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A comparative study on the nesting materials used by House Sparrow *(Passer domesticus)* for Open and Inbox nests

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Abstract House Sparrow *(Passer domesticus)* is a bird species connected to humans, widely distributed in most of the human settlements. They build nests in the crevices of our homes. The recent changes in house design minimized the crevices to build the nests and lead to habitat loss. The nest boxes are the alternative ways to re-establish the decreased House Sparrow population. We investigated the usage of nesting materials by House Sparrow with reference to construction of Open nests and Inbox nests in our study area. Because of its flexible attitude, it utilizes all the available materials for nest construction. In our study area at Jangareddigudem, we have examined about 100 Inbox nests and 40 Open nests. There are around 29 varieties of nesting materials used by Sparrows in the examined Inbox nests and around 27 varieties in the Open nests. Dūrvā grass found to be the major component of all the analyzed nesting materials in both Open and Inbox nests that constituted 43% and 36.5% respectively. The other structural materials such as coconut fibre (3.5%) and broom fibre (6%) were found to be more in Inbox nests. Synthetic fibre was more in Open nests (3.7%). We found significant differences between the Open and Inbox nests with respect to quantum of each nesting material type used, weight of the nests and time taken for nest construction by House Sparrow.

Keywords: House Sparrow, nesting materials, nest boxes, Inbox nests, Open nests

Összefoglalás A házi veréb *(Passer domesticus)* kultúrakövető madárfaj, amely a legtöbb emberi településen előfordul. Fészkeiket az épületek réseibe építik. A házak tervezésének – építésnek a közelmúltban bekövetkezett változásai minimálisra csökkentették a fészkelési lehetőségeket, ami az élőhelyük csökkenéséhez vezetett. A fészekodúk kihelyezésével a lecsökkent házi veréb populáció helyreállítható. A faj fészkelőanyag-használatát vizsgáltuk két fészektípusban (nyitott fészek, odú). A madarak rugalmas hozzáállása miatt minden rendelkezésre álló anyagot felhasználtak a fészeképítéshez. A Jangareddigudemben található vizsgálati területünkön körülbelül 100 fészekodút és 40 nyitott fészket vizsgáltunk meg. A vizsgált odúkban 29 féle fészkelőanyagot találtunk, a nyitott fészkekben pedig 27 félét. Az összes elemzett fészkelőanyag fő összetevője a csillagpázsit volt mind a nyitott fészkekben, mind az odúkban, amely aránya 43%, illetve 36,5% volt. A többi fészekanyag, például a kókuszrost (3,5%) és a seprűszál (6%) nagyobb arányban volt az odúkban. A szintetikus szál több volt a nyitott fészkekben (3,7%). Az odúkban levő és a nyitott fészkek között szignifikáns különbségeket találtunk az egyes használt fészkelőanyag-típusok mennyisége, a fészkek tömege és a fészeképítéshez szükséges idő tekintetében.

Kulcsszavak: házi veréb, fészekanyag, odú, nyitott fészek

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Introduction

House Sparrow *(Passer domesticus)* is a widely distributed bird species in human settlements (Summer-Smith 1988). The population of this tiny bird is under decline in several parts of the world (Royal Society for Protection of Birds 2002, Hussain *et al*. 2016). Though these birds were protected initially by the Red List (Paul 2015), they have been shifted to least concerned species (Bird life international, 2018), and their population is still declining at some parts of the globe (Berigan *et al*. 2020). One of the major reasons for their decline is the lack of nesting sites (Vincent 2005). As the House Sparrow is an opportunistic secondary nesting bird, it can utilize the nest boxes for its breeding activities (Bhattacharya *et al*. 2011, Chetan 2012, Balaji 2014, Mahesh & Suseela 2021). It can cope-up in all kinds of ecological conditions, and can use available and suitable nesting materials for nest construction including grasses, feathers, stalks, threads, fibres, paper, wool, etc. (Indykiewiez 1990).

The modified house architecture is unable to provide crevices as in the tiled-roofs or thatched houses. In search of breeding space, House Sparrow invaginated the present RCC buildings and started using available spaces such as ventilators, gaps of false roofs made up of POP ceilings, sanitary pipes, behind the compressor of air-conditioners, on electrical meter boxes etc. Construction of a secured nest in open areas requires more effort and also more material.

In this study, we concentrated on the usage of nesting materials by House Sparrow for nest construction in open areas (henceforth referred as 'Open nests') and a comparison was made with the nests constructed in provided nest boxes (henceforth termed as 'Inbox nests'). Statistical analysis was carried out by using T-test (paired two samples for mean) to identify the significant differences between Open and Inbox nests. The hypotheses made to carry out the present study are as follows.

Hypotheses of the study

H_{01}: The quantum of each material type used by House Sparrow for construction of Open nests and Inbox nests is the same.

H_{a1}: The quantum of each material type used by House Sparrow for construction of Open nests and Inbox nests significantly differs.

H_{02}: The overall weight of Open and Inbox nests constructed by House Sparrow remains the same.

H_{a2}: The overall weight of Open and Inbox nests constructed by House Sparrow significantly differs.

H_{03}: There is no significant difference in nest construction time by House Sparrow for the construction of Open nests and Inbox nests.

H_{a3}: There is significant difference in nest construction time by House Sparrow for the construction of Open nests and Inbox nests.

Methods

Jangareddigudem (17.1223° N, 81.2923° E) is an upland area of West Godavari District of Andhra Pradesh state of India. Its altitude is 74 meters above the median sea level, with 15.8 km^2 area. Jangareddigudem is a semi-urban town with a tropical climate. The town consists more of open areas *(Figure 1)* and is selected as the study area for conservation of House Sparrow by providing nest boxes since 2014. The occupancy rate of the nest boxes was reported as 97% in this town (Mahesh & Suseela 2021).

The total number of Inbox nests in each nest box was determined by carefully separating the nests starting from the uppermost nests to the bottom nest.

The abandoned Open nests and Inbox nests were collected, and analyzed for the nesting materials. In case of Open nests, they were collected carefully and the entire nesting material was made free from the dried excreta. The entire nest was then weighed and the nesting materials were separated systematically from core (inner cup) of the nest to outer structural materials. The quantity of all the nesting materials was determined. For Inbox nests, the nests were removed from the rear window, and then made them free from dried pellets and dust. Then each of the nests was weighed separately to find out the quantity of nesting materials in each nest. The nesting materials were separated carefully and calculated for their proportion.

Statistical analysis was carried out by using T-test (paired two samples for mean) to identify the significant differences between Open and Inbox nests with respect to quantum

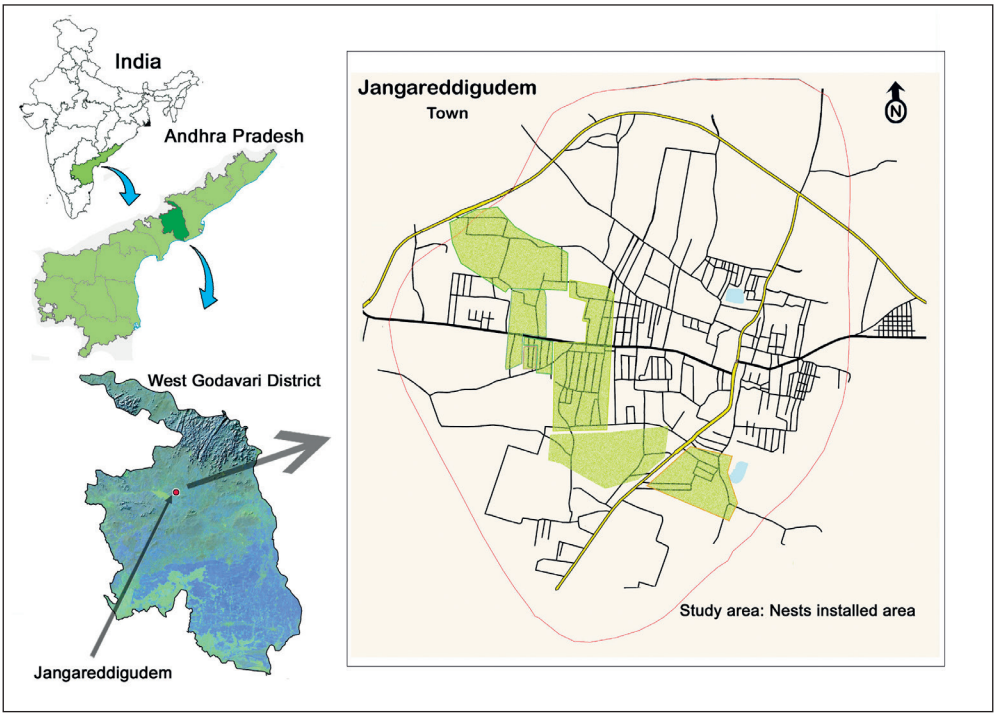

Figure 1. Map showing the study area (Nest boxes installation area)
1. ábra A vizsgálati terület térképe

of each nesting material type used, weight of the nests and time taken for nest construction by the House Sparrow. For statistical analysis, the nesting materials collected from 40 Inbox and 40 Open Nests was compared to find out the significant differences between the two.

Construction time for the nests was also observed. For Open nests, paired sparrows use to search for crevices. If any secured place they find, will start the collection of materials. For Inbox nests from the day of installation we observed for occupancy, then onwards regular monitoring was done for collection of nesting materials from structural and up to the thermal insulators.

Results

For the analysis of nesting materials, we surveyed around 40 Open nests, those were made on sanitary pipes, ventilators, and available crevices. The average weight of Open nests was found to be 94 g (range: 52–142). Among the observed Open nests, 37.5% were constructed with more than 100 g of material, 27.5% of the nests build with 91 to 100 g of material, and 35% of the nests with 50 to 90 g of nesting material.

Among the nesting materials of Open nests, highest quantity was observed with dūrvā grass *(Cynodon dactylon)* with 43%, and the second-largest quantity was found with jute fibre *(Corchorus olitorius)* with 15.41%. In the Open nests, the paddy grass *(Oryza sativa)* was used as the outermost structural material *(Figure 2)*.

With regard to the frequency of nesting materials, dūrvā grass was found in all the nests. The lining material that is jute fibre was found in 83% of the nests. Paddy grass was found only in 62.5% of the nests that were made on sanitary pipes. Broom fibre *(Thysanolanena maxima)* was used in 95% of the nests *(Table 1)*.

In all the nest boxes, we have noticed more quantity of the nesting material in the first nest (Bottom most Inbox nest). The Sparrows built the first Inbox nest by collecting structural materials up to a height of 3 inches. To make the nest to such a height, they collect the available structural materials such as dūrvā grass, coconut fibre, broom fibre, etc. Of the examined nests, the average weight of the bottom nest was found to be around 42.2 g. On observation, it was noticed that Sparrows fill the first nest (bottom most) up to the closure of the rear window (an opening at the rear bottom, used to remove old Inbox Nests, without any disturbance to the nest box). From the second nest onwards, the weight of the nests was found to decrease by 20 g. The average weight of the second nests was about 21.23 g. The average weight of all the nests, from bottom to superficial layers was shown in *Figure 3*. For the construction of the 11th nest, Sparrows collected only 10.7 g of nesting material *(Figure 3)*, which comes to around one-fourth of the first nest. The weight of the nests is inversely proportional to the height of the nest box.

The data shown in *Table 2* represent the number of nests in examined 100 nest boxes. In 50% of the nest boxes, Sparrows made seven Inbox nests. In rare case, as in case of nest box no. 23, consisted of 14 Inbox nests *(Table 2)*.

Among all the surveyed Inbox nests, on an average more than one third of the nesting material was dūrvā grass that constituted around 36.4%. Lining material, jute fibre (extracted from gunny bags, jute rope and jute thread (used for packing of grocery) was

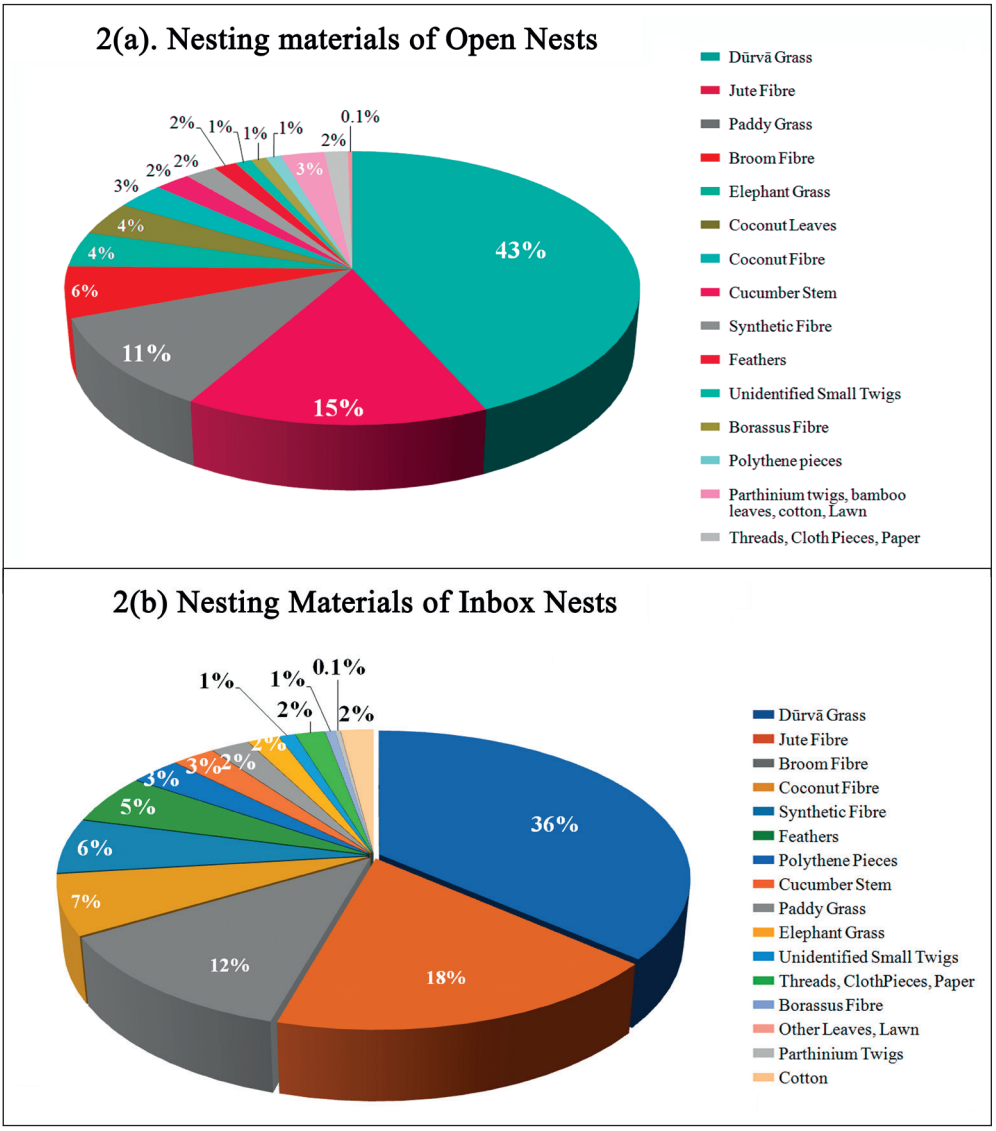

Figure 2. Composition of nesting materials in Open nests and Inbox nests
2. ábra A fészekanyag összetétel a két fészektípusban

the second-largest material, and constituted around 18.08%. Along with dūrvā grass, broom fibre and coconut fibre were found in all the nests, and constituted around 5.03% and 2.78% of the total weight, respectively *(Table 1)*.

Out of 15 structural materials that were tested, null hypothesis (H_0) was rejected for 11 (dūrvā grass, goose grass *(Eleusine indica)*, paddy grass, carrot grass *(Parthenium hysterophorus)* twigs, unidentified leaves, coconut leaves, lawn, cucumber stem (*Cucumis* sp.), bamboo leaves, palmyra *(Borassus flabillier)*, small twigs), indicating that there is significant difference in the quantum of these structural materials between the two types of

Table 1. Composition of nesting materials in Open and Inbox nests
1. táblázat A fészekanyag összetétele a két fészektípusban

Structural Materials					
				Open nests	Inbox nests
No.	**Species / material**	**Origin**	**Parts used**	**Weight (g)**	**Weight (g)**
1	Dūrvā grass *(Cynodondactylon)*	P	Stem & Leaves	40.4	15.38
2	Broom fibre *(Thysanolanena maxima)*	P	Inflorescence	5.5	5.03
3	Coconut *(Cocas nucifera)*	P	Fibre of fruit	3.12	2.78
4	Cucumbers *(Cucumis species)*	P	Stem	2.15	1.11
5	Paddy grass (*Oryza sativa)*	P	Grass	10.55	0.97
6	Goose grass *(Eleusine indica)*	P	Leaves	4.025	0.82
7	Small twigs (unidentified)	P	Twigs	1.2	0.42
8	Palmyra (*Borassus flabillifer)*	P	Fibre of petiole	0.875	0.27
9	Neem *(Azadirecta indica)*	P	Leaves	0.15	0.025
10	Nylon threads	M	Fibre	0.67	–
11	Carrot grass (*Parthenium hysterophorus)*	P	Twigs	0.75	0.15
12	Drumstick *(Moringa oleifera)*	P	Bark	–	0.1
13	Leaves (Unidentified)	P	Leaves	0.65	0.1
14	Tamarind *(Tamarindus indica)*	P	Leaves	0.17	0.087
15	Lawn grass *(Zoysia japonica)*	P	Leaves	0.65	0.075
16	Coconut *(Cocas nucifera)*	P	Leaf fibre	0.45	0.075
17	Bamboo*(Bambusa vulgaris)*	P	Leaves	0.65	0.02
18	Jujube *(Zizipusjujube)*	P	Thorns	–	0.01
Lining and core of nest					
19	Jute *(Corchorus olitorius)*	P	Fibre	14.475	7.63
20	Synthetic fibre	M	Fibre	2.05	2.5
21	Polythene	M	Pieces	0.85	1.31
22	Cotton *(Gossypium herbaceum)*	P	Cotton fibres	0.775	0.825
24	Cloth pieces	M	Pieces	0.625	0.375
25	Domestic fowl *(Gallus gallus)*	A	Feathers	1.67	1.87
26	Silk cotton *(Bombax cieba)*	P	Fibre	0.23	0.051
27	Threads	M	Small pieces	0.64	0.025
28	Paper	M	Small pieces	0.57	0.175
29	House Sparrow *(Passer domesticus)*	A	Feathers	–	0.01
30	Cigarette buds	M	Fibre	0.101	0.01

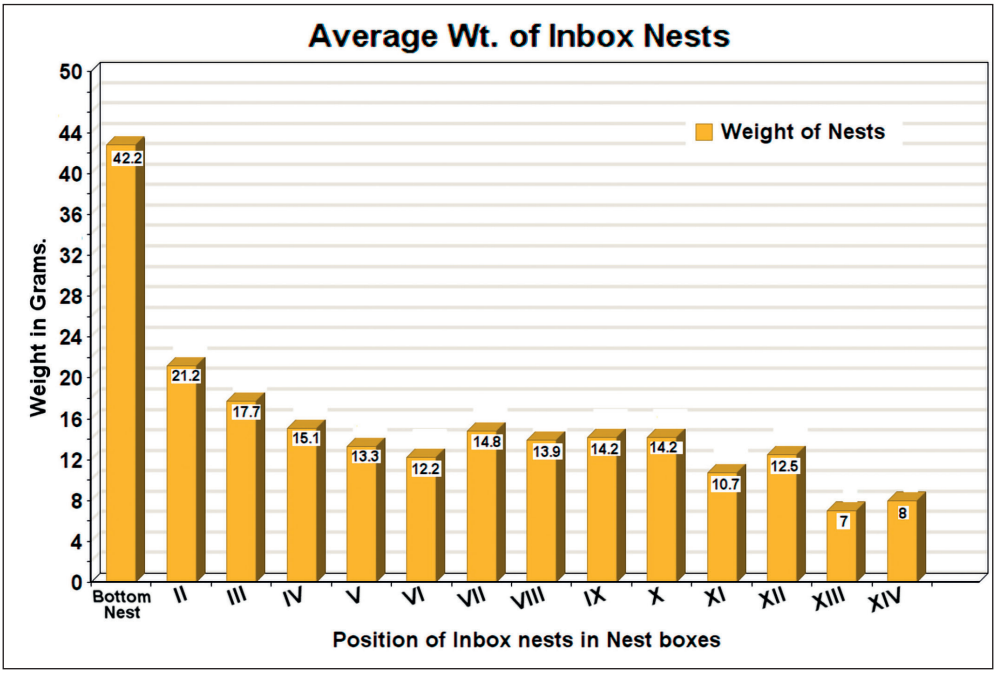

Figure 3. The average weight of Inbox nests in nest boxes
3. ábra A fészekoduba rakott fészkek átlagos tömege

nests. These 11 structural materials were mainly used for construction of outermost part of the nest i.e. at base level to build a basic platform. In case of Open nests, Sparrows need more of structural materials to make this outermost platform to fill surrounding gaps where they make the nests. For the other four structural materials (coconut fibre, broom fibre, tamarind leaves *(Tamarindus indica)* and neem leaves *(Azadirecta indica)* leaves), H_0 was accepted indicating that there is no significant difference between the two types of nests with regard to the quantum of these four structural materials. Among these four structural materials, Sparrows use coconut fibre and broom fibre to form the inner rim of the basic platform and hence there is no much difference in their quantum between the two types of nests. Whereas neem leaves and tamarind leaves were used as outer structural materials and were rarely found in few of the nests *(Table 3a)*.

Table 2. Number of nests in nest boxes (layer wise)
2. táblázat A fészkek száma a fészekodúkban

Nest location in the Nest box from bottom to top	First Nest / Bottom Nest	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Ninth	Tenth	Eleventh	Twelfth	Thirteenth	Fourteenth
No. of examined nest boxes that contained the specified nests	100	98	95	90	75	63	50	40	17	13	8	4	3	1

Table 3. T-test results of comparative analysis of quantum of each nesting material type (a), weight of nests (b) and construction time (c) between Open and Inbox nests

3. táblázat Az egyes fészkelőanyag-típusok mennyiségére (a), a fészkek tömegére (b) és az építési időre (c) vonatkoztatott összehasonlító elemzés (T-teszt) eredményei a két fészektípus között

(a) Analysis of Structural Materials

S. No.	Material	Mean		Variance		Obs.	H.M.	df	t-Stat	H_0
		Open Nests	Inbox Nests	Open Nests	Inbox Nests					
1	Dūrvā grass	40.4	15.388	197.990	79.122	40	0	39	9.3576	Rejected
2	Goose grass	4.025	0.825	14.794	3.840	40	0	39	4.7554	Rejected
3	Paddy grass	10.55	0.975	251.638	1.102	40	0	39	3.8933	Rejected
4	Carrot grass	0.75	0.150	1.423	0.490	40	0	39	2.8006	Rejected
5	Leaves (unidentified)	0.65	0.100	1.874	-1.231	40	0	39	2.5619	Rejected
6	Coconut leaves	0.45	0.075	0.450	0.075	40	0	39	2.7328	Rejected
7	Lawn	0.65	0.075	3.926	0.225	40	0	39	1.9936	Rejected
8	Cucumber stem	2.15	1.113	5.874	2.019	40	0	39	2.2483	Rejected
9	Bamboo leaves	0.65	0.025	5.413	2.459	40	0	39	1.6899	Rejected
10	Palmyra fibre	0.875	0.275	3.599	0.615	40	0	39	1.7883	Rejected
11	Neem leaves	0.15	0.025	0.285	0.025	40	0	39	1.4035	Accepted
12	Small twigs	1.2	0.425	1.497	5.635	40	0	39	1.7247	Rejected
13	Tamarind leaves	0.175	0.088	0.302	0.306	40	0	39	1.0447	Accepted
14	Coconut fibre	3.2	2.788	8.677	7.217	40	0	39	0.6536	Accepted
15	Broom fibre	5.5	5.038	13.897	12.441	40	0	39	0.5261	Accepted

*tested at 5% level of significance

(b) Analysis of Lining Materials

S. No.	Material	Mean		Variance		Obs.	H.M.	df	t-Stat	H_0
		Open Nests	Inbox Nests	Open Nests	Inbox Nests					
1	Jute fibre	14.475	7.638	37.846	33.538	40	0	39	5.2678	Rejected
2	Threads	0.641	0.026	0.657	0.026	40	0	39	4.9152	Rejected
3	Paper pieces	0.575	0.025	2.199	0.025	40	0	39	1.1380	Accepted
4	Cloth pieces	1.025	0.225	4.128	0.281	40	0	39	1.4034	Accepted
5	Polythene pieces	0.850	1.640	0.797	7.494	40	0	39	-1.7311	Accepted
6	Silk cotton	0.231	0.051	0.445	0.103	40	0	39	1.4818	Accepted
7	Cigarette buds	0.102	0.076	0.147	0.072	40	0	39	0.3295	Accepted
8	Synthetic fibre	2.050	2.563	2.459	4.490	40	0	39	-1.2313	Accepted
9	Cotton	0.825	1.188	1.379	2.317	40	0	39	-0.2169	Accepted
10	Feathers	1.675	1.875	3.097	2.894	40	0	39	-0.4554	Accepted

*tested at 5% level of significance

(c) Analysis of Weight of the Nest and Construction Time

Parameter considered	Mean		Variance		Obs.	H.M.	df	t-Stat	H_0
	Open Nests	Inbox Nests	Open Nests	Inbox Nests					
Weight of the nest	94.07	42.203	497.97	160.99	40	0	39	11.03	Rejected
Construction Time	22.57	14.75	8.096	1.423	40	0	39	15.943	Rejected

*tested at 5% level of significance

It is also evident from the results that the usage of dūrvā grass in Open nests was significantly more compared to their usage in Inbox nests ($P < 0.001$). The quantum of paddy grass was also more in Open nests with 11.21% of the total weight, which is significantly more in Open nests than Inbox nests ($P \leq 0.001$). The cucumber stem was widely used in both Open and Inbox nests, almost in equal number of nests (occurred in around 70% of the nets). But the quantum of cucumber stems was significantly more in Open nests ($P = 0.015$).

Among the tested ten lining materials, H_0 was accepted for eight (feathers, cloth pieces, synthetic fibre, cotton, silk cotton, paper pieces, cigarette buds and polythene pieces), indicating that there is no significant difference in the quantum of these lining materials between the two types of nests. This is because of the uniform size of the cup of this bird. Lining materials such as jute fibre and threads rejected null hypothesis, indicating that quantum of these materials between the two types of nests is significantly different. The usage of jute fibre was significantly more in Open nests, which cover 15.41% of the total weight of the nests. It could be due to the uneven space that is left after construction of basic platform (outermost and inner rim) using structural materials *(Table 3b)*.

To comparison, the jute fibre was occurred in all Open nets and its usage was found in 87% of the Inbox nests, with a quantity of 15.41% of the total weight in Open nests and 18% in Inbox nests. Feathers were also found to be predominant lining materials found in 77% of the both types of nests. But the quantum of feathers was significantly more in Inbox nests with 4.43% of the total weight. The usage of synthetic fibre and polythene pieces was more in Inbox nests than Open nests.

With regard to the type of materials (both structural and lining) that were used for construction of nests by House Sparrows, there is no much difference between the two types of nests.

From the results of statistical analysis, it is clear that the weight of the nests is more for Open nests and the analysis rejected the null hypothesis with a significant P value ($P < 0.001$). Hence from the test results, it is concluded that the weight of nesting materials used by House Sparrow for construction of Open nests and Inbox nests significantly differ *(Table 3c)*.

From the results, it is clear that Open nests takes more time for their construction compared to Inbox nests, and the analysis rejected the null hypothesis with a significant P value ($P < 0.001$). Hence, from the test results, it is concluded that the construction time taken by the House Sparrow for construction of Open nests and Inbox nests significantly differ, and it is more for Open nests *(Table 3c)*.

Discussion

As per the observations by Fitzgerald and Martin (2005), House Sparrow exhibit behavioral flexibility. They utilize any kind of nesting materials for their nest building, which are readily available in their surroundings. Our current study also revealed the same flexible behavior. For construction of nests, Sparrows collected mostly green material. The observational studies of Dubiec *et al*. (2013) revealed that green materials in the avian nests decrease the abundance of parasites and pathogens. In addition to this, the volatile compounds of green materials also stimulate the immune system of nestlings.

The developed new generations by our nest box installations, utilized 29 different varieties of nesting materials. The uncommon materials like the peels of moringa stem *(Moringa oleifera)* were also found in the nests. Usage of paddy grass was found only in few nests as there is no paddy cultivation in the study area. Whatever the paddy grass that is present in the nests may be obtained from the cattle fodder.

The comparative analysis of the quantum of each of the nesting material type (both structural and lining materials) used by House Sparrow for constructing Open and Inbox nests revealed a significant difference with regard to quantum of each of the structural material type that is used by the Sparrows to construct both the nests. This could be due to the fact that Sparrows need more of the structural material to build a safer outer base in case of Open nests, and comparatively lower quantity of each of the structural material is sufficient to build Inbox nests due to availability of basic structure.

When construction comes to the core of nest with lining materials, our observations state that the quantum of each of the lining material that is used remains almost same. This is because each of the species make cup according to its need and its size. Hence, there is no much variation in the quantity of each of the lining material that is used between Open and Inbox nests. In Inbox nests, synthetic fibre was found to be more compared to Open nests and this could be attributed to the availability of materials during construction time. But coming to the type of materials, almost similar kind of structural and lining materials were observed in both the nests.

On comparison, the Open nests needed two times more structural materials than the Inbox nests. Utilization of dūrvā grass was 7% more in Open nests. The paddy grass also found 9% more in Open nests than Inbox nests. This could be due to the fact that during initial phase of construction of Open nests, structural materials use to fell down and several attempts are needed to form the base which necessitates the use of more dūrvā grass and paddy grass. This comparison also indicates that they need double time period to build the Open nests with more effort. Utilization of goose grass was found in 10% of Inbox nests, where in Open nests it was used around 60% of nests. Bamboo leaves were found in only two Open nests where the bamboo plants are present. The structural materials like palmyra fibre *(Borrassus flabillifer)*, lawn, coconut leaves and lining materials like cotton (*Gossipium* sp.), cotton threads, jute threads constituted only 2% of the volume of Open nests.

Usage and composition of nesting materials depends on the availability of nesting materials in that location (Wimberger 1984). The same was reflected in our observations, at nest box no.339, most of the constructive material was peels of moringa stem. In two of the

nest boxes, fowl feathers were the major nesting materials, where the rearing of domestic fowl was noticed. At the nest box no.90, sparrow feathers (wing feathers primaries and secondaries) were found in the core of the nest. Usage of anthropogenic materials was also noticed and they may also benefit the nestlings. As per Suárez-Rodtguez *et al*. (2013), the presence of cigarette butts in the sparrow nests prevented the pests, it could be short term but increased proportion of cigarette butt in nests along with the cellulose also increases genotoxicity in the blood cells of the nestlings (Suárez-Rodtguez & Garcia 2014). In our studies, we found butts of cigarettes only in two nests, but no mortality was recorded. The presence of anthropogenic materials like nylon fibre caused the death of two fledglings in one Open nest during our observational studies. The fibres coiled irregularly around the legs of the fledglings and that detained them in the nest.

According to Dhanya *et al*. (2016), the presence of animal matter like fowl feathers and human hair (in the core of the nest) may increase the presence of parasites and this could be a potential menace for the tolerance of nestlings and the procreation capacity of the parents. Lombardo *et al*. (1995) experimentally proved the importance of feather lining in the nests and its benefits to birds. Feather lining benefits the birds in two ways, as insulators and also act as a barrier between nest parasites and nestlings. Nest insulation affects the brooding performance. Lombardo *et al*. (1995) in their experimental studies on Tree Swallows *(Tachycineta bicolor)* proved that the nests without feather lining delayed the incubation and hence resulted in production of fewer fledglings than the feather lining nests.

In our studies, feathers were found in 84% of the Inbox nests and 80% of the Open nests. The fledgling success was recorded 83% in the Inbox nests. Since remote time, most of the birds used feathers to construct the core of the nests because of their thermos resistant property. The dry protein substances like feathers and hairs after shedding from the body never become a habitat for parasites, unless they expose to water continuously. In our studies, as most of the nest boxes were installed under the roof, there is no chance of wetting of the nests due to rains and other reasons. As per the observations of Blue Tits *(Cyanistes caeruleus)* nests by Hanmer *et al.* (2017), increase in the anthropogenic material in the nests decreases the arthropods and also affects the breeding success. As per our observational studies, there was no impact of usage of anthropogenic materials in the abundance of arthropods and the breeding success.

Conclusion

In conclusion, Open nests need more of structural materials than the Inbox nests. This also indicates that sparrows need more time and effort to build Open nests compared to Inbox nests. The total amount of materials used for the construction of first nest in Inbox nests is less than half of the Open nest material. In other words, Sparrows need to collect more than double the quantity of nesting material for the construction of Open nests. This also requires more effort and time. There is 10 to 12 days delay in egg laying from the day of start of nest construction in Open nests, than the Inbox nests and it may impact successive breeding attempts of the pair of the Sparrows.

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