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FORAGING BEHAVIOUR OF BIRDS IN ORGANIC AND CONVENTIONAL CHEMICAL FERTILIZERS AGROECOSYSTEM

Sirsat CV, Gaikwad PB and Aher PD

Department of Zoology, Vinayakrao Patil Mahavidyalaya, Vijapur – 423 701, Dist. Aurangabad (MS) India.

Abstract:

Present study is an attempt to promote benefits from organic farming to enhance populations of agroecosystem farmbirds and to speculate importance of different aspects of organic farming in the local agricultural area. Use of vermicopost and vermiwash in place of chemical fertilizers and pesticides increasing area of organic farming made a significant positive impact on abundance of avian diversity. In the present study total 53 species among which insectivorous (43.40 %), omnivorous (35.85%), predatory (13.21%), and granivorous (7.54%), observed from organic farming out of which only 29 that is 54.72 % in which insectivorous (24,53%), omnivorous (20.75%), predatory (5.66%), granivorous (3.77%) were reported from conventional chemical fertilizers farming during the study period from July 2022 to December 2022.

Further, highest frequency for organic farm visiting birds was 209 and lowest frequency was 49, highest mean pecking rate recorded in the organic farming sites was 122 at morning hours and 109 at evening hours. Whereas, search time was comparatively higher in the conventional chemical fertilizers farming as compared to organic farming. Spearman's correlation coefficient for search time against pecking rate between organic and conventional chemical fertilizers farming were 0.978 which showed excellent correlation of bird search time against number of pecks in organic farming in contrast to chemical fertilizers farming.

Keywords: Foraging behavior, organic farming, agroecosystem, vermicomposting, avian diversity etc.

Material and methods:

Study site and location:

Vaijapur located at 19.92°N 74.73°E has a city with a municipal council and consists of 164 villages and has 7 revenue circle, situated on the Narangi river. Vaijapur is located 514 m (1,666 ft) above sea level on the western margin of the Deccan plateau in Aurangabad district in the Indian state of Maharashtra. It is bordered by the Nashik districts to the west, Kannad tehsil to the north, Gangapur tehsil to the east, and Ahmednagar districts to the south. Vaijapur is the headquarters of Vaijapur tehsil and also known as the Gateway of Marathwada. For this project from July 2022 to December 2022 we selected Lakh khandala, Aghur, Bhivgaon and Golwadi villages as shown in Map includes organic farming in the area for the study of foraging activities of some birds. In this area at least 150 farmers for their own and commercial purposes practising about 300 acres under organic farming.

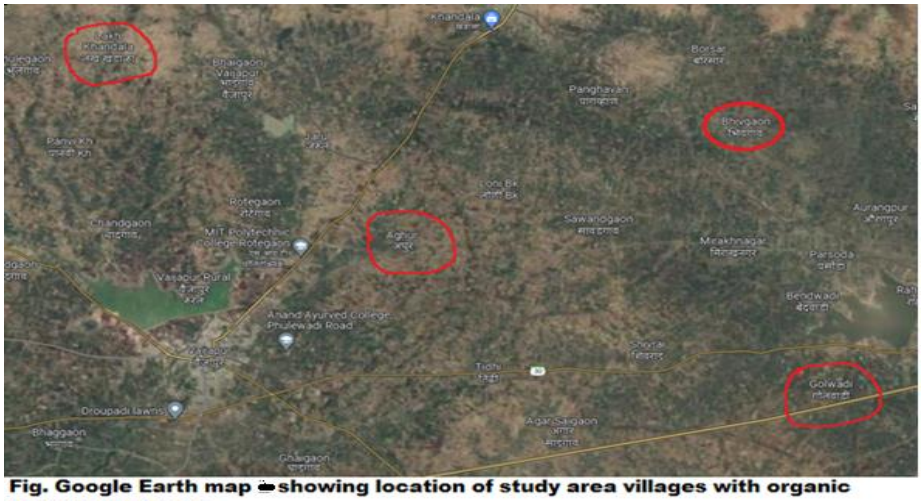


Fig. Google Earth map showing location of study area villages with organic farming practices

We used Point count and Line transect method (Burnham et al 1980) as used by Javed (1996), has been followed for estimating the abundance of birds in terrestrial habitat. Habitat wise linear transects in each plot were marked and monitored regularly during study period. The sampling was done by constant speed in each plot so as to spend equal number of hours of field work. The observations of all transect were maintained and analysed separately for abundance and plot preference of the birds. Four pairs of farms were selected (one pair = one organic and one conventional farm): 1 at Lakh khandala (FO1 & FC1), 1 at Aghur (FO2 & FC2), 1 at Bhivgaon (FO3 & FC3) and 1 at Golwadi (FO4 & FC4). Organic farms were selected by contacting and discussing with farm owners, Only authorised operations were included; that is, farms where no synthetic fertilizers or pesticides were used for at least three years and that met all other certification standards, including a holistic approach to maintaining ecological integrity and sustainability. Each organic farm was then matched with a nearby conventional farm having similar land cover features based on recommendations from organic farmers. Bird point counts were conducted at one farm pair on each survey date, with four repeated visits to each farm pair. Counts were conducted from July 2022 to Decemer 2022 in at all selected sites and it were conducted early in the morning that is 06:00–10:30 hr and evening hrs that is 16.00- 19.00hrs, on days without precipitation or excessive wind. At each location, birds were counted by observers using semicircular point counts (Freemark & Rogers, 1995). Observers conducted point counts while standing at field edges and recorded all bird detections in a 180° semicircle facing into the field during a 10-min point count, with an effective maximum sampling detection distance of 200–300 m (Freemark & Rogers, 1995, 2001). A pair of binoculars was used to observe birds. Observations were carried out while sitting at a distance from the birds to avoid causing any disturbance to their foraging behaviour. Other tools used for observation included a stop watch, digital camera, notebook and field guides. The following parameters were recorded: time of the day, bird species, bird's arrival time, bird's departure time, and number of pecks. The search time for each bird was calculated using the following equation: Bird's search time = bird's departure time - bird's arrival time All times were noted in seconds (sec). Descriptive statistics of the data were calculated. Spearman's correlation was applied to find the hypothesized associations. Correlation was set significant at the level of 0.05 (2- tailed). The analysis was performed using IBM SPSS Statistics and Microsoft Excel (Yousaf MA et al 2020).

Result and discussion:

Birds play an important and essential role in agricultural production by eating unwanted pests and vermin from both crops and livestock, helping to prevent the depletion of crops and ultimately agroecosystem. Birds are the good indicators of the ecosystem and take the benefit of favourable and healthy conditions of the ecosystem. Survey from July 2022 to December 2022 showed that insectivorous (43.40 %), omnivorous (35.85%),, predatory (13.21%), and granivorous (7.54%) as well as fruit eating, necterivorous and scavenger birds reported from all sites of the study area (Table 1). Studies on food and feeding behaviour of birds is now getting sizable importance. Total 53 species observed during the study hours out of which only 29 reported from conventional chemical fertilizers farming. This conclusion matches with Wilcox et al (2013) reported that ten out of the thirty six species tested showed a significant higher abundance value in organic agriculture. When the ratio was significantly different from zero, the abundance was 1.5–18 times higher in organic systems in comparison to conventional systems. Whereas Ailsa et al (2009) have concluded that bird diversity is greater and abundance is around 50% higher on organic than on conventionally-managed farms. Promoting organic farming could, therefore, enhance populations of farmland birds many of which have fallen dramatically in Europe over recent decades. In the present study 54.72 % reported from the conventional chemical fertilizers

farming sites. Further Karin et al (2021) showed that the average (median) species numbers of flora on arable land were 95% higher under organic management as well as 61% higher for seed bank and 21% higher for field margin vegetation. For field birds, the species richness was 35%, and the abundance was 24% higher in organic farming.

Table 1 : The Checklist of birds from organic and chemical agroecological study area Vaijapur, (MS) India

Sr. No.	Order/ Family	English Name	Scientific Name	Location & Status	Habit/ Habitat
1.	**Galliformes** Phasianidae	Indian Peafowl	*Pavo cristatus*	FOA, FCA, RC	Omnivorous
2.	Piciformes Megalaimidae	Lineated Barbet	*Megalaima lineata*	FO1, RRa	Omnivorous
3.	**Upupiformes** Upupidae	Common Hoopoe	*Upupa epops*	FO2, FC1, RC	Insectivorous
4.	**Coraciiformes** Coraciidae	Indian Roller	*Coracias benghalensis*	FO1, FO3, RC	Insectivorous
5.	Alcedinidae	Small Blue Kingfisher	*Alcedo atthis*	FO2, FO4,RU	Predatory
6.	Dacelonidae	White-Breasted Kingfisher	*Halcyon smyrnensis*	FOA, FCA, RC	Predatory
7.	Meropidae	Small Bee-eater	*Merops orientalis*	FOA, FCA, RC	Insectivorous
8.	,,	Blue-cheeked Bee-eater	*M.persicus*	FO2, RRa	Insectivorous
9.	Cuculiformes Cuculidae	Brainfever Bird	*Hierococcyx varius*	FO4, FC3, RmRa	Omnivorous
10.	,,	Banded Bay Cuckoo	*Cacomantis sonneratti*	FO2, FC3, RmRa	Insectivorous
11.	Centropodidae	Lessser Coucal	*Centropus bengalensis*	FO1, FC1, RRa	Insectivorous
12.	,,	Greater Coucal	*C. sinensis*	FO2, FC3, RU	Insectivorous
13.	**Strigiformes** Strigidae	Spotted Owl	*Bubo bubo*	FO1, FO3, RS	Predatory
14.	,,	Spotted Owlet	*Athene brama*	FO1, FC2, RRa	Insectivorous
15.	Caprimulgidae	Indian Jungle Nightjar	*Caprimulgus indicus*	FO3, RU	Insectivorous
16.	Charadriidae	Red-Wettled Lapwing	*Vanellus indicus*	FO3, RC	Insectivorous
17.	,,	Yellow-wettled Lapwing	*V.malabaricus*	FO3, LmRa	Insectivorous
18.	Accipitridae	Black-shouldered Kite	*Elanus caeruleus*	FO2, FC4, RU	Predatory
19.	,,	Indian Shikra	*Accipiter badius*	FO2, RRa	Predatory
20.	Psittaciformes psittscidae	Rose ringed parakeet	*Psittacula krameri*	FOA, RC	Frugi and granivorous
21.	**Columbiformes** columbielae	Little Brown Dove	*Streptopelia senegalensis*	FOA, FCA,RC	Granivorous
22.	,,	Eurassian Collard Dove	*Streptopelia decaocto*	FOA , RC	Granivorous
23.	,,	Blu Roock Pigeon	*Columba livia*	FOA, FCA, RC	Granivorous
24.	**Passeriformes** Pittidae	Indian pitta	*Pitta brachyura*	FO1, RS	Insectivorous
25.	Irenidae	Common Iora	*Aegithina tiphia*	FO2, FC3, RU	Insectivorous
26.	Lanidae	Rufous-Backed Shrike	*Lanius schach*	FO1, RU	Predatory
27.	,,	Grey Shrike	*L. exubiter*	FO2, FC3, RU	Predatory
28.	,,	Eurasian Golden Oriole	*Oriolus oriolus*	FO1, FC4, RmS	Omnivorous
29.	,,	Black Drongo	*Dicrurus macrocercus*	FOA, FCA, RC	Omnivorous
30.	,,	Common Woodshrike	*Tephrodornis pondicerianus*	FO4, FC2, RC	Insectivorous
31.	,,	Small Minivet	*Pericrocotus cinnamomeus*	FO1, FC1, RS	Insectivorous
32.	Muscicapidae	Indian Chat	*Cercomela fusca*	FO3, MC	Insectivorous
33.	,,	Ultramarine Flycatcher	*Ficedula superciliaris*	FO4, FC1, MC	Insectivorous
34.	,,	Common Tailor bird	*Orthotomus sutorius*	FO3, RC	Insectivorous
35.	,,	Indian Robin	*Saxicoloides fulicata*	FOA, FCA, RC	Insectivorous
36.	,,	Oriented Magpie-Robin	*Copsychus saularis*	FO3, FC3, RC	Insectivorous
37.	,,	Black Redstart	*Phoenicurus ochruros*	FO4, RU	Insectivorous
38.	Sturnidae	Common Myna	*Acridotheres tristis*	FOA, FCA, RVc	Omnivorous
39.	,,	Brahminy Myna	*Sturnus pagodarum*	FO2, FC2, LmC	Omnivorous
40.	Paridae	Great Tit	*Parus major*	FO4, RS	Omnivorous
41.	Hirudinidae	House Swallow	*H. tahitica*	FO1, FC1, RC	Insectivorous
42.	Pycnonotidae	Red-Vented Bulbul	*Pycnonotus cafer*	FO4, FC2, RC	Omnivorous
43.	Silvidae	Large Grey Babbler	*Turdoides malcolmi*	FO3, FC2, RC	Omnivorous
44.	Alaudidae	Bush Lark	*Mirafra cantillans*	FO4, RU	Omnivorous
45.	,,	Galerida Crested Lark	*Galerida cristata*	FO3, FO4,RC	Omnivorous

46.	Corvidae	House crow	*Corvus splendens*	FOA, FCA,RC	Omnivorous
47.	Nectariniidae	Small Sunbird	*Nectarinia minima*	FO1, FO3, RU	Omnivorous
48.	,,	Purple Rumped Sunbird	*Nectarinia zeylonica*	FO3, FO4,RC	Omnivorous
49.	,,	Plain Flowerpecker	*Dicaeum concolor*	FO2, FO3, RRa	Omnivorous
50.	Passeridae	House Sparrow	*Passer domesticus*	FOA, FCA, RC	Omnivorous
51.	,,	Baya Weaver	*Ploceus philippinus*	FOA, FCA, RC	Omnivorous
52.	,,	White throated Munia	*Lonchura malabarica*	FO1, RmC	Omnivorous
53.	,,	Citrine Wagtail	*Motacilla citriola*	FO1, FO4,MC	Insectivorous

Note: FOA-all organic farm sites 1,2,3 & 4 sites, FCA- all chemical fertilizers farm sites1,2,3 & 4 sites, R- Residential, M-migratory, Lm-local migratory, Vc- Very common, C-common, U-uncommon, Ra- Rare, Rm- Residential migratory, S-stray

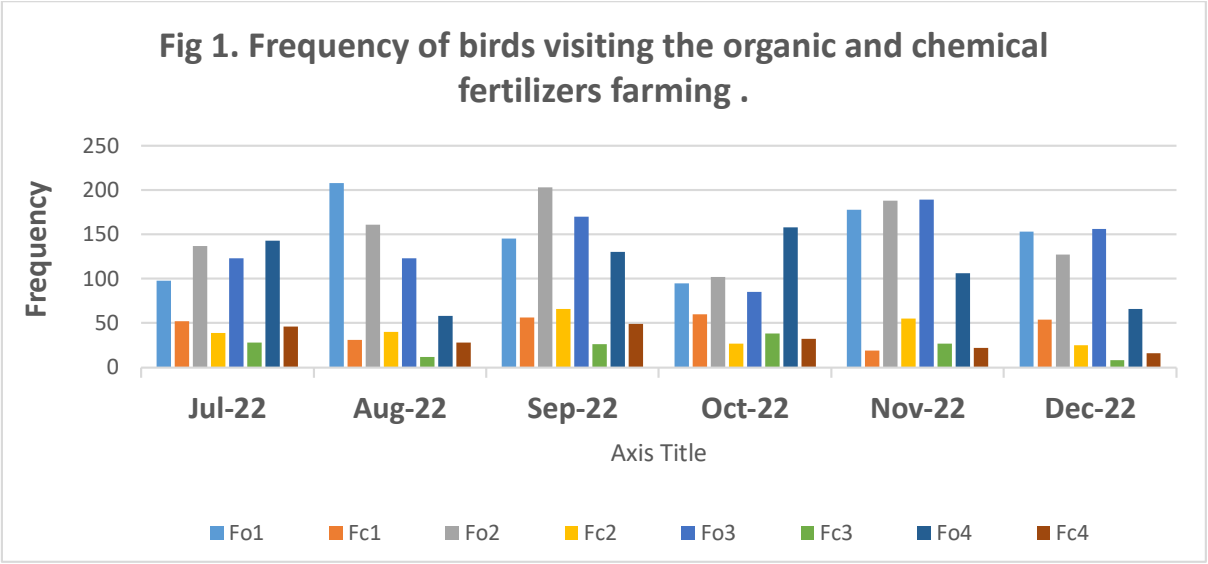
Table 2: Feeding habit of birds in study area

Sr. No.	Feeding habit of birds	Total number in organic farm	Percentage in organic farm	Total number in conventional farm	Percentage in conventional farm
1.	Insectivorous	23	43.40 %	13	24.53%
2.	Omnivorous	19	35.85%	11	20.75%
3.	Predatory	07	13.21%	03	5.66%
4.	Granivorous	04	7.54%	02	3.77%

Surveys of bird from all organic and chemical farming sites found that large number of insectivorous 23 species, omnivorous 19 species, predatory 7 species and granivorous 4 species (Table 2). Which clearly shows that a granivorous species observed very few (7.54%) in number from organic farming sites. Thus the birds are beneficial to agriculture as percentage of insectivorous, omnivorous and predatory bird are more than 92% in the agroecosystem. Selected birds species were concentrated for the study of frequency of visiting birds, pecking rate and search time per birds for feeding from organic and conventional chemical farms (Table 3).

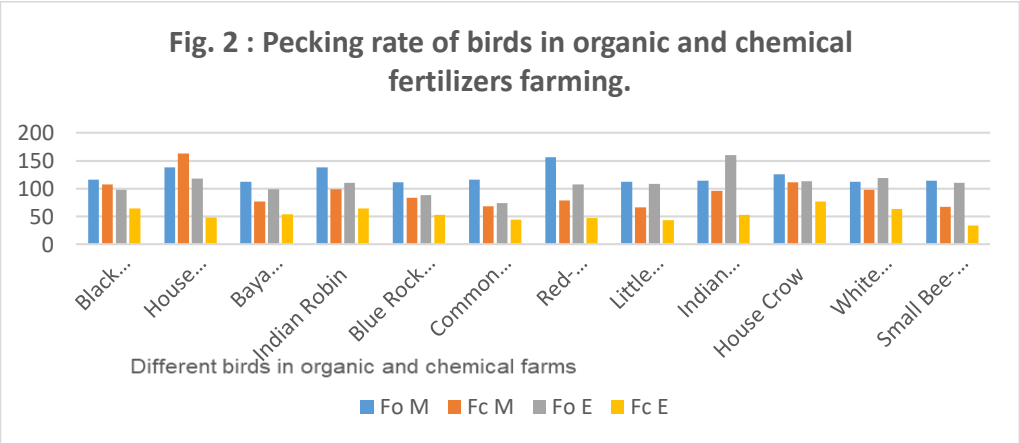
Table 3: Association / Spearman correlation at organic and chemical farming between search time and number of pecks by birds.

Birds of the field	Organic farming/chemical farming	Search time Vs No. of pecks	Significance (ρ)
Black Drongo	FOM/FCM	0.774741	<0.01
House Sparrow	FOM/FCM	0.476288	<0.01
Baya Weaver	FOM/FCM	0.776429	<0.01
Indian Robin	FOM/FCM	0.959283	<0.01
Blue Rock Pigeon	FOM/FCM	0.426524	<0.01
Common Myna	FOM/FCM	0.687765	<0.01
Red-vented Bulbul	FOM/FCM	0.838937	<0.01
Little Brown Dove	FOM/FCM	0.81297	<0.01
Indian Peafowl	FOM/FCM	0.50375	<0.01
House Crow	FOM/FCM	1.048946	<0.01
White breasted Kingfisher	FOM/FCM	0.348	<0.01
Small Bee-eater	FOM/FCM	0.736493	<0.01

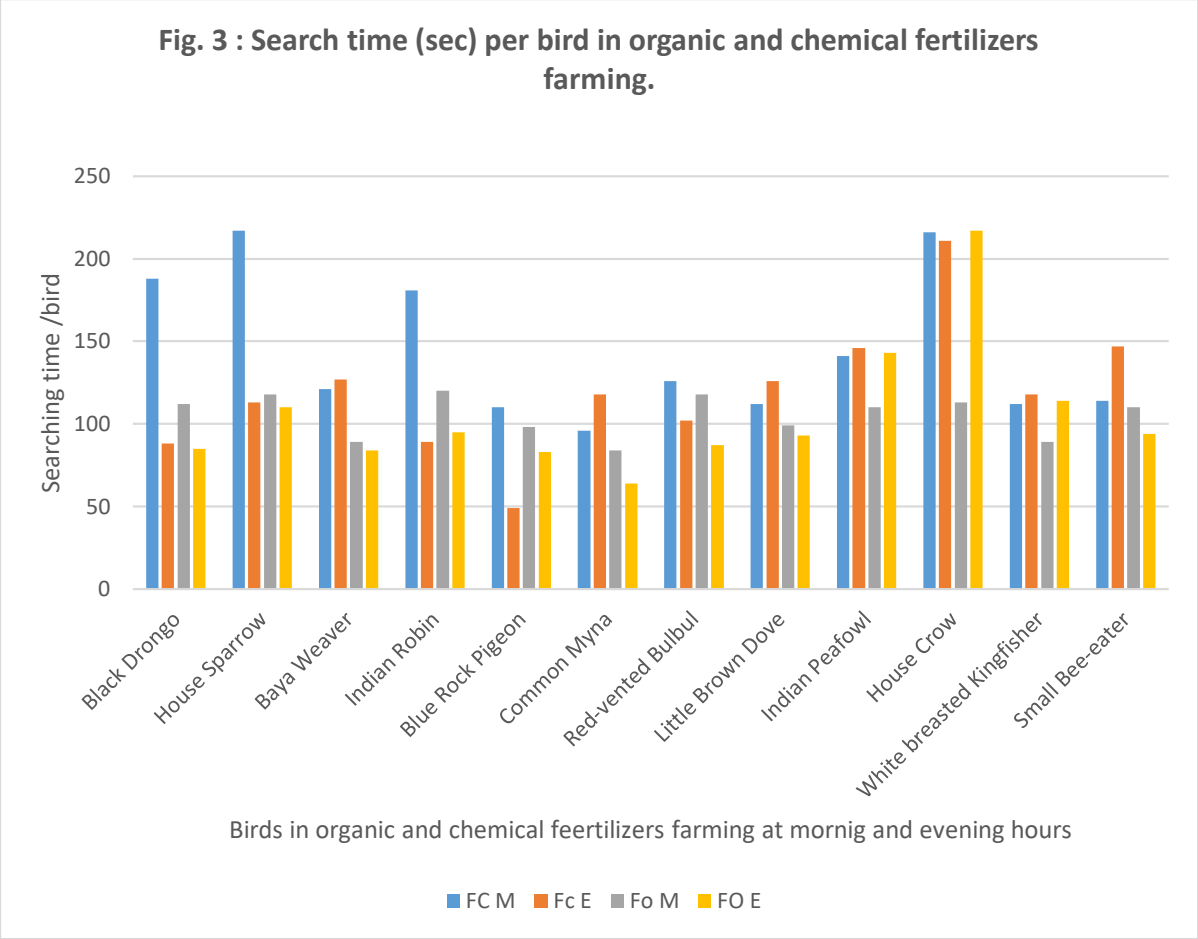


Overall highest frequency for organic farm visiting birds was 209 and lowest frequency was 49, whereas overall frequency of visiting birds was highest 66 and lowest 08 for chemical fertilizers farm sites. It was found that overall frequency of visiting birds considerably higher in organic farming sites in contrast to chemical fertilizers farming sites.

The rate of pecking by birds related to the frequency of selected 12 visiting bird showed highest mean pecking rate recorded in the organic farming sites was 122 at morning hours and 109 at evening hours, whereas in the chemical fertilizers farming sites it was 93 at morning hours and 54 at evening hours, which clearly showed that birds prefer organic farming sites rather than that of chemical fertilizers farming sites.



The search time was comparatively higher in the chemical fertilizers farming as compared to organic farming as it is directly related to consumption risk, food quality and availability, predator-prey security and nature of habitat that is without any risk. Birds such as House sparrow, House crow, Black drongo and Indian robin took more search time for food.



Statistical analysis for association between search time and the number of pecks showed direct relationship between search time and number of pecks by bird. The data collected from all four field sites indicated the presser of a significant ($\rho < 0.01$) correlation between search time and number of pecks (Table 3). Correlating score were interpreted following Cohen J (1992) who described the score for week 0 to 0.25, fair 0.25 to 0.5, good 0.5 to 0.75 and excellent more than 0.75. In the present study Spearman's correlation coefficient for search time against pecking rate between organic and chemical fertilizers farming were 0.978 which showed correlation of bird search time against number of pecks in organic farming in contrast to chemical fertilizers farming. It opinions that organic farming provide healthy, eco-friendly and riskless feeding requirement of birds.

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