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RESEARCH ARTICLE

PROBABLE REASONS FOR DECLINING POPULATIONS OF HOUSE SPARROW, *PASSER DOMESTICUS* (LINNAEUS) (PASSERIFORMES: PASSERIDAE) IN RURAL VELLORE DISTRICT, TAMIL NADU, INDIA.

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Abstract

This study pertains to evaluation of probable reasons for declining populations of Passer domesticus, in 153 villages in rural Vellore district, Tamil Nadu. A questionnaire survey was undertaken with 1715 residents of houses where birds built nests. A total of 1903 active nests and 6452 *P. domesticus* were enumerated. Lack of nesting sites, change from the traditional architecture of houses, declining areas of cultivation, lack of food grains, destruction of hedgerows, invasion by exotic weeds, threat from predators, and killing due to superstitious beliefs are the reasons for decline of *P. domesticus* populations. Replacement of traditional tile or thatched roofing of houses by flat, concrete roofs reduces nesting substrata. Replacement of traditional handlooms by power looms (*n*=3022) also causes loss of habitats of birds in 10 villages having predominant weaver community. Incidents of killing of sparrows for meat due to superstitious beliefs occurred in 42 villages. Active nests and birds were found in 116 villages where mobile phone towers were installed.

Introduction:-

The house sparrow, *Passer domesticus* (Aves: Passeriformes: Passeridae), a native of Eurasia, is among the most widespread and abundant birds in the world (Anderson 2006). Their geographical range extends over large parts of the world, such as Europe, North Africa, and parts of Asia. In the Indian subcontinent, *P. domesticus* are found in India, Pakistan, Bangladesh, Sri Lanka, Andaman Islands and Maldives (Ali & Ripley 1987). They live closely associated with human-dominant landscapes and build nest in holes and crevices of human-made structures (Summers-Smith 1988). Breeding activities of these birds mostly occur in February—September in India and nest building is most intense during January—May (Vincent 2005).

Passer domesticus has been an integral part of Tamil culture in the state of Tamil Nadu, South India dating back to at least the Sangam Age (1st century BC—2nd century AD). Evidences of *P. domesticus* are available in *Aganãnuru* in which these birds are referred to as *Kuree* in Tamil. In classical Tamil literature, *P. domesticus* are also referred variously as *oorpul, adaikkalakuruvi, kalli, kalingam, kuligam, sagadam, pulingam, and manaiyuraikuruvi. Kurunthogai* (verse 72) indicates that *P. domesticus* live in households, eat the grain dried in

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house backyards, dig cow dung in streets, and settle with their nestlings during nights. *Purananuru* includes references to the fact that while making nests, house sparrows use broken strings of an ancient musical instrument y*azh* and hair shed by animals. The earliest Tamil epic *Silapatikãram* quotes *kuruvi*, while referring to a tribal community in *Vanchi-k-kãndam* and the kuruvi is P. domesticus. Songs of freedom fighter-cum-poet Subramania Bharathi which kindled patriotism and nationalism during freedom struggle include references to *chittu-k-kuruvi*. Several film songs after 1950s have included references to *P. domesticus*. In the name of house sparrow, *Chittu-k-Kuruvi Kaliamman Temple* in Madurai city constructed in 1960s celebrates *P. domesticus*. Flocks of these birds used to fly around the temple and surrounding areas all day, with grain trade occurring busily in the vicinity of the temple. Populations of these birds have now totally vanished from the temple areas (Arockiaraj 2015).

In recent decades, the species has undergone significant declines across the Eurasian portions of its distribution (Leasure 2011) and North-Western Europe (Prowse 2002; Mulsow 2005, 2006). The Chinese campaign against *P. domesticus* under the perceived notion that these birds occur as invasive pests in China resulted in killing of millions of birds in 1958 (Deepa 2013). Since mid 1970's, rural and urban/suburban populations in the UK have declined by 47% and 60% respectively (Robinson et al. 2005). From 1979, rural populations of *P. domesticus* in Britain declined by 60%, but stabilized at reduced levels in the 1990s (Summers-Smith 2005). It is reported that the once widely distributed species in most parts of Europe and Asia is slowly disappearing from urban areas (Gulati 2005). Many hypotheses are postulated to explain decline of *P. domesticus*, such as lack of nesting sites in modern and renovated buildings (Vincent 2005; Anderson 2006; Shaw et al. 2008), shortage of food supply (Bower 1999; Newton 2004), and increasing developmental activities (Summers-Smith 2003). The species was red-listed in U.K. in 2002 and declared as near-threatened in Germany as a result of decline (Summers-Smith, 2005). In India their populations have decreased considerably across Bengaluru, Mumbai, and Hyderabad. (Rajashekar and Venkatesha 2008; Daniels 2008; Khera et al. 2010; Bhattacharya et al. 2010). Predation from the domesticated and wild cats (*Felis catus*, *Carnivora: Felidae*) and sparrow hawks (*Accipiter nisus*, *Accipitriformes: Accipitridae)*, and the electromagnetic radiation from cell-phone towers are considered as reasons for their decline (Balmori & Hallberg, 2007). *Passer domesticus* populations are vanishing from different metropolises and in newly developing urban areas (Srivatsava et al. 2010). A survey by the Indian Council of Agricultural Research confirms that the house sparrow population in Andhra Pradesh has dropped by 80% and in other States such as Kerala, Gujarat, and Rajasthan by 20%, while in coastal areas the drop is close to 80% (Bhattacharya et al. 2010). According to a Bombay-Natural History Society's study, the population of *P. domesticus* is lower at present than in the past and this is consistent across the country (Citizen Sparrow 2018). International Union for Conservation of Nature (IUCN) Red List has evaluated the house sparrow's conservation status as 'Least Concern' (Birdlife International 2012).

In this paper, therefore, I sought answer to the question considering the growing concern over the decline of *P. domesticus* population in India in general: What are the probable reasons for decline of its populations in rural villages of Arakkonam and Nemili taluks, Vellore district, Tamil Nadu?

Materials And Methods:-

Study Area:-

Arakkonam (13^{o} 04'N & 79 ^{o} 40'E) and Nemili (12^{o}35'N & 78^{o}30'E) taluks are situated in the north-eastern part of Tamil Nadu, 70 km east from the district headquarters Vellore town (12^{o}15'N–13^{o}15'N & 78^{o}15'E-79^{o}50'E) and 71 km west from the state capital Chennai (13^{o}5'N & 80^{o}17'E) covering 828 km^{2} with a district population of 39,36,331 (1011 census) (Vellore 2017). The present survey was carried out in 153 villages covering both Arakkonam and Nemili taluks (Fig. 1). The principal occupation of people of these areas is agriculture followed by weaving. The altitude of the area is 81 m AMSL. Soil is made of red-sandy loam and black-cotton soil. The major crops of this area are *Oryza sativa*, *Sorghum bicolor*, *Pennisetum glaucum*, *Eleusine coracana*, *Setaria italica*, *Saccharum officinarum* (Poaceae), *Vigna radiata* and *Arachis hypogaea* (Fabaceae). Monoculture of *Casuarina equisetifolia* (Casuarinaceae) is common in the water-scarce parts of the taluks. Cultivation of ornamental flowers, and vegetables also occurs (vww.vellore.nic.in).The average annual rainfall of the district for the past 20 years (1997—2016) is 1037.8 mm. The monthly minimum mean temperatures are: min. 22.4^{o}C, max. 34.1^{o}C.

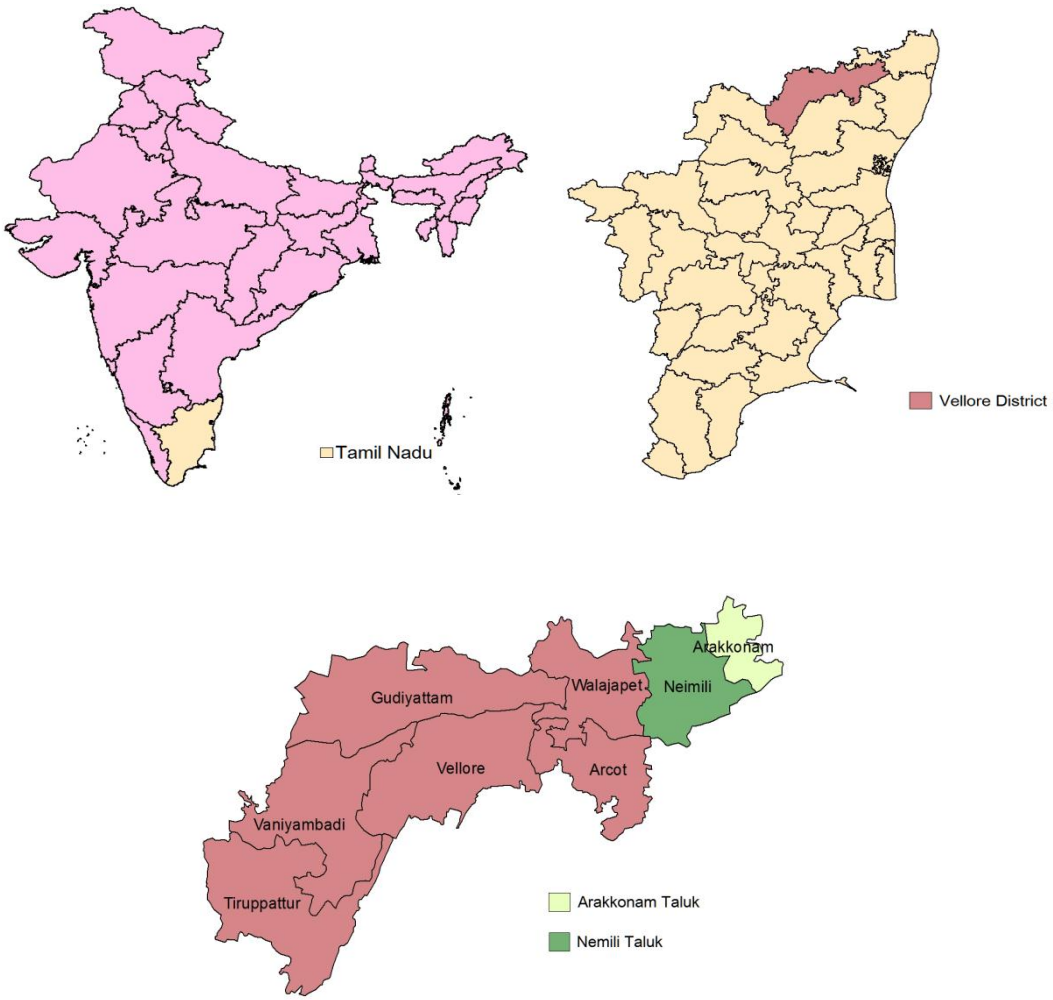

Fig 1:-Study area map: (a) India map showing Tamil Nadu, (b) Tamil Nadu map showing Vellore district, and (c) Vellore district map showing Arakkonam and Nemili taluks.

With help from local people (12), 1715 houses covering 153 villages in these two taluks were identified in which active nests and populations of *P. domesticus* were found. The houses were surveyed between 0600 and 0900 hours and 1500 and 1800 hours over three months (February—April, 2017). Then adult residents of those 1715 houses were interviewed using a Tamil questionnaire designed to contain details such as type of house, numbers of active nests, numbers of birds observed in the vicinity of nests/houses, predatory animals, incidence of hunting/killing bird for meat, and impacts of domestic electrical appliances. The numbers of mobile phone towers in the villages were verified and listed. Other than these, other biological notes on *P. domesticus* populations and their nests were made by direct observation using a pair of Super Zenith field binoculars (Model No. 20x50 Field 3^{O}, Jack Berg, El Paso, Texas, USA). The total count was used to develop the numbers of nests, types of houses preferred, and numbers of birds. In addition, 153 senior citizens, former civic representatives, farmers, and womenfolk, were interviewed using data sheets in Tamil and the details of past *P. domesticus* populations and their population trends over the last 30 years were tracked and recorded. Photographs and videographs were made using a digital camera (HDR-CX130, Sony Corporation, Minato, Japan) without disturbing the nests and birds.

Results And Discussion:-

A total of 1903 active nests and 6452 individuals of *P. domesticus* were enumerated in the human habitations (1715) of 153 villages covering Arakkonam and Nemili taluks, Vellore district. Based on the results of interviews conducted using the questionnaire, the probable reasons for population decline of *P. domesticus* were deduced as discussed below.

Fig 2:-(a) Temple in the name of House Sparrow (*Passer domesticus)* in Madurai city, Tamil Nadu (b) Male and female individuals perching on window grills, (c) *Passer domesticus* nest built in an unused table fan, (d) Nest of *Passer domesticus* on damaged street lamp, (e) Nest built on electric meter box in a residence, and (f) Female individual taking dust bath in the backyard of house.

Impact of powerlooms:-

Interactions with the elders of the villages revealed that prior to 1980, each street in the villages had hundreds of *P. domesticus*, which flew in flocks every day. They built nests in traditional concrete flat-terraced buildings, thatched/tile rooftop houses, cattle sheds, schools, Government buildings and street lamps. Sparrow also preferred to build nests in the vicinity of handlooms in the houses of weavers' community in 10 villages, such as Minnal, Narasingapuram, Guruvarajapettai, Valarpuram, Melkalathur, Paravathur, Sampathrayanpettai, Nagavedu, Nemili, and Panappakkam. Installations of handloom apparatus created many crevices/holes on the walls which became safe haven for sparrows to build nests. People in the weaver community and farmers believed that building of nests followed by successive breeding in their houses were good omens. Even the operations of handlooms created some noise, but the sparrows got accustomed to it and coexisted with the weavers. Likewise, sparrows became an integral part of the day to day activities of farmers in rural areas. This situation suddenly changed after 1980s. Power looms

had slowly replaced traditional handlooms in the rural areas and now 3022 power looms (Source: Assistant Director, Handloom & Textiles, Vellore district) are there in 10 villages where the weaver community is predominant. Hence the architecture of these houses changed resulting in the loss of nesting sites and noise pollution from power looms further drove away sparrows from the vicinity. The present investigation revealed that nests as well as sparrows were not to be found in the vicinity of buildings/houses where these 3022 power looms operate in the study area. The exact impact of power looms and its noise pollution on the nesting habits of *P. domesticus* needs further study.

Changes in the architecture of concrete buildings:-

The impact of change in architecture of houses on sparrow population has been studied elsewhere. Post-1984 homes are less attractive for nesting sparrows, as newer buildings, incorporating modern materials and constructed to confirm to current building regulations, seem to provide no access to the roof space (Wotten et al. 2002) and lack of holes on modern and renovated buildings is a probable cause of sparrow population decline in the UK (Vincent 2005). Summers-Smith (2003) has observed that reduction in the availability of suitable nesting sites in modern buildings and renovated old buildings must have been responsible for dwindling *P. domesticus* populations. *Passer domesticus* were avoiding newer buildings (built after 1985) or those that had undergone extensive roof repairs (Shaw et al. 2008). *Passer domesticus* populations decreased between 2005 and 2012 in Wrzecion, Poland due to renovation of old buildings for insulation (Wegrzynowicz 2012).

The traditional tiled/thatched houses in the area of study had gaps between roof and wall, and open windows, allowing free movement of birds even when the houses were locked. *P. domesticus* prefer to build nests within houses and cattle sheds to protect their nests and nestlings from possible predators. From 2007—2008 to 2017—2018, the government constructed 22,600 concrete flat-rooftop houses for rural people in these two taluks under free housing schemes (Vellore 2018). These dwellings which restrict entry as compared to the traditional houses have resulted in reduction of habitat suitable for nesting. Yet 50% of nests (n=3278) are in concrete houses. Sparrows avoid building nests on walls that are exposed to predators. They prefer to construct nests on lamps, electrical junction boxes, electrical fittings, ventilators, and holes and crevices formed on removal of scaffoldings from the walls after completion of construction in concrete flat-terrace houses having iron grill gates and windows with narrow bars, which preclude entry of predatory animals such as crows, cats, monkeys and sparrow hawks. The exact impact of modern buildings and renovated old buildings on the sparrow populations in the study sites is to be examined in detail.

Accidental Deaths:-

The Study revealed that electric ceiling fans which are common feature in every household pose a serious threat to sparrow populations as the birds are often killed by swirling fan blades. Such kind of mortality has been reported in 86 villages that were surveyed in this study. Five house holders have stated that during breeding season (April—May) in 2016, nests constructed on electric meter boxes were gutted owing to fire caused by short circuit. It is also revealed that in 15 houses, the eggs and broods fell down from nests accidentally causing destruction of eggs and death of broods.

Decline in areas of cultivation:-

Rapid industrialization and urbanization resulting in shifting of traditional practices of cultivation of cereals/pulses to non-agricultural sectors also causes lack of food grains and insect fauna for the sparrows. Declining trend of cultivation, harvesting, drying and other activities relating to processing of cereals in rural areas caused acute shortage of grains to the birds. According to the Statistical department, Vellore, 43,576 hectares of lands were under cultivation in 1984—1985, and this has reduced to 25,677 hectares in 2014—2015 i.e. 41% decrease in areas of cultivation. Hence, reduction in cultivation also might have caused decline in *P. domesticus* populations.

Felling of native trees and invasion by exotic plants:-

Traditional rural houses are surrounded by at least a few native plants. Due to indiscriminate felling of these trees and fallowing of cultivable lands, these areas are invaded and dominated by weeds (invasive alien species), such as *Prosopis juliflora*, *Lantana camara*, *Ipomoea carnea*, and *Parthenium hysterophorus*. Carolina et al. (2010) had observed that arthropod abundance was reduced by 39% and species richness by 19% in the experimental plots invaded by the exotic plant species. Similarly the spread of exotic plants may cause much less arthropod material being available to the sparrow chicks.

Destruction of hedgerows:-
Urbanization and contemporary landscaping are doing away with hedgerows and that has also contributed to disappearance of sparrows. Chamberlain et al. (2007) has observed that the destruction of hedgerows in private gardens and horticulture areas reduce density of *P. domesticus* populations. Development of urban areas results in losses of green space (Shaw et al. 2008) and existing vegetation harbor poor insect fauna caused reproductive failure of the birds due to lack of arthropod diet to its chicks (Southwood 2008). Destruction of vegetation on breeding ground has adversely affected sparrow populations (Heij 1985). Avian densities increased with arthropod richness (Thomas et al. 2011). Thick hedgerows around houses and native trees along the roads protected birds from predators, besides providing rich sources of arthropod fauna. Higher richness of arthropods through hedgerow management may increase the abundance and distribution of avian species which select for arthropod-rich habitat as a source of food (Aviron et al. 2007). Similarly house sparrows prefer to rest during day on hedgerows and loss of such hedgerows causes of loss of habitat and food.

Non-availability of water:-
Sparrows prefer to take dust and water baths habitually. House sparrows create small saucer shaped dust pits and bathe communally before they roost. Dust bath might help clean the feathers and skin from external parasites (Ali & Ripley 1983). Traditionally rural folk used to store water in pots and other utensils in the backyards of houses, which attracted sparrows to take bath as well as to drink. Water supply in closed pipes, and covered water storage have prevented sparrows from enjoying such pleasures particularly during summer seasons. Bitumen topped or concrete road surfaces in rural areas have deprived sparrows of dust baths.

Non-availability of grains:-
Sparrows feed on grains such as paddy, pearl millet, finger millet, sorghum and other millets, which spill during harvest, transportation, drying, grinding, and storage in houses, shops, and mills. Only seven active nests were observed in shops. The study reveals as grocery articles are packed in polythene covers, there is no spillage of grains in shops. Further, lack of crevices in the buildings and use of steel shutters hinder movement of these birds. Online trade, modern packing of groceries and separate locked grocery storage in houses have prevented spilling of grains. This has caused acute shortage of availability of food grains to sparrows.

Garbage disposals:-
Previously, rural people used to dump garbage in pits in the backyards of their houses. During decomposition, these organic materials encouraged populations of insects and worms, which were eaten by sparrows, or were fed to their chicks. Absence of such traditional solid waste management has resulted in non-availability of fauna to feed their chicks. Due to urbanization, spilled food grains and left-over cooked food are now disposed of in polythene bags and this reduces availability of food for the birds.

Impact of predators:-
In view of urbanization and increasing population in rural areas, generation of huge quantities of garbage and recycling processes at garbage dump yards has resulted in greater number of house crow (Corvus plendens: Passeriformes: Corvidae). Crows could be a nuisance for sparrows because of their kleptoparasitic behavior and their tendency to predate eggs and chicks from nests (Long 1981; Cramp 1994; Khera et al. 2009). In eastern Africa crows are known to pillage passerine nests (Lim et al. 2003). House crow, sparrow-hawks (Accipiter nisus: Accipitriformes: Accipitridae), cats (Felis catus: Carnivora: Felidae), monkeys (Macaca radiata: Primates: Cercopithecidae), and snakes are the potential predators to *P. domesticus*. In four instances noticed in the area of this study, monkeys had destroyed nests constructed on trees and shrubs in the backyards of houses. Common crows freely enter human residences through grill gates, windows, doors, and explore for sparrow nests, destroying eggs and chicks. Twenty-four house holders have stated that crows visit their houses chasing adult sparrows and predate eggs and broods. Increasing number of predators and their continuing attack on the thinning populations of *P. domesticus*, their nests and nestlings are principal causes for declining population of sparrows.

Mobile phone tower radiation:-
Electromagnetic radiation from cell phone towers is also one other reason for the decline of sparrow population (Balmori & Hallberg 2007). However, experimental studies involving ex-situ simulations of different strengths of electro-magnetic radiations in Europe have yielded mixed results on their impacts on reproduction of birds, and no conclusive evidence has been produced so far. Interactions with villagers during this study revealed that even before the installations of mobile phone towers at rural areas, in the 1980s, *P. domesticus* started to disappear. The study

also revealed that 73.5% nests (*n*=1398) and 73.9% sparrows (*n*=4768) were observed in 116 villages where mobile phone towers are installed. Even after the installation of mobile phone towers, these birds survive in the villages where mobile phone towers exist. Hence, the exact impact of electro-magnetic radiations from the mobile phone towers on the survival of *P. domesticus* is to be studied in greater detail.

Superstition:-

Some of the traditional health practitioners in the rural areas used to sell medicine called 'Chittukuruvi Legiyam' made with ingredients of meat of sparrow and the people believed that the consumption of either the meat of sparrow or legiyam (paste) has an aphrodisiac effect. Incident of selling of house sparrow meat at Karur district was reported in 2013, as a section of people in rural areas believed that herbal preparation of sparrow meat would enhance virility in men (Oppili 2013). The present survey revealed that incidents of hunting/killing of sparrow have been prevalent in 42 villages for meat due to such superstitious belief.

Conclusion:-

The probable causes for declining trend of *P. domesticus* was studied in 156 villages in rural Vellore district, Tamil Nadu. A total of 6452 birds, 1903 active nests, and mobile phone towers were counted in these villages (153). The replacement of traditional handlooms by power looms, structural modifications of houses to suit power looms, changes in the architecture of concrete houses, accidental deaths due to ceiling fans, declining areas of cultivation, replacement of native plants by exotic plants, destruction of hedgerows, non-availability water and mud to take bath, non-availability of food gains, predators and killing of birds for superstition may pose a threat to the populations of *P. domesticus*. Active nests and populations of *P. domesticus* occur in villages (*n*=116) where mobile phone towers are installed and the impact of radiations from such towers needs further study.

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