|------------------------------|
| 1 | Asian Pied Starling | <i>Sturnus contra</i> |
| 2 | Baya Weaver Bird | <i>Ploceus philippinus</i> |
| 3 | Blue Rock Pigeon | <i>Columba livia</i> |
| 4 | Common Myna | <i>Acridotheres tristis</i> |
| 5 | House Crow | <i>Corvus splendens</i> |
| 6 | House Sparrow | <i>Passer domesticus</i> |
| 7 | Cattle Egret | <i>Bubulcus ibis</i> |
| 8 | Purple Sunbird | <i>Nectarinia asiatica</i> |
| 9 | Red-vented Bulbul | <i>Pycnonotus cafer</i> |
| 10 | Spotted Munia | <i>Lonchura punctulata</i> |
| 11 | Common Swift | <i>Apus apus</i> |
| 12 | Wire-tailed Swallow | <i>Hirundo smithii</i> |
| 13 | Rose-ringed Parakeet | <i>Psittacula krameri</i> |
| 14 | Eurasian Collared-Dove | <i>Streptopelia decaocto</i> |
| 15 | Red-wattled Lapwing | <i>Vanellus indicus</i> |

Seven nesting patterns were observed for bird species at both the studied locations. According to our observations, Asian Pied Starling and Spotted Munia had constructed dome shaped nests having an entrance hole (Table 2). Asian Pied Starling preferred electric poles, trees and transmission towers to build their nests at both the selected locations. Materials used for nest building was mainly twigs of trees (*Melia azedarach*, *Morus alba* and *Eucalyptus globules*), wheat straw, fibres (cotton, jute), grass blades plastic bits, Threads, Ribbons and galvanized wires. Asian Pied Starling had constructed nests on minimum height of 4.26 m and 3.76 m on electric poles at location I and II respectively. Maximum height of nest was 12.28 m and 12.84 m on Palkan tree at location I and II respectively (Table 2). Spotted Munia was found to prefer trees of average height in residential areas/houses like Dhek at location I and Cheeku at location II. Nesting material used for building of nest was wheat straw, grass blades, tree twigs and leaves of trees (*Azadirachta indica*, *Pyrus communis* and *Melia azedarach*). Spotted Munia was recorded to build nests on trees with maximum height of 6.46 m as recorded at both selected locations. Baya Weaver Bird and Purple Sunbird were noted building pendant shaped nests. The nests of Baya Weaver Bird were observed hanging from the branches of trees having two compartments. Nests of Baya Weaver Bird were found at indigenous trees (Ber) at both said locations; it also preferred fruit tree (Pear) at location I and exotic tree (Areca Palm) at location II. The nesting material used were grass (dry), leaves of trees (*Ziziphus mauritiana*, *Azadirachta indica*, *Pyrus communis*), fibres (cotton) and strips (of palm fronds and *Saraca asoca*), cloth pieces and animal hair. Nest height of Baya Weaver Bird ranged from 7.00 m to 9.00 m at location I and from 7.00 m to 13.00 m at location II. Purple Sunbird constructed oval shaped nests suspended from twigs of plant with an opening at anterior end. Nest was made up of tree leaves (*Citrus nobilis*, *Ziziphus mauritiana* and *Cassia fistula*), grass blades and twigs of trees (*Psidium guajava*, *Azadirachta indica*), animal hair and plastic threads. Purple Sunbird was found to build nest at height of 0.94 m at location I (Table 2). Similar kind of results had been mentioned by different workers on nesting structures. Dome shaped nests in case of Spotted Munia was observed using different nesting material like grasses, fibers and feathers [30]. It was further mentioned that Purple Sunbird used different materials like threads, cotton, paper, bark, and spider web at different locations. Mazumdar had reported Purple Sunbird building oval shaped nest with

anterior opening composed of dry leaves, dry grass, small pieces of wires and paper. He further noticed the nest height of Purple Sunbird which was varying from 1.2m to 2 m^[31]. In our study, Blue Rock Pigeon, House Crow, Cattle Egret and Ring Dove had been observed to build platform nests. These nests were mainly made up of sticks from branches of trees (*Acacia nilotica*, *Melia azedarach*, *Embllica officinalis* and *Morus alba*), tree twigs (*Dalbergia sissoo*, *Cassia fistula*, *Azadirachta indica* and *Populous deltoid*), plastic pieces (hangers, spoons and packaging clips), metal wires (aluminum, iron and galvanized) and paper (wrappers, packing papers and newspaper). Nests of Blue Rock Pigeon were located on shutters of shops, sheds, ventilators, under water tanks, loft of houses and under roof spaces at both the said locations. Blue Rock Pigeon was found to build nests at minimum nest height 3.04 m and 4.54 m i.e on loft of house at both the locations I and II respectively. Maximum nest height of Blue Rock Pigeon was recorded in hole of wall (6.58 m) at location I and under-roof spaces (10.01 m) at location II. Solitary nests of House Crow were noticed on exotic trees (Safeda) and indigenous tree (Lasura) at location I and on indigenous tree (Peepal) and exotic trees (Safeda and Poplar) at location II. It was surprising to observe that iron wires were woven with twigs in all the observed nests. The range of nest height of House Crow varied from 11.54 m to 19.23 m at location I; at location II it varied from 16.64 m to 19.65 m. In our study, nest sites preferred by Eurasian Collared Dove were indigenous tree (Dhek) at both locations I and II. Other preferred nesting sites were narrow shelves at location I and window sills at location II. Nest height of Eurasian Collared Dove was noted to be 5.19 m to 10.15 m at both the said locations. At location I, Cattle Egret Heronries were located on Kikkar. Their nest number ranged from 5 to 30 per colony. Cattle Egret was found to build nest at height of 7.15 m at location 1 (Table 2). The nesting pattern of some bird species observed in our study seemed to be corresponding to previous studies. Tripathi noted nesting sites of Blue Rock Pigeon on lofts, walls, towers and in old buildings^[32]. He further mentioned that Blue Rock Pigeon had used unusual materials like plastic spoons, pieces of bangles, packing strips and safety pins for nesting House Crow preferred to build nests on Poplar, Safeda and Kikkar^[33]. House Crow made platform nests by using twigs and mostly preferred large trees with large canopy^[30]. Moosavi observed *Zizyphus numullaria* as nesting tree in case of Eurasian Collared-Dove^[34]. Roshnath and Sinu reported heronry of Cattle Egret on Mango, Banyan and jackfruit^[35]. Different bird species had used different nesting materials mainly grasses, fibres, leaves, twigs, threads, cotton and bark^[30]. Our studies showed that previous work revealed same type of findings. Some workers reported the average height of the nesting trees of heronry was 6–11 m that might be related with the habitat preference^[36, 37, 38, 39, 40]. Red-vented Bulbul was found to construct its nests on dense shrubs including *Ficus* species, Lemon, Dhek in both locations I and II. Kronnda was also selected by Red-vented Bulbul for nest building at location II. Nesting material used for nest was fibres (cotton), tree twigs (*Melia azedarach*, *Cordia myxa* and *Ficus benjamia*), plastic threads, paper pieces, animal hair and ribbons. Range of nest height varied from 5.23m to 1.23 m at location I. at location II, range varied from 6.15 m to 1.96 m. Common Swift and Wire-tailed Swallow were found to be mud nesters at location II. Observations revealed that they collected mud from rice fields, canal bank and village pond (Table 2). Nests of Common Swift and Wire-tailed Swallow were found on walls

of buildings situated adjacent to crop fields or ponds at location II. Wire-tailed Swallow and Common Swift were found to build their nests near to roofs having height of 6.41 m and 5.76 m respectively. Red-wattled Lapwing was found to be ground nester in agricultural fields and near water bodies at both the selected locations. Kler had mentioned similar type of findings on the nesting behavior of Red-wattled Lapwing^[41]. Red-rumped Swallows found to be mud nester using sandy mud for nest construction and preferred walls for nesting^[30]. Red-vented Bulbul preferred to build nest in thorny trees and bushes and mostly nested in central position^[42]. Study of Zia revealed about the tree species used by Red vented Bulbul for nest construction were Ber (*Zizyphus nummularia*), Guava (*Psidium guajava*), Sheesham (*Dalbergia sissoo*) and Date palm (*Phoenix dactylifera*)^[43]. They further stated that more successful nests were constructed in middle of shrubs. Nests of Red-wattled Lapwing were found in ploughed field and areas near to water bodies^[44]. Muralidhar and Brave observed nesting of Red-wattled Lapwing on roof of buildings^[45]. Nest height was related to choice of nesting substrate according to their findings^[46].

Different types of cavities/holes were occupied by Common Myna, House Sparrow and Rose-ringed Parakeet and their selection of nesting material and nesting sites differed greatly at both studied locations. Rose-ringed Parakeet was observed to occupy natural holes and excavated holes on indigenous tree (Neem) at location I and II but in addition used Mango tree at location II. Rose-ringed Parakeet was found to occupied cavities at maximum height of 11.46 m and 6.46 m at both locations I and II. Common Myna had constructed their nests in cavities of Dhek, wall and on electric poles at both the selected locations (Table 2). Other nesting sites were Mango at location I and Neem at location II. Nesting materials used were cloth (pieces), feathers, tree twigs (*Acacia nilotica*, *Azadirachta indica*, *Ficus religiosa*, *Cordia myxa* and *Dalbergia sissoo*), paper pieces, caps of water bottles, rubber rings, snake slough and plastic threads. Nest height of Common Myna fluctuated between 3.26 m and 11.33 m at location I and ranged from 4.96 m to 10.86 m at location II. Observations revealed that nesting of House Sparrow was found in crevices of roofs and electrical fittings at both the selected locations while its nest were also found on Bougainvillea and *Ficus benjamia* at location I; on street lights and space between wall and girder at location II. House Sparrow built nests on minimum height of 1.46 m (*Ficus*) and maximum height of 7.01 m (crevices in roof) at location I. Nest height of House Sparrow varied from 6.17 m to 8.37 m at location II. The nest was found to be consisting of grass stems, sticks of trees (*Azadirachta indica*, *Ficus religiosa*), feathers, plastic threads and cloth pieces. Nesting of House Sparrow was recorded on shrubs at location I. No such observations had been mentioned by previous workers. The shift in nesting site preference might be due to adaptations in avian nesting behavior in relation to exotic and ornamental vegetation found in rural residential houses.

Observations on Common Myna using dry leaves, feathers, wool and animal hair were mentioned^[25]. Dhandhukia and Patel referred Common Myna had constructed their nests on tress, wells, holes of walls and roof of houses^[47]. Ali *et al* stated that some birds constructed their own nests and referred as primary cavity nesters such as the Rose-ringed Parakeet^[29]. Similar observation on nests of House Sparrow; in crevices of walls, in holes of un-cemented walls, in cavities of roof having wooden ceiling of mud houses and cattle sheds^[48].

Table 2: Details about avian nesting behavior observed at selected locations

| Bird species | Location I | | | | | | Location II | | | | | |
|---------------------|--------------|--|---------------|--|---------------------------------|----------------------------|---|--|---------------|--|---------------------------------|----------------------------|
| | No. of nests | Nest site | Nest type | Nesting material | Height of nest site (in meters) | Height of nest (in meters) | No. of nests | Nest site | Nest type | Nesting material | Height of nest site (in meters) | Height of nest (in meters) |
| Asian Pied Starling | 2 | Electric Pole | Dome shaped | Twigs, sticks, wheat straw, plastic bits, threads, ribbons | 4.57 | 4.26 | 1 | Electric Pole | Dome shaped | Twigs, sticks, wheat straw, plastic pieces, galvanized wires | 4.26 | 3.76 |
| | 1 | Transformer | | | 5.48 | 7.03 | 1 | Transformer | | | 6.78 | 5.54 |
| | 1 | Pilkan (<i>Ficus lacor</i>) | | | 17.89 | 12.28 | 1 | Pilkan (<i>Ficus lacor</i>) | | | 14.76 | 12.84 |
| Baya Weaver Bird | 3 | Pear (<i>Pyrus communis</i>) | Pendant nest | Grass blades, leaves, fibres, strips of palm fronds, Cloth pieces | 10.54 | 8.58 | 1 | Ber (<i>Ziziphus mauritiana</i>) | Pendant nest | Grass blades, fibres, leaves, strips of palm fronds, animal hair | 8.98 | 7.48 |
| | 2 | Ber (<i>Ziziphus mauritiana</i>) | | | 8.57 | 7.78 | 3 | Palm tree (<i>Areca palm</i>) | | | 15.01 | 13.64 |
| Blue Rock Pigeon | 1 | Hole in Wall | Platform nest | Small sticks, fibers, grass stems, plastic, wires, paper pieces, packaging clips, wrappers | 9.28 | 6.58 | 4 | Under-roof spaces | Platform nest | Small sticks, fibers, grass stems, safety pins, nylon threads, cloth pieces | 10.64 | 10.01 |
| | 3 | Under-roof spaces | | | 3.28 | 3.04 | 1 | Loft of house | | | 5.78 | 4.54 |
| | 1 | Loft of house | | | 4.02 | 3.56 | 2 | On ledge | | | 7.07 | 5.39 |
| | 2 | On ledge | | | 5.57 | 4.01 | 1 | Shutter of shops | | | 7.64 | 5.36 |
| | 1 | Ventilator | | | 7.23 | 6.74 | | | | | | |
| Common Myna | 2 | Cavity in Dhek (<i>Melia azedarch</i>) | Cavity nest | Twigs, grass blades, metal wires, plastic, cloth, feathers, snake slough, cap of bottles, galvanized wires | 9.23 | 8.76 | 2 | Cavity in Dhek (<i>Melia azedarch</i>) | Cavity nest | Twigs, grass blades, metal wires, plastic, cloth, feathers, snake slough, wrappers | 10.96 | 9.02 |
| | 1 | Mango (<i>Mangifera indica</i>) | | | 16.76 | 11.33 | 1 | Hole in wall | | | 8.45 | 7.15 |
| | 1 | Electric pole | | | 4.68 | 3.26 | 2 | Electric pole | | | 5.04 | 4.96 |
| | 2 | Hole in wall | | | 8.77 | 7.05 | 2 | Hole in Neem (<i>Azadirachta indica</i>) | | | 11.26 | 10.86 |
| | 1 | Hole in Neem (<i>Azadirachta indica</i>) | | | 8.78 | 7.19 | | | | | | |
| House Crow | 1 | Lasura (<i>Cordia myxa</i>) | Platform nest | Twigs, sticks, plastic threads, iron wires, paper pieces | 14.68 | 11.54 | 1 | Peepal (<i>Ficus</i> | Platform nest | Twigs, sticks, plastic threads, iron wire | 18.43 | 16.64 |
| | | 2 | | | | | Safeda (<i>Eucalyptus tereticornia</i>) | 19.64 | | | 17.43 | |
| | 4 | Safeda (<i>Eucalyptus tereticornia</i>) | | | 20.64 | 19.23 | 1 | Popolar (<i>Populus deltoids</i>) | | | 21.48 | 19.65 |
| House Sparrow | 1 | Shrub (<i>Ficus benjamia</i>) | Cavity nest | Grass stems, sticks, feathers, plastic threads | 2.34 | 1.46 | 3 | Electrical fitting | Cavity nest | Grass stems, sticks, feathers, plastic threads, cloth pieces | 7.58 | 6.17 |
| | 3 | Electrical fitting | | | 6.47 | 5.13 | 5 | Crevices in roof | | | 8.37 | 8.37 |
| | 4 | Crevices in roof | | | 7.01 | 7.01 | 3 | Space between wall and girder | | | 8.19 | 8.08 |
| | 1 | Bougainvillea | | | 2.87 | 2.13 | | Street lights | | | 2.64 | 1.96 |
| Cattle Egret | 9 | Kikkar (<i>Acacia nilotica</i>) | Platform nest | Sticks, pieces of paper, twigs, animal hair, thread, ribbons | 8.64 | 7.15 | - | - | - | - | - | - |
| Purple Sunbird | 1 | Brinjal plant (<i>Solanum</i> | Pendant nest | Leaves, grass blades, animal hair, plastic threads | 1.44 | 0.94 | - | - | - | - | - | - |

| | | | | | | | | | | | | |
|------------------------|---|------------------------------------|----------------|---|-------|-------|---|------------------------------------|----------------|--|------|------|
| | | <i>melongena</i> | | | | | | | | | | |
| Red-vented Bulbul | 1 | Dhek (<i>Melia azedarch</i>) | Cup nest | Fibres, twigs, plastic threads, paper pieces, animal hair | 6.38 | 5.23 | 2 | Dhek (<i>Melia azedarch</i>) | Cup nest | Fibres, twigs, plastic threads, ribbons, animal hair | 7.01 | 6.15 |
| | 6 | Shrub (<i>Ficus benjamia</i>) | | | 2.64 | 1.23 | 5 | Shrub (<i>Ficus benjamia</i>) | | | 2.64 | 1.96 |
| | 2 | Lemon (<i>Citrus Lemon</i>) | | | 3.28 | 2.47 | 3 | Kronda (<i>Carissa carandas</i>) | | | 3.01 | 2.58 |
| | | | | | | | | Lemon (<i>Citrus Lemon</i>) | | | 3.49 | 2.47 |
| Eurasian Collared Dove | 2 | Dhek (<i>Melia azedarch</i>) | Platform nest | Sticks, fibres, twigs, toffee wrappers, paper pieces | 11.44 | 10.15 | 4 | Dhek (<i>Melia azedarch</i>) | Platform nest | Sticks, fibres, twigs, threads, paper pieces | 8.37 | 7.42 |
| | 4 | Narrow shelves | | | 6.76 | 5.19 | 1 | Window sills | | | 5.13 | 4.45 |
| Rose-ringed Parakeet | 4 | Neem (<i>Azadirachta indica</i>) | Cavity nest | - | 9.36 | 8.11 | 6 | Neem (<i>Azadirachta indica</i>) | Cavity nest | - | 7.92 | 6.46 |
| | 1 | Mango (<i>Mangifera indica</i>) | | | 13.93 | 11.46 | | | | | | |
| Spotted Munia | 1 | Dhek (<i>Melia azedarch</i>) | Dome shaped | Twigs, grass blades, fibres, leaves | 7.34 | 6.46 | 1 | Cheeku (<i>Manilkara zapota</i>) | Dome shaped | Twigs, grass blades, leaves | 3.56 | 3.56 |
| Red-wattled Lapwing | 2 | Ground-nesting | Shallow scrape | Pebbles, hard clay | - | - | 1 | Ground nesting | Shallow scrape | Pebbles, hard clay | - | - |
| Wire-tailed Swallow | - | - | - | - | - | - | 1 | Underneath roof | Mud nest | Mud | 6.41 | 6.41 |
| Common Swift | - | - | - | - | - | - | 3 | Underneath roof | Mud nest | Mud | 5.76 | 5.76 |

Adaptive nesting pattern had been mentioned by different workers. More count of House Sparrow at industrial sites than in houses ^[49]. Changes in habitat area lead to adaptation in bird species ^[51]. Some birds made their nests at odd places (at top of building, sewage, gas pipes and inter space among girders) due to absence of suitable nesting sites ^[50-52] Human presence also affected the nest placement of avian species ^[53, 54]. Urban features were found to be important for predicting nest-site selection ^[55]. Urbanization decreased the availability of breeding areas, change original habitat and reduced the choice of nesting material ^[32]. Our observations on the use of anthropogenic materials used for nesting had been corroborated by many workers. Discarded cigarette butts were found in the nest of House Sparrows (*Passer domesticus*) ^[56]. According to him, choice in material and use of anthropogenic material was due to their availability in surrounding areas. Anthropogenic materials such as nylon, treated cotton, hair from animals and humans, materials from exotic garden were observed in the avian nests ^[57].

3. Conclusion

From our study, it might be concluded that adaptations in nesting behavior of bird species were found dependent upon the presence of cultivated crops, indigenous trees/shrubs, exotic trees/shrubs and manmade structures. Nesting sites of House Sparrow on the street lights, electrical fittings and shrubs indicated its adaptative behavior in rural residential areas. Preferences of different housing structures by Blue Rock Pigeon, Eurasian Collared-Dove, Common Myna and House Sparrow, Common Swift and Wire-tailed Swallow showed their commensal nature. Indigenous trees were used for exclusive nesting sites by Cattle Egret and Rose-ringed Parakeet. Shift in nest site selection had been recorded in Baya Weaver Bird, House Crow, Red-vented Bulbul and Spotted Munia towards exotic trees/shrubs and ornamental plants.

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