

Biodiversity of Arthropods Associated with Canal Territories in Agroecological Zones of Sheikhpura, Punjab, Pakistan

Ali Raza^{1*}, Nureen Rana¹, Muhammad Saqib², Ayesha Parveen¹ and Umer Liaqat¹

1. Department of Zoology, Wildlife and Fisheries, University of Agriculture, Faisalabad. 38040
2. Department of Entomology, University of Agriculture, Faisalabad. 38040

*Corresponding Author: alizoologist786@gmail.com

ABSTRACT

The arthropod communities in Sheikhpura's canal territories exhibit significant diversity influenced by agricultural practices, vegetation composition, and hydrological conditions. These canal-associated ecosystems serve as critical biodiversity reservoirs within Pakistan's agricultural landscape, providing essential ecosystem services while facing multiple anthropogenic pressures that require targeted conservation strategies. Diptera and Coleoptera representing the most abundant orders across microhabitats. The present study provides insight into some common arthropods associated with canal territories of Sheikhpura, factors influencing arthropod biodiversity in canal agroecosystems and ecological significance and conservation challenges.

Keywords: Arthropods, Agriculture, Biodiversity, Conservation Diptera

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Introduction

Arthropods constitute the most diverse and ecologically significant group of organisms in terrestrial ecosystems, playing critical roles in pollination, decomposition, nutrient cycling, and biological pest control. In agricultural landscapes, arthropod communities contribute significantly to ecosystem functioning and crop productivity by regulating pest populations and maintaining ecological balance. Habitat heterogeneity, the vegetation structure, and condition of the environment in the agroecosystems have significant effects on the diversity and distribution of arthropods. Recent research emphasizes that agricultural eco systems with varying microhabitat contribute to an increased number of arthropods with functional diversity that acts as a resilience and sustainability in ecosystems [1].

The irrigation canals and the lands around them form individual ecological niches in the agroecological zone due to the presence of moisture gradients, vegetation corridors, and refuges of different arthropod groups. These habitats may support some useful arthropods (predators, parasitoids and pollinators) as well as pests so that there is the effect of agricultural productivity. In its study of irrigated agroecosystems located in Punjab, Pakistan, a significant arthropod diversity in various orders, including Coleoptera, Diptera, Hemiptera, Hymenoptera and Lepidoptera has been reported to play an ecological role (as a crop-based system) [2].

Although the importance of the arthropod biodiversity with the canal-territory has ecological importance, its documentation is poor in most agroecological regions in Pakistan. There could be a wide variety of arthropod species in Sheikhpura district, which is an intensive agricultural region with a large network of canals to irrigate it. Thus, it is necessary to evaluate biodiversity of arthropods in the areas of canals in agroecological zones of Sheikhpura to comprehend the dynamics of the ecosystem and to work out the policies of sustainable agricultural management.

Geographic and Ecological Context of Sheikhpura Canal Territories Location and Physical Characteristics

Sheikhpura belongs to the Rechna Doab in the Punjab province of Pakistan and covers a total land area of nearly 28,500 km² with Chenab River flowing northwest and Ravi River flowing southeast. This interfluvial area is situated between the 71deg48'-75deg 20' east longitudes and 30deg3-32deg 51' north latitudes and extends south eastwards to a distance of about 403 km with a peak width of about 113 km [3].

In this region, the canal-based agro system promotes the growth of such significant crops as wheat, rice, gram, pulses, oil-seeds, fodders, millets, and cotton and sugarcane that form a patch work of cultivated lands and corridors of natural vegetation along the waterways [4]. These canal lands serve as linear ecosystems and links between disaggregated agricultural habitats that serve as essential habitat corridors to a number of different arthropod species. The combination of natural vegetation on these canals together determines a variety of microhabitats of arthropod communities [3].

Methodological Approaches in Canal Biodiversity Studies

Arthropod diversity in the canal territories is usually studied using systematic sampling based on a set grid, where study area has been subdivided into grid units with grid size being 24x28 km² to cover the entire area [5]. In particular canal studies, as was done in studies on Dingroo

and Kamal Pur canals in Faisalabad (which are nearby districts of Sheikhpura), the standardized collection methods are used to estimate diversity of insecta classes in the streams surrounding the canal areas [6]. These procedures frequently involve both active methods of collection (sweep-netting, timed counts) and passive trapping routes (baited butterfly traps) to gain the entire variety of arthropod life in diverse micro-habitats [5, 6].

Arthropod Diversity Composition in Canal Territories

The area of Arthropod in the canal lands, Sheikhpura, is an indication of the abundance of ecology that was formed due to the presence of irrigated agriculture and the water bodies. The habitats harbor a great diversity of insects, spiders, and other arthropods which are useful in the ecosystem. The habitat of pollinators, predators, and decomposers is provided by crop fields, banks of canals, and plants. Some of the common groups comprise beetles, butterflies, ants and dragonflies (Table 1).

Taxonomic Composition and Abundance Patterns

The taxonomic richness of the arthropods groups in areas associated with canals is rather high, and in other similar ecosystems, it has been observed that up to 24 orders of arthropods exist in various microhabitats of the study. Diptera and Coleoptera are always the most diverse arthropod orders in the canal territories under diverse microhabitats indicating their ecological usefulness to cavities of water and soils that are directly linked to the canal systems [7]. The most abundant arthropods are usually found in the riverine areas near the canals, and the proportion of all the studied arthropods that were found in these particular habitat were riverine (31 percent), forest spray channel (28 percent), forest site (23 percent), and open spray channel (18 percent) [8]. The unique conditions of the microhabitat of canals establish arthropod assemblages with Hymenoptera and Opiliones having a special affinity to riverine environments and a very limited occurrence in open spray channels. The habitat of Homoptera has shown itself to have greater richness in open spray channels as opposed to others and this implies specialized ecological demands. Different yet ecologically important orders are less numerous but often used as bioindicators of environmental conditions: Plecoptera, Zygoptera, Thysanura and Trichoptera [9].

Diversity Metrics and Ecological Indicators

To measure the arthropods within the canal territory, two or more ecological measures are commonly used, such as the species richness, evenness, dominance, and indexes of diversity, which are all used to describe the health and well-being of arthropods within the canal. These measures are useful in obtaining information about the ecological soundness of canal-related living environments, and their ability to carry complicated food webs. Specialist taxa may be used as sensitive indicators of water quality and habitat status in such anthropogenically controlled environments as in some Diptera and Coleoptera species [6].

Canal ranges with a mixed natural vegetation cover offer much higher arthropod indices of evenness than regions with simplified vegetation. This trend is consistent with higher ecological principles that suggest that the complexity of habitat directly relates to the level of biodiversity because varying vegetation also offers different food resource, shelter and microclimatic conditions in which a number of arthropod species with versatile ecological needs thrive [10].

Table 1: Commonly present arthropods in canal territories in agroecological zones of Sheikhpura

Sr #.	Common Name	Scientific Name	Order	Family	Habitat / Crop Association
1	Cotton aphid	<i>Aphis gossypii</i>	Hemiptera	Aphididae	Cotton, vegetables
2	Bird cherry–oat aphid	<i>Rhopalosiphum padi</i>	Hemiptera	Aphididae	Wheat, cereals
3	Corn leaf aphid	<i>Rhopalosiphum maidis</i>	Hemiptera	Aphididae	Maize
4	English grain aphid	<i>Sitobion avenae</i>	Hemiptera	Aphididae	Wheat
5	Silverleaf whitefly	<i>Bemisia tabaci</i>	Hemiptera	Aleyrodidae	Cotton, vegetables
6	Onion thrips	<i>Thrips tabaci</i>	Thysanoptera	Thripidae	Vegetables, cotton
7	Cotton jassid	<i>Amrasca biguttula</i>	Hemiptera	Cicadellidae	Cotton
8	Pink bollworm	<i>Pectinophora gossypiella</i>	Lepidoptera	Gelechiidae	Cotton
9	American bollworm	<i>Helicoverpa armigera</i>	Lepidoptera	Noctuidae	Cotton, vegetables
10	Armyworm	<i>Spodoptera litura</i>	Lepidoptera	Noctuidae	Field crops
11	Spotted bollworm	<i>Earias vittella</i>	Lepidoptera	Nolidae	Cotton
12	Spiny bollworm	<i>Earias insulana</i>	Lepidoptera	Nolidae	Cotton
13	Rice grasshopper	<i>Oxya bidentata</i>	Orthoptera	Acrididae	Rice and grasses
14	Painted grasshopper	<i>Poeciloceris pictus</i>	Orthoptera	Pyrgomorphidae	Weedy areas
15	Seven-spotted ladybird beetle	<i>Coccinella septempunctata</i>	Coleoptera	Coccinellidae	Predator of aphids
16	Three-striped ladybird beetle	<i>Brumoides suturalis</i>	Coleoptera	Coccinellidae	Agricultural crops
17	Eight-spotted ladybird	<i>Harmonia octomaculata</i>	Coleoptera	Coccinellidae	Aphid predator
18	Ladybird beetle	<i>Anegleis cardoni</i>	Coleoptera	Coccinellidae	Predatory insect
19	Ladybird beetle	<i>Scymnus nubilus</i>	Coleoptera	Coccinellidae	Biological control agent
20	Ladybird beetle	<i>Scymnus latemaculatus</i>	Coleoptera	Coccinellidae	Predator in crops
21	Green lacewing	<i>Chrysoperla carnea</i>	Neuroptera	Chrysopidae	Predator of aphids
22	Jumping spider	<i>Plexippus paykulli</i>	Araneae	Salticidae	Agricultural fields
23	Ant-mimic jumping spider	<i>Myrmarachne bengalensis</i>	Araneae	Salticidae	Fields, gardens
24	Spitting spider	<i>Scytodes thoracica</i>	Araneae	Scytodidae	Buildings, vegetation
25	Crab spider	<i>Thomisus spp.</i>	Araneae	Thomisidae	Vegetation and crops
26	House Fly	<i>Musca domestica</i>	Diptera	Muscidae	Common around livestock sheds, manure heaps, and crop fields
27	Fruit Fly	<i>Bactrocera dorsalis</i>	Diptera	Tephritidae	Attacks fruits mango, guava, and citrus in orchards
28	Mosquito	<i>Culex pipiens</i>	Diptera	Culicidae	Breeds in stagnant water of canals, drains, and rice fields
29	Leaf Miner Fly	<i>Liriomyza trifolii</i>	Diptera	Agromyzidae	Vegetables like tomato, potato, and beans
30	Hover Fly	<i>Eristalis tenax</i>	Diptera	Syrphidae	Found around flowering crops; larvae live in polluted water

Factors Influencing Arthropod Biodiversity in Canal Agroecosystems Agricultural Management Practices

One of the most important factors which change the arthropod biodiversity in the canal lands is agricultural intensification, through which the traditional farming methods like ploughing directly and indirectly contribute to the presence of arthropods living above and below the ground [11]. Such effects comprise the physical body injury to arthropods, habitat alteration or destruction, and a change in the availability of nutrients that reverberate via food webs. Compounds of the problems that arthropod communities encounter in these agricultural landscapes is indirect impacts like soil compaction, loss of soil organic matter, and disruption of trophic interactions [12].

Biodiversity of the arthropods in the canal-related agroecosystems is fixed on four main characteristics, which are agroecosystem vegetation diversity within and surrounding the crops, permanence of crops in the agroecosystem, the intensity of management and isolation with natural vegetation. In the case of canal lands with the integration of conservation tillage and rough soil surfaces, with late-season sowing cover crops, the

arthropod biodiversity indices are higher than in the has been situation of standard agricultural systems [6, 10].

Vegetation Composition and Habitat Structure

The presence of canal banks natural vegetation is important in enhancing the diversity of the arthropods as plants are a source of important resources such as food, shelter and even breeding grounds. The occurrence of local species including *Prosopis spicigera* (jand), *Tamarix articulata* (farash) and *Calatropis procera* (ak) result in the heterogeneous habitat structures that provide specialized arthropod assemblages. These vegetation corridors act as ecological bridges between agricultural field and natural habitats in which genetic exchange and movement of arthropods through the landscape is possible [3].

Intercropping methods including the integration of certain species such as *Lolium perenne* L. or legume mixes along canal banks have proved useful in improving the arthropod biodiversity by means of their provision of additional resources as well as eliminating other environmental stressors. The practices not only sustain arthropod communities but enhance biological control of pests, minimize the erosion of sediments and sustain

farmland biological communities all year round [10]. The ecological role of having a seasonal range of arthropods by the presence of vegetation cover during season changes depends on the temporal shell of vegetation cover along the canals.

Hydrological and Water Quality Factors

It is a hydrological regime of the canal territories that is crucial in the composition of the arthropod communities, salinity and temperature being the water quality Canal systems which are characterized by relatively stable parameters in water quality are able to sustain a higher arthropod communities, which includes special aquatic and semi aquatic species that help in the overall functioning of the ecosystem. Canal waters interconnected with the surrounding agricultural areas cause complex ecotones with the interplay of terrestrial and aquatic arthropod communities, which increase overall biodiversity. Nonetheless, these delicate balances can be disturbed by anthropogenic perturbed events like agricultural runoff, industrial discharge and other perturbed flow regimes causing changes in arthropod community composition to species that are more permissive to pollution [13]. Early warning of conditioning water quality deterioration may be given by the presence of delicate indicator species such as some insect species (Diptera and Coleoptera). Environmental value and preservation issues.

Ecological Significance and Conservation Challenges

Ecosystem Services Provided by Arthropod Communities

In canal lands, arthropods form over three quarters of the number of species and have very important functions in the work of ecosystems. These communities mediate the important ecosystem functions such as recycling organic matter, pollination, biological pest control and nutrient cycles which would otherwise be cost-prohibitively expensive to artificially substitute. Both above- and below-ground ecosystem stability is highly reliant on arthropod community diversity and density as they ease complex trophic interactions critical towards ecological stability [10].

Arthropods in the agricultural environment are known to be natural pest regulators, where a selection of predators helps to regulate the potential pest outbreaks without the use of chemicals in agricultural landscapes surrounding canals [14]. This control control activity is a good type of ecosystem service in that the farmers do not have to use chemical pesticides and remain productive in their crop productions. Existence of varying communities of arthropods along the canal corridors also increases the pollination of agricultural produce as well as native plant species, which adds to the general productivity of the landscape [10].

Conservation Challenges and Threats

Arthropod communities related to canals are subject to various anthropogenic pressures threatening them to loss of diversity and ecological processes. Some of the main challenges to the population maintenance of healthy arthropods in these ecosystems include agricultural intensification, habitat fragmentation, pesticide application, and water pollution [6, 10]. The loss of biodiversity is further aggravated by the isolation of canal territories of natural vegetation patches to restrict the possibility of dispersal and genetic exchange between the populations of arthropods.

Some of the barriers to the conservation process are the low level of knowledge of arthropods and the existing stereotypes concerning these types of organisms among general populations [2, 3]. Arthropods have

never been thought of as desirable wildlife to protect under conservation programs and as such, there is no sufficient protection of these essential parts of the canal ecosystems despite their ecological significance. The inability to tackle arthropod communities within the canal territories with a full-scale monitoring program is another factor that prevents the proper conservation planning and implementation.

Conclusion and Recommendations

The arthropod populations in the canal lands of Sheikhpura are a crucial part of the agroecology of the area, as they offer important ecosystem services, and indicate the general health of the landscape modified on an anthropogenic scale. These communities show a significant taxonomic richness, with Diptera and Coleoptera as a common feature among different microhabitats, however, there is a strong dependence on the agricultural activities, vegetation structure and water quality parameters as well. The research work specifically aim at creating standardized monitoring protocols with respect to canal-related arthropod communities, with special interests aimed at the identification of the indicator species, which may be used as the early-warning signs of the poor environment. Ignorance and fragmented work by the researchers, agricultural extension and local society will play critical roles in formulating and executing the conservation programs that will ensure that agricultural productivity does not compromise with conservation biodiversity of the canal landscapes of Sheikhpura.

References

- [1] N'Woueni, D.K. and O.G. Gaoue, Plant diversity increased arthropod diversity and crop yield in traditional agroforestry systems but has no effect on herbivory. *Sustainability*, 2022. 14(5): p. 2942.
- [2] Samreen, K.B. and F. Manzoor, Assessing arthropod biodiversity with DNA barcoding in Jinnah Garden, Lahore, Pakistan. *PeerJ*, 2024. 12: p. e17420.
- [3] Jabbar, A., et al., Transfer of radioactivity from soil to vegetation in Rechna Doab, Pakistan. *Isotopes in environmental and health studies*, 2010. 46(4): p. 495-505.
- [4] Ahmad, N., et al., Hydrological modeling of the Lahore aquifer using isotopic chemical and numerical techniques. *Back Issues J. Sci. Vis*, 2002. 7: p. 16.
- [5] Jabbar, A., et al., Assessment of environmental gamma dose in northern Rechna Doab in Pakistan. *Nuclear Technology and Radiation Protection*, 2009. 24(1): p. 56-60.
- [6] Waqar, M., et al., Diversity of foliage insects around different canal territories: A case study of Dingroo and Kamal Pur canal, Faisalabad, Pakistan. *GSC Biological and Pharmaceutical Sciences*, 2019. 6(1): p. 007-015.
- [7] Khan, Q., A. Kakar, and K. Kamran, New faunistic data on Diptera (Hexapoda, Insecta) from the Ziarat Juniperus forest ecosystem (Pakistan). *Biodiversity Data Journal*, 2024. 12: p. e114414.
- [8] Haider, S., et al., Assessing the role of conservation strips in enhancing beneficial fauna in the wheat-cotton agricultural system in Punjab, Pakistan. *Pak. J. Zool*, 2024. 56: p. 1-9.
- [9] Waseem, M., et al., The insect fauna of Pakistan: diversity, ecological significance, and conservation challenges. *The Journal of Basic and Applied Zoology*, 2025. 86(1): p. 93.
- [10] Norris, S.L., et al., Improving above and below-ground arthropod biodiversity in maize cultivation systems. *Applied Soil Ecology*, 2016. 108: p. 25-46.
- [11] Hawes, J., et al., Diversity and composition of Amazonian moths in primary, secondary and plantation forests. *Journal of Tropical Ecology*, 2009. 25(3): p. 281-300.
- [12] Crotty, F.V., et al., Divergence of feeding channels within the soil food web determined by ecosystem type. *Ecology and Evolution*, 2014. 4(1): p. 1-13.
- [13] Diaz, P., et al., Anthropogenic perturbations to the trophic structure in a permanent hypersaline shallow lake: La Salada de Chiprana (north-eastern Spain). *International Journal of Salt Lake Research*, 1998. 7(3): p. 187-210.
- [14] Liedgens, M., A. Soldati, and P. Stamp, Interactions of maize and Italian ryegrass in a living mulch system:(1) Shoot growth and rooting patterns. *Plant and Soil*, 2004. 262(1): p. 191-203.