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VERTICAL DIVERSITY AND ABUNDANCE OF SOIL MACRO-FAUNA IN DRY AND WET TERRITORY AT FAISALABAD, PAKISTAN

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Abstract:

During the present study it was observed and following results were recorded. From (1-6′ layer), maximum population was recorded 62.57% (N = 219) from Fish-farm; whereas, least population was recorded 37.43% (N = 131) from Agro-farm. However, in (7-12′ layer), maximum population was recorded 69.29% (N = 185) from Fish-farm and least population was recorded 30.71% (N = 82) from Agro-farm; Whereas in (13-18′ layer), maximum population was recorded 80.09% (N = 177) from Fish-farm and least population was recorded 19.91% (N = 44) from Agro-farm. However, from 1-6 layer of fishfarm, it was accessed that *Alaus oculatus* (Elateridae) was existing with maximum relative abundance. From 7-12 layer of fishfarm, it was accessed that *Tinea pellionella* (Tineidae) was existing with maximum relative abundance i.e. 18.92% (N = 35), From 13-18 layer of fishfarm, it was accessed that *Tinea pellionella* (Tineidae)was existing with maximum relative abundance i.e.18.64% (N = 33). It was concluded from the entire research survey that placing of regular moisture enhance the diversity and abundance of soil macrofauna, which results in healthy soil. Diversity, richness, dominance and evenness elevations were recorded in same trends, while overall results were differe significantly (P<0.001; F=83.05).

Keywords: Biodiversity, Soil types, significance

INTRODUCTION

Soil is the solid material on the Earth's surface that results from the interaction of weathering and biological activity on the parent material. It is capable of supporting plant life and is vital to life on earth (Ward, 2008). Whereas, soil biodiversity is the number of faunal species present below- above ground (Hooper *et al*., 2000). There is variability within species, between species and between ecosystems (Dodd, 2002). These organisms are classified into macro-fauna, meso-fauna and micro-fauna included earthworms, microarthropods and nematodes, which have particular importance in agricultural grassland (Cook and Yeates, 1993).

Macro-fauna in soil is one centimeter or long but smaller an earthworm i.e. Pot-worms, myriapods, centipedes, millipedes, slugs, snails, fly larvae, beetles, beetle larvae and spiders. They have long been recognized for their influence on soil physical, chemical and biological properties

and processes (Lavelle *et al*., 1992; Shah *et al*., 2022). Many burrows in the soil, aiding soil drainage and aeration; in addition, some organic material passes into the soil through the burrows (Brussaard, 1998). They are important soil organic matter dynamics, regulators of decomposition, pathways of water movement and nutrient cycling. An agricultural soil is very rich in faunal diversity (Anderson and Flanagan, 1989; Bilal *et al*., 2024).

In addition, earthworms are considered ecosystem engineers, contributing to the physical alteration of the soil, often in the form of bioturbation. Earthworm effects on soils extend beyond the physical and structural and include effects on soil chemistry as well as soil microbial characteristics (Meysman *et al*., 2006).

In arable soils, macro-invertebrates are dramatically affected by cultural and agricultural practices those eliminate the beneficial contribution of soil invertebrates and influence soil biodiversity (Ouedraogo *et al*., 2006). Soil arthropods are considered to be indicators of the state of soil conditions and health (Lavelle *et al*., 2006; Rombke*et al*., 2006).

Vertical distribution patterns and compartmentalization of the soil macro-fauna also affected by seasonal and microhabitat variations depending on environmental conditions (Frouz*et al*., 2004). Vertical stratification in the soil causes higher variability in the soil fauna than horizontal or temporal variations (Berg and Bengtsson, 2007).

Agriculture is the single biggest division, financing 21% in absolute GDP procuring of the nation and utilizing 44% of the work force. It is primary wellspring of work for 66% of the nation's population (Anonymous, 2008-09).

Due to this ecological importance of soil macroinvertebrates in the maintenance of soil reliability, the present study was conducted to record the "Vertical diversity and abundance of soil macro-fauna in dry and wet territory" to accomplish their significance.

MATERIALS AND METHODS

The present study was conducted to record "Vertical diversity and abundance of soil macro-fauna in dry and wet territory" with regard to ecological succession in dry and wet Agro-ecosystem (Agro-field of Malkhanwala; Fish farm Satyana Road, Faisalabad) during the session 2016-2017.

Collection of Data

Soil sampling from the selected areas were made to collect soil macro-fauna from the samples measuring for this purpose, five quadrate samples was taken from the two sites. In each quadrate sampling, 18 cm soil was dug that were further divided in to 3 layers from top to bottom. The soil samples from each 6cm soil layer were collected and sorted into stock bottles. Same method was done in agriculture land soil sampling of macro-fauna. Sampling was initiated from pre- to post-harvest stage. Various groups representing macro-fauna were sorted by following methods:

1- Direct hand picking
2- Using forceps
3- Through berlese funnel

The collected specimens were identified with: Naked eye, with microscope and Magnifying glass and they were identified upto species level (Zulifqar, 2016). Wherein data was analyzed statistically for inferences and ecological components were made as per Zulifqar (2016).

RESULTS AND DISCUSSION

Soil is the solid material on the Earth's surface that results from the interactions of weathering and biological activity on the parent material and underlying hard rock. It is a complex mixture of minerals, water, air, organic matter, and countless organisms that are the decaying remains of once-living things. It forms at the surface of land, it is the "skin of the earth", and suppors plant life and is also vital to life on earth (Ward, 2008). Macro-fauna in soil are one centimeter or long but smaller an earthworm i.e. Pot-worms, myriapods, centipedes, millipedes, slugs, snails, fly larvae, beetles, beetle larvae and spiders. They have long been recognized for their influence on soil physical, chemical and biological properties and processes (Lavelle*et al.*, 1992). Many burrows in the soil, aiding soil drainage and aeration; in addition, some organic material passes into the soil through the burrows (Brussaard, 1998). They are important soil organic matter dynamics, regulators of decomposition, pathways of water movement and nutrient cycling. An agricultural soil is very rich in faunal diversity (Anderson and Flanagan, 1989). Accordingly, Rana *et al.* (2006) highlighted the importance of soil macro-invertebrates in all agro-ecosystems. Soil samples were collected from three micro- habitats viz. sub-shadow, open edges and inside the field of each randomly selected field over two consecutive years. Total 1185 specimens were collected to 16 orders, 57 families and 126 species from both the field's e.g. 859 from LIP and only 326 from HIP. Out of 126 species, 102 were recorded LIP and 62 in HIP fields. T-test analysis between LIP and HIP was remarkable ($t = 3.369$; $p < 0.01$).
The present study was conducted to accord the "Vertical diversity and abundance of soil macro-fauna in dry and wet territory" during the session 2016-2017 under the ecological conditions of district Faisalabad. Data was collected on monthly basis amongst the selected Agro-fields and Fish-farm.

Data presented in (Table 1-3) is pertaining to population dynamics of soil macro-invertebrates recorded from Agro-farm and fish-farm. From (1-6′ layer), maximum population was recorded 62.57% (N = 219) from Fish-farm; Whereas, least population was recorded 37.43% (N = 131) from Agro-farm. However, in (7-12′ layer), maximum population was recorded 69.29% (N = 185) from Fish-farm and least population was recorded 30.71% (N = 82) from Agro-farm; Whereas in (13-18′ layer), maximum population was recorded 80.09% (N = 177) from Fish-farm and least population was recorded 19.91% (N = 44) from Agro-farm.

Data regarding the taxa composition recorded from Fish-farm and Agro-farm during present study. From 1-6 layer of Fish-farm, entire population was recorded pertaining to 11 orders, 27 families, 31 genera and 35 species; whereas in Agro-farm population was recorded pertaining to 10 orders, 30 families, 44 genera and 47 species. However, from 7-12 layer, 10 orders, 23 families, 31 genera and 34 species were recorded from Fish-farm and 13 orders, 27 families, 33 genera and 39 species were recorded from Agro-farm however, in 13-18 layer of fish farm, 11 orders, 23 families, 29 genera and 33 species were recorded and 8 orders, 15 families, 19 genera and 19 species population were recorded from Agro-farm.

In case of 1-6 layer of Fish-farm, maximum population was recorded during 2nd sampling 3.58 ± 43(18.99) at 32°C temperature and 40% humidity; followed by 3.08 ± 37(14.75) (1st sampling) at 21°C temperature and 38% humidity; 2.92 ± 35(13.34) (3rd sampling) at 29°C temperature and 41% humidity; 1.75 ± 21(3.44) (5th sampling) at 35°C temperature and 48% humidity; 1.42 ± 17(0.61) (11th sampling) at 15°C temperature and 41% humidity; 1.17 ± 14(1.51) (9th sampling) at 30°C temperature and 40% humidity; 0.92 ± 11(3.63) (10th sampling) at 21°C temperature and 41% humidity; 0.83 ± 10(4.34) (9th sampling) at 36°C temperature and 54% humidity; 0.75 ± 9(5.05) and 0.75 ± 9(5.05) (4th and 7th sampling) at 36°C and 33°C temperature and 32% and 46% humidity; 0.58 ± 7(6.46) (12th sampling) at 9°C temperature and 98% humidity. However, least frequency was recorded during 8th sampling i.e. 0.50 ± 6(7.17) at 32°C temperature and 69% humidity.

In case of 7-12 layer of Fish-farm, maximum population was recorded during 3rd sampling 4.50 ± 54(26.77) at 29°C temperature and 41% humidity; followed by 3.50 ± 42(18.29) (2nd sampling) at 32°C temperature and 40% humidity; 1.83 ± 22(4.14) (1st sampling) at 21°C temperature and 38% humidity; 1.25 ± 15(0.81) (11th sampling) at 15°C temperature and 41% humidity; 0.83 ± 10(4.34) (4th sampling) at 36°C temperature and 32% humidity; 0.75 ± 9(5.05) (8th and 10th sampling) at 32°C and 21°C temperature and 69% and 41% humidity; 0.42 ± 5(7.88) (5th sampling) at 35°Ctemperature and 48% humidity. However, least frequency was recorded during 7th, 9th and 12th sampling i.e. 0.33 ± 4(8.58) at 33°C, 30°C and 9°C temperature and 46%, 40% and 98% humidity.

In case of 13-18 layer of Fish-farm, maximum population was recorded during 2nd sampling 4.67 ± 56(28.19) at 32°C temperature and 40% humidity; followed by 3.17 ± 38(15.46) (3rd sampling) at 29°C temperature and 41% humidity; 1.83 ± 22(4.14) (1st sampling) at 21°C temperature and 38% humidity; 1.17 ± 14(1.51) (4th sampling) at 36°C temperature and 32% humidity; 0.83 ± 10(4.34) (5th sampling) at 35°C temperature and 48% humidity; 0.75 ± 9(5.05) (7th sampling) at 33°C temperature and 46% humidity; 0.67 ± 8(5.76) (6th sampling) at 36°C temperature and 54% humidity; 0.33 ± 4(8.58) (10th and 12th sampling) at 21°C and 9°C temperature and 41% and 98% humidity; 0.25 ± 3(9.29) (11th sampling) at 15°C temperature and 41% humidity. However, least

frequency was recorded during 9th sampling i.e. 0.17 ± 2(10.00) at 30°C temperature and 40% humidity.

Number of species in a particular landscaping alters with regard to existing chemical profile as well as physical nature structure nature of existing of soil macro-invertebrates. Hence, exploring of their abundance is milestone factor to formulate the management strategy for best outcomes and it was documented, accordingly. Currently, in the case of 1-6 layer of Fish farm, species abundance was recorded maximum during 2nd and 3rdsampling (11 species) at 32 and 29°C temperature and 40 and 41% humidity respectively; followed by 10 species 9th sampling at 30°C temperature and 40% humidity; 9 species during 1st and 10th sampling at 21°C and 21°C temperature, 38% and 41% humidity; 7 species during 5th sampling at 35°C temperature and 41% humidity; 6 species during 4th, 6th, 8th and 11th sampling at 36°C, 36°C, 32°C and 15°C temperature and 32%, 54%, 69% and 41% humidity. However, least abundance was recorded during 5 species during 7th and 12thsampling at 33°C and 9°C temperature, 46% and 98% humidity respectively.

In the case of 7-12 layer of Fish farm, species abundance was recorded maximum during 3rdsampling (19 species) at 29°C temperature and 41% humidity; followed by 11 species 2nd sampling at 32°C temperature and 40% humidity; 7 species during 4th and 6th sampling at 36°C and 36°C temperature, 32% and 54% humidity; 6 species during 8th sampling at 32°C temperature and 69% humidity; 5 species during 1st and 11th sampling at 21°C and 15°Ctemperature, 38% and 41% humidity ; 4 species during 7th, 9th and 10th sampling at 33°C, 30°C and 21°C temperature, 46%, 40% and 41% humidity. However, least abundance was recorded during 3 species during 5th and 12th sampling at 35°C and 9°C temperature, 48% and 98% humidity, respectively.

In the case of 13-18 layer of Fish farm, species abundance was recorded maximum during 2nd sampling (16 species) at 32°C temperature and 40% humidity; followed by 11 species 3rd sampling at 29°C temperature and 41% humidity; 7 species during 1st sampling at 21°C temperature and 38% humidity; 5 species during 4th and 7th sampling at 33°C temperature and 46% humidity; 4 species during 5th, 8th and 12th sampling at 35°C, 32°C and 9°C temperature, 48%, 69% and 98% humidity. However, least abundance was recorded during 3 species during 6th, 10th and 11th sampling at 36°C, 21°C and 15°C temperature, 54%, 41% and 41% humidity, respectively.

The biomass per sampling was also calculated along with standard deviation (SD) for significant outcomes (Table 4.3). In case of 1-6 layer of Fish-farm, maximum biomass was recorded during 3rd sampling 5.11±2.38 at 29°C and 41% humidity, followed by 3.74±1.41 during 4th sampling at 36°C and 32% humidity; 2.45±0.50 during 2nd sampling at 32°C and 40% humidity; 2.32±0.40 during 11th at 15°C and 41% humidity; 1.89±0.10 during 6th sampling at 36°C and 54% humidity; 1.82±0.05 during 8th sampling at 32°C and 69% humidity; 1.68±0.05 during 7th sampling at 33°C and 46% humidity; 1.52±0.16 during 5th sampling at 35°C and 48% humidity; 1.42±0.23 during 12th sampling at 9°C and 98% humidity; 1.28±0.33 during 9rd sampling at 30°C and 40%

humidity; 1.02±0.52 during 1st sampling at 21°C and 38% humidity. However, least biomass was recorded during 10th sampling 0.78±0.69 at 21°C and 41% humidity.

In case of 7-12 layer of Fish-farm, maximum biomass was recorded during 4th sampling (5.42±2.60) at 36°C and 32% humidity, followed by 4.83±2.18 during 3rd sampling at 29°C and 41% humidity; 2.02±0.19 during 2nd sampling at 32°C and 40% humidity; 1.28±0.33 during 6th at 36°C and 54% humidity; 1.27±0.34 during 11th sampling at 15°C and 41% humidity; 1.14±0.43 during 9th and 12th sampling at 30°C and 9°C, 40% and 98% humidity; 0.96±0.56 during 5th sampling at 35°C and 48% humidity; 0.93±0.58 during 1st sampling at 21°C and 38% humidity; 0.86±0.63 during 7th sampling at 33°C and 46% humidity; 0.58±0.83 during 8thsampling at 32°C and 69% humidity. However, least biomass was recorded during 10th sampling (0.36±0.98) at 21°C and 41% humidity.

In case of 13-18 layer of Fish-farm, maximum biomass was recorded during 3rd sampling (4.71±2.09) at 29°C and 41% humidity, followed by 3.01±0.89 during 4th sampling at 36°C and 32% humidity; 1.96±0.15 during 2nd sampling at 32°C and 40% humidity; 1.45±0.21 during 5th sampling at 35°C and 48% humidity; 1.37±0.27 during 8th sampling at 32°C and 69% humidity; 1.6±0.11 during 1st sampling at 21°C and 38% humidity; 0.86±0.63 during 6th sampling at 36°C and 54% humidity; 0.63±0.79 during 7th sampling at 33°C and 46% humidity; 0.53±0.86 during 11th sampling at 15°C and 41% humidity; 0.43±0.93 during 12th sampling at 9°C and 98% humidity and 0.36±0.98 during 9th sampling at 30°C and 40% humidity. However, least biomass was recorded during 10th sampling (0.26±1.05) at 21°C and 41% humidity.

Wherein the population dynamic as per sampling frequency, means values was also calculated along with standard deviation (SD) (Table 4.4). In case of 1-6 layer of Agro-Farm, maximum population was recorded during 2ndsampling 1.67±20(9.09) at 32°C temperature, and 40% humidity; followed by 1.08±13(4.14) (3rd, 7th and 9th sampling) at 31°C, 36°C and 30°C temperature and 36% , 47% and 46% humidity; 1.00±12(3.44) (5th sampling) at 37°C temperature and 45% humidity; 0.92±11(2.73) (4th and 8th sampling) at 34°C and 31°C temperature, 38% and 63% humidity; 0.75±9(1.32) (6th and 10th sampling) at 34°C and 21°C temperature and 59% and 41% humidity; 0.58±7(0.10) (1st and 11th sampling) at 22°C and 14°C temperature, 35% and 40% humidity. However, least frequency was recorded during 12th sampling i.e. 0.50±6(0.81) at 9°C temperature and 97% humidity.

In case of 7-12 layer of Agro-Farm, maximum population was recorded during 3rdsampling 0.92±11(2.73) at 31°C temperature and 36% humidity; followed by 0.83±10(2.02) (2nd and 9th sampling) at 32°C and 30°C temperature, 40% and 46% humidity; 0.67±8(0.61) (4th sampling) at 34°C temperature and 38% humidity; 0.58±7(0.10) (8th sampling) at 31°C temperature, 63% humidity; 0.50±6(0.81) (5th, 7th and 10th sampling) at 37°C, 36°C and 21°C temperature and 45%, 47% and 41% humidity; 0.42±5(1.51) (1st and 6th sampling) at 22°C and 34°C temperature, 35%

and 59% humidity. However, least frequency was recorded during 11th and 12th sampling i.e. 0.33±4(2.22) at 9°C temperature and 97% humidity.

In case of 13-18 layer of Agro-Farm, maximum population was recorded during 2ndsampling 0.50±6(0.81) at 32°C temperature and 40% humidity; followed by 0.42±5(1.51) (3rd, 9th and 12th sampling) at 31°C, 30°C and 9°C temperature and 36%, 46% and 97% humidity; 0.33±4(2.22) (4thand 10th sampling) at 34°C and 21°C temperature, 38% and 41% humidity; 0.25±3(2.93) (5th, 7th, 8th and 11th sampling) at 37°C, 36°C, 31°C and 14°C temperature, 45%, 47%, 63% and 40% humidity; 0.17±2(3.63) (1st sampling) at 22°C temperature and 35% humidity. However, least frequency was recorded during 6th sampling i.e. 0.08±1(4.34) at 34°C temperature and 59% humidity.

In the case of 1-6 layer of Agro-Farm, species abundance was recorded maximum during 2ndsampling (16 species) at 32°C temperature and 40% humidity; followed by 13 species 3rd and 9th sampling at 31°C and 36°C temperature and 30% and 46% humidity; 11 species during 4th and 8th sampling at 34 and 31°C temperature, 38 and 63% humidity; 9 species during 7th sampling at 36°C temperature and 47% humidity; 8 species during 5th and 10th sampling at 37 °C and 21°C temperature, 45% and 41% humidity; 7 species during 1st and 11th sampling at 22 °C and 14°C temperature, 35% and 40% humidity. However, least abundance was recorded during 6 species during 6th and 12th sampling at 34°C and 9°C temperature, 59% and 97% humidity.

In the case of 7-12 layer of Agro-Farm, species abundance was recorded maximum during 9thsampling (10 species) at 30°C temperature and 46% humidity; followed by 9 species 2nd and 3rd sampling at 32°C and 31°C temperature, 40% and 36% humidity; 7 species during 4th and 8th sampling at 34 and 31°C temperature, 38 and 63% humidity; 6 species during 5th 7th and 10th sampling at 37°C, 36°C and 21°C temperature, 45%, 47% and 41% humidity; 5 species during 1st sampling at 22°C temperature and 35% humidity. However, least abundance was recorded during 4 species during 6th, 11th and 12th sampling at 34°C, 14°C and 9°C temperature, 59%, 40% and 97% humidity.

In the case of 13-18 layer of Agro-Farm, species abundance was recorded maximum during 2nd, 3rd and 9thsampling (5 species) at 32°C, 31°C and 30°C temperature, 40%, 36 and 46% humidity; followed by 4 species 4th, 10th and 12th sampling at 34°C, 21°C and 9°C temperature, 38%, 41% and 97% humidity; 3 species during 5th, 7th, 8th and 11th sampling at 37°C, 36°C, 31°C and 14°C temperature, 45%, 47%, 63% and 40% humidity; 2 species during 1st sampling at 22°C temperature and 35% humidity. However, least abundance was recorded during 1 species during 6th sampling at 34°C temperature and 59% humidity.

In case of 1-6 layer of Agro-Farm, maximum biomass was recorded during 9th sampling (1.53±0.76) at 30°C and 46% humidity, followed by 1.49±0.73 during 8th sampling at 31°C and 63% humidity; 0.68±0.16 during 2nd sampling at 32°C and 40% humidity; 0.66±0.14 during 7th

sampling at 36°C and 47% humidity; 0.63±0.12 during 10th sampling at 21°C and 41% humidity; 0.51±0.04 during 6th sampling at 34°C and 59% humidity; 0.46±0.00 during 4th sampling at 34°C and 38% humidity; 0.45±0.00 during 11th sampling at 14°C and 40% humidity; 0.38±0.05 during 3th sampling at 31°C and 36% humidity; 0.37±0.06 during 12th sampling at 9°C and 97% humidity; 0.36±0.07 during 5th sampling at 37°C and 45% humidity. However, least biomass was recorded during 1stsampling (0.07±0.27) at 22°C and 35% humidity.

In case of 7-12 layer of Agro-Farm, maximum biomass was recorded during 4th sampling (10.34±4.31) at 34°C and 38% humidity, followed by 0.57±0.08 during 8th sampling at 31°C and 63% humidity; 0.51±0.04 during 10th sampling at 21°C and 41% humidity; 0.41±0.03 during 9th sampling at 30°C and 46% humidity; 0.39±0.05 during 7th sampling at 36°C and 47% humidity; 0.35±0.07 during 11th sampling at 14°C and 40% humidity; 0.33±0.09 during 5th sampling at 37°C and 45% humidity; 0.24±0.15 during 12th sampling at 9°C and 97% humidity; 0.22±0.17 during 2nd sampling at 32°C and 40% humidity; 0.21±0.17 during 3rd sampling at 31°C and 36% humidity; 0.17±0.20 during 6th sampling at 34°C and 59% humidity. However, least biomass was recorded during 1stsampling (0.06±0.28) at 22°C and 35% humidity.

In case of 13-18 layer of Agro-Farm, maximum biomass was recorded during 1th sampling (1.6±0.81) at 22°C and 35% humidity, followed by 0.77±0.22 during 4th sampling at 34°C and 38% humidity; 0.37±0.06 during 2nd sampling at 32°C and 40% humidity; 0.34±0.08 during 8th sampling at 31°C and 63% humidity; 0.33±0.09 during 3rd sampling at 31°C and 36% humidity; 0.23±0.16 during 10th sampling at 21°C and 41% humidity; 0.18±0.19 during 11th sampling at 14°C and 40% humidity; 0.16±0.21 during 5th and 12th sampling at 37°C and 9°C, 45% and 97% humidity; 0.15±0.22 during 9th sampling at 30°C and 46% humidity; 0.11±0.24 during 7th sampling at 36 °C and 47% humidity; 1.11±2.21 during 3rd sampling at 29 °C and 67% humidity; 1.07±4.19 during 8th sampling at 26°C and 73 % humidity. However, least biomass was recorded during 6thsampling (0.06±0.28) at 34°C and 59% humidity.

Doblas-Miranda *et al.* (2009) studied the vertical distribution of soil macro-fauna in an arid ecosystem. For 2 years, macroinvertebrates were sampled in the litter and mineral soil beneath shrubs, ant nest mounds and bare soil using cores to a depth of 50 cm. It showed that macroinvertebrate richness, abundance and biomass decreased gradually with soil depth with small differences between microhabitats. Assemblage composition also varied with depth. In addition, seasonal differences in the vertical distribution of detritivores tenebrionid larvae indicate that this connection varies in time, emphasizing the importance of temporal variability in the connection between the surface layer and the below- ground soil.

Table 1: Population Dynamics recorded from Fish-farm and Agro-farm

Fields	1-6'	7-12'	13-18'
Fish-farm	62.57% (219)	69.29% (185)	80.09% (177)
Agro-farm	37.43% (131)	30.71% (82)	19.91% (44)
Total	**350**	**267**	**221**

Table 2: Record of Mean ± N(SD), Biomass ± SD, Species Abundance, Temperature, Humidity and Wind-speed From Fish-farm

Sample No.	Mean± N (SD)	Species	Temperature (°C)	Humidity (%)	Wind speed (km/hr)	Biomass±SD
1	3.08±37(14.75)	9	21	38	15	1.02±0.52
	1.83±22(4.14)	5				0.93±0.58
	1.83±22(4.14)	7				1.6±0.11
2	3.58±43(18.99)	11	32	40	12	2.45±0.50
	3.50±42(18.29)	11				2.02±0.19
	4.67±56(28.19)	16				1.96±0.15
3	2.92±35(13.34)	11	29	41	31	5.11±2.38
	4.50±54(26.77)	19				4.83±2.18
	3.17±38(15.46)	11				4.71±2.09
4	0.75±9(5.05)	6	36	32	19	3.74±1.41
	0.83±10(4.34)	7				5.42±2.60
	1.17±14(1.51)	5				3.01±0.89
5	1.75±21(3.44)	7	35	48	13	1.52±0.16
	0.42±5(7.88)	3				0.96±0.56
	0.83±10(4.34)	4				1.45±0.21
6	0.83±10(4.34)	6	36	54	22	1.89±0.10
	0.58±7(6.46)	7				1.28±0.33
	0.67±8(5.76)	3				0.86±0.63
7	0.75±9(5.05)	5	33	46	17	1.68±0.05
	0.33±4(8.58)	4				0.86±0.63
	0.75±9(5.05)	5				0.63±0.79
8	0.50±6(7.17)	6	32	69	15	1.82±0.05
	0.75±9(5.05)	6				0.58±0.83
	0.58±7(6.46)	4				1.37±0.27
9	1.17±14(1.51)	10	30	40	7	1.28±0.33
	0.33±4(8.58)	4				1.14±0.43
	0.17±2(10.00)	2				0.36±0.98
10	0.92±11(3.63)	9	21	41	10	0.78±0.69
	0.75±9(5.05)	4				0.36±0.98
	0.33±4(8.58)	3				0.26±1.05
11	1.42±17(0.61)	6	15	41	7	2.32±0.40
	1.25±15(0.81)	5				1.27±0.34
	0.25±3(9.29)	3				0.53±0.86
12	0.58±7(6.46)	5	9	98	6	1.42±0.23

	0.33±4(8.58)	3				1.14±0.43
	0.33±4(8.58)	4				0.43±0.93

able 3: Record of Mean ± N(SD), Biomass ± SD, Species Abundance, Temperature, Humidity and Wind-speed from Agro-farm

Sample No.	Layers	Mean± N (SD)	Species	Temperature (°C)	Humidity (%)	Wind speed (km/hr)	Biomass±SD
1	1-6"	0.58±7(0.10)	7	22	35	12	0.07±0.27
	7-12"	0.42±5(1.51)	5				0.06±0.28
	13-18"	0.17±2(3.63)	2				1.6±0.81
2	1-6"	1.67±20(9.09)	16	32	40	14	0.68±0.16
	7-12"	0.83±10(2.02)	9				0.22±0.17
	13-18"	0.50±6(0.81)	5				0.37±0.06
3	1-6"	1.08±13(4.14)	13	31	36	17.4	0.38±0.05
	7-12"	0.92±11(2.73)	9				0.21±0.17
	13-18"	0.42±5(1.51)	5				0.33±0.09
4	1-6"	0.92±11(2.73)	11	34	38	28	0.46±0.00
	7-12"	0.67±8(0.61)	7				0.89±0.31
	13-18"	0.33±4(2.22)	4				0.77±0.22
5	1-6"	1.00±12(3.44)	8	37	45	18	0.36±0.07
	7-12"	0.50±6(0.81)	6				0.33±0.09
	13-18"	0.25±3(2.93)	3				0.16±0.21
6	1-6"	0.75±9(1.32)	6	34	59	19	0.51±0.04
	7-12"	0.42±5(1.51)	4				0.17±0.20
	13-18"	0.08±1(4.34)	1				0.06±0.28
7	1-6"	1.08±13(4.14)	9	36	47	15	0.66±0.14
	7-12"	0.50±6(0.81)	6				0.39±0.05
	13-18"	0.25±3(2.93)	3				0.11±0.24
8	1-6"	0.92±11(2.73)	11	31	63	11	1.49±0.73
	7-12"	0.58±7(0.10)	7				0.57±0.08
	13-18"	0.25±3(2.93)	3				0.34±0.08
9	1-6"	1.08±13(4.14)	13	30	46	7	1.53±0.76
	7-12"	0.83±10(2.02)	10				0.41±0.03
	13-18"	0.42±5(1.51)	5				0.15±0.22
10	1-6"	0.75±9(1.32)	8	21	41	9	0.63±0.12
	7-12"	0.50±6(0.81)	6				0.51±0.04
	13-18"	0.33±4(2.22)	4				0.23±0.16
11	1-6"	0.58±7(0.10)	7	14	40	7	0.45±0.00
	7-12"	0.33±4(2.22)	4				0.35±0.07
	13-18"	0.25±3(2.93)	3				0.18±0.19
12	1-6"	0.50±6(0.81)	6	9	97	6	0.37±0.06
	7-12"	0.33±4(2.22)	4				0.24±0.15
	13-18"	0.42±5(1.51)	4				0.16±0.21

Table 4: Sampling wise Population Dynamic ± SD recorded from 1-6 layer of fish farm

FF-1-6												
	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD
Coleoptera	24±14.59	16±8.55	11±5.53	2±0.84	1±0.64	2±0.77	5±2.96	0±0.39	4±1.93	5±2.83	4±1.74	2±0.96
Hemiptera	2±0.96	1±2.06	1±1.54	0±0.58	0±1.35	0±0.64	0±0.58	0±0.39	0±0.90	0±0.71	0±1.09	0±0.45
Hymenoptera	1±1.67	13±6.43	5±1.29	0±0.58	1±0.64	2±0.77	0±0.58	1±0.32	3±1.22	2±0.71	8±4.56	2±0.96
Lepidoptera	3±0.26	10±4.31	0±2.25	1±0.13	5±2.19	0±0.64	0±0.58	1±0.32	0±0.90	0±0.71	1±0.39	0±0.45
Isopoda	5±1.16	0±2.76	5±1.29	3±1.54	**13±7**.84	3±1.48	1±0.13	1±0.32	2±0.51	0±0.71	3±1.03	2±0.96
Blattodea	2±0.96	0±2.76	0±2.25	0±0.58	0±1.35	0±0.64	0±0.58	0±0.39	0±0.90	0±0.71	0±1.09	0±0.45
Orthoptera	0±2.38	2±1.35	6±1.99	1±0.13	1±0.64	0±0.64	0±0.58	2±1.03	2±0.51	0±0.71	0±1.09	0±0.45
Chilopoda	0±2.38	0±2.76	1±1.54	1±0.13	0±1.35	1±0.06	2±0.84	1±0.32	1±0.19	1±0.00	1±0.39	0±0.45
Pulmonata	0±2.38	0±2.76	1±1.54	1±0.13	0±1.35	1±0.06	0±0.58	0±0.39	1±0.19	0±0.71	0±1.09	1±0.26
Dermaptera	0±2.38	0±2.76	0±2.25	0±0.58	0±1.35	0±0.64	0±0.58	0±0.39	0±0.90	1±0.00	0±1.09	0±0.45
Araneae	0±2.38	1±2.06	5±1.29	0±0.58	0±1.35	1±0.06	1±0.13	0±0.39	1±0.19	2±0.71	0±1.09	0±0.45

Table 5: Sampling wise Population Dynamic ± SD recorded from 7-12 layer of fish farm

FF-7-12												
	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD
Pulmonata	1±0.51	0±1.67	0±2.89	0±0.58	0±0.19	0±0.45	0±0.26	0±0.51	0±0.26	0±0.58	0±0.64	0±0.06
Lepidoptera	2±0.19	16±9.64	9±3.47	1±0.13	2±1.22	0±0.45	0±0.26	1±0.19	0±0.26	0±0.58	5±2.89	3±2.06
Coleoptera	19±12.21	2±0.26	17±9.13	0±0.58	2±1.22	2±0.96	2±1.16	3±1.61	1±0.45	2±0.84	1±0.06	0±0.06
Stylommatophora	0 ±1.22	2 ±0.26	0 ±2.89	0 ±0.58	0 ±0.19	0 ±0.45	0 ±0.26	0 ±0.51	0 ±0.26	0±0.58	0±0.64	0±0.06
Hymenoptera	0 ±1.22	9 ±4.69	11 ±4.89	0 ±0.58	0 ±0.19	1 ±0.26	0 ±0.26	0 ±0.51	0 ±0.26	6±3.66	6±3.60	1±0.64
Orthoptera	0 ±1.22	7 ±3.28	8 ±2.76	2 ±0.84	1 ±0.51	0 ±0.45	1 ±0.45	0 ±0.51	0 ±0.26	0±0.58	0±0.64	0±0.06
Isopoda	0 ±1.22	1 ±0.96	1 ±2.19	4 ±2.25	0 ±0.19	1 ±0.26	1 ±0.45	3 ±1.61	0 ±0.26	0±0.58	2±0.77	0±0.06
Neuroptera	0 ±1.22	1 ±0.96	1 ±2.19	0 ±0.58	0 ±0.19	0 ±0.45	0 ±0.26	0 ±0.51	0 ±0.26	0 ±0.58	0±0.64	0±0.06
Chilopoda	0 ±1.22	0 ±1.67	2 ±1.48	2 ±0.84	0 ±0.19	0 ±0.45	0 ±0.26	1 ±0.19	1 ±0.45	0 ±0.58	1±0.06	0±0.06
Dermaptera	0 ±1.22	0 ±1.67	0 ±2.89	1 ±0.13	0 ±0.19	0 ±0.45	0 ±0.26	0 ±0.51	0 ±0.26	0 ±0.58	0±0.64	0±0.06
Thysanoptera	0 ±1.22	0 ±1.67	0 ±2.89	0 ±0.58	0 ±0.19	1 ±0.26	0 ±0.26	0 ±0.51	0 ±0.26	0 ±0.58	0 ±0.64	0 ±0.06
Hemiptera	0 ±1.22	0 ±1.67	0 ±2.89	0 ±0.58	0 ±0.19	0 ±0.45	0 ±0.26	1 ±0.19	0 ±0.26	0 ±0.58	0 ±0.64	0 ±0.06
Araneae	0 ±1.22	4 ±1.16	5 ±0.64	0 ±0.58	0 ±0.19	2 ±0.96	0 ±0.26	0 ±0.51	2 ±1.16	1 ±0.13	0 ±0.64	0 ±0.06

Table 6: Sampling wise Population Dynamic ± SD recorded from 13-18 layer of fish farm

FF-13-18												
	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD
Lepidoptera	4±1.41	24±13.37	2±1.03	0±0.90	0±0.64	0±0.51	3±1.54	0±0.45	0±0.13	0±0.26	0±0.19	1±0.45
Isopoda	3±0.71	2±2.19	19±10.99	9±5.46	4±2.19	6±3.73	3±1.54	5±3.09	0±0.13	2±1.16	0±0.19	1±0.45
Hymenoptera	1±0.71	11±4.18	6±1.80	1±0.19	2±0.77	0±0.51	0±0.58	0±0.45	0±0.13	0±0.26	1±0.51	0±0.26
Stylommatophora	3±0.71	0±3.60	0±2.44	0±0.90	0±0.64	0±0.51	0±0.58	0±0.45	0±0.13	0±0.26	0±0.19	0±0.26
Coleoptera	11±6.36	8±2.06	7±2.51	1±0.19	0±0.64	0±0.51	2±0.84	0±0.45	0±0.13	0±0.26	0±0.19	1±0.45
Orthoptera	0±1.41	4±0.77	0±2.44	0±0.90	0±0.64	0±0.51	1±0.13	0±0.45	0±0.13	0±0.26	0±0.19	0±0.26
Dermaptera	0±1.41	1±2.89	1±1.74	0±0.90	0±0.64	0±0.51	0±0.58	1±0.26	0±0.13	0±0.26	0±0.19	0±0.26
Chilopoda	0±1.41	2±2.19	1±1.74	1±0.19	0±0.64	0±0.51	0±0.58	0±0.45	0±0.13	0±0.26	0±0.19	0±0.26
Pulmonata	0±1.41	0±3.60	1±1.74	2±0.51	4±2.19	2±0.90	0±0.58	0±0.45	0±0.13	0±0.26	±0.19	0±0.26
Hemiptera	0±1.41	0±3.60	1±1.74	0±0.90	0±0.64	0±0.51	0±0.58	0±0.45	0±0.13	0±0.26	0±0.19	0±0.26
Araneae	0±1.41	4±0.77	0±2.44	0±0.90	0±0.64	0±0.51	0±0.58	1±0.26	2±1.29	2±1.16	2±1.22	1±0.45

Table 7: Sampling wise Population Dynamic ± SD recorded from 1-6 layer of agro-farm

Agri-1-6												
	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD
Isopoda	1±0.21	6±2.83	3±1.20	1±0.07	4±1.98	0±0.64	2±0.49	1±0.07	2±0.49	1±0.07	2±0.92	2±0.99
Coleoptera	1±0.21	3±0.71	3±1.20	4±2.05	3±1.27	5±2.90	5±2.62	2±0.64	4±1.91	4±2.19	0±0.49	1±0.28
Diptera	1±0.21	0±1.41	0±0.92	0±0.78	0±0.85	0±0.64	0±0.92	1±0.07	0±0.92	0±0.64	0±0.49	0±0.42
Hymenoptera	2±0.92	3±0.71	2±0.49	0±0.78	0±0.85	1±0.07	0±0.92	3±1.34	0±0.92	2±0.78	4±2.33	3±1.70
Dermaptera	1±0.21	2±0.00	0±0.92	0±0.78	0±0.85	0±0.64	0±0.92	0±0.78	2±0.49	0±0.64	0±0.49	0±0.42
Lepidoptera	0±0.49	3±0.71	2±0.49	0±0.78	2±0.57	0±0.64	0±0.92	0±0.78	0±0.92	0±0.64	0±0.49	0±0.42
Hemiptera	0±0.49	1±0.71	1±0.21	1±0.07	0±0.85	0±0.64	1±0.21	0±0.78	0±0.92	0±0.64	0±0.49	0±0.42
Orthoptera	0±0.49	0±1.41	1±0.21	2±0.64	1±0.14	3±1.48	3±1.20	2±0.64	1±0.21	1±0.07	1±0.21	0±0.42
Stylommatophora	0±0.49	0±1.41	0±0.92	0±0.78	0±0.85	0±0.64	0±0.92	0±0.78	0±0.92	1±0.07	0±0.49	0±0.42
Araneae	1±0.21	2±0.00	1±0.21	3±1.34	2±0.57	0±0.64	2±0.49	2±0.64	4±1.91	0±0.64	0±0.49	0±0.42

Table 8: Sampling wise Population Dynamic ± SD recorded from 7-12 layer of agro-farm

Agri-7-12												
	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD
Isopoda	2±1.06	2±0.71	3±1.34	2±0.85	1±0.28	1±0.35	1±0.28	1±0.21	1±0.00	1±0.28	1±0.42	0±0.28
Blattodea	0±0.35	0±0.71	0±0.78	0±0.57	0±0.42	0±0.35	0±0.42	0±0.49	0±0.71	1±0.28	0±0.28	0±0.28
Coleoptera	0±0.35	1±0.00	4±2.05	1±0.14	1±0.28	3±1.77	1±0.28	1±0.21	2±0.71	1±0.28	0±0.28	0±0.28
Hymenoptera	2±1.06	2±0.71	3±1.34	0±0.57	1±0.28	1±0.35	1±0.28	2±0.92	2±0.71	1±0.28	3±1.84	3±1.84
Dermaptera	0±0.35	2±0.71	0±0.78	0±0.57	0±0.42	0±0.35	0±0.42	0±0.49	1±0.00	0±0.42	0±0.28	0±0.28
Lepidoptera	0±0.35	0±0.71	0±0.78	0±0.57	1±0.28	0±0.35	0±0.42	0±0.49	0±0.71	0±0.42	0±0.28	0±0.28
Hemiptera	0±0.35	0±0.71	0±0.78	1±0.14	0±0.42	0±0.35	1±0.28	0±0.49	0±0.71	0±0.42	0±0.28	0±0.28
Orthoptera	0±0.35	0±0.71	1±0.07	1±0.14	0±0.42	0±0.35	1±0.28	1±0.21	1±0.00	1±0.28	0±0.28	0±0.28
Ephemeroptera	0±0.35	0±0.71	0±0.78	0±0.57	0±0.42	0±0.35	0±0.42	0±0.49	±10.00	0±0.42	0±0.28	0±0.28
Araneae	1±0.35	3±1.41	0±0.78	3±1.56	2±0.99	0±0.35	1±0.28	2±0.92	2±0.71	1±0.28	0±0.28	1±0.42

Table 9: Sampling wise Population Dynamic ± SD recorded from 13-18 layer of agro-farm

Agri-13-18												
	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD	N±SD
Isopoda	1±0.39	2±0.55	1±0.08	1±0.08	0±0.47	1±0.55	1±0.24	1±0.24	1±0.08	1±0.08	2±0.94	2±0.71
Coleoptera	0±0.31	1±0.16	3±1.34	0±0.63	0±0.47	0±0.16	0±0.47	0±0.47	0±0.79	0±0.63	0±0.47	1±0.00
Hymenoptera	1±0.39	1±0.16	0±0.79	0±0.63	1±0.24	0±0.16	1±0.24	2±0.94	2±0.63	2±0.79	1±0.24	1±0.00
Dermaptera	0±0.31	1±0.16	0±0.79	0±0.63	0±0.47	0±0.16	0±0.47	0±0.47	0±0.79	0±0.63	0±0.47	0±0.71
Lepidoptera	0±0.31	0±0.86	1±0.08	0±0.63	0±0.47	0±0.16	0±0.47	0±0.47	0±0.79	0±0.63	0±0.47	0±0.71
Hemiptera	0±0.31	0±0.86	0±0.79	1±0.08	0±0.47	0±0.16	0±0.47	0±0.47	0±0.79	0±0.63	0±0.47	1±0.00
Orthoptera	0±0.31	0±0.86	0±0.79	1±0.08	2±0.94	0±0.16	0±0.47	0±0.47	1±0.08	1±0.08	0±0.47	0±0.71
Araneae	0±0.31	1±0.16	0±0.79	1±0.08	0±0.47	0±0.16	1±0.24	0±0.47	1±0.08	0±0.63	0±0.47	0±0.71

Fraser *et al.* (1995) revealed the effects of cropping history on the size and composition of earthworm populations. They investigated these effects on a range of mixed cropping farms. Total 105 fields located at 24 different commercial farms were sampled during spring. No native megascolecid earthworms were recorded. Up to five introduced European species were identified at sample sites. About 80% of earthworms were *Aporrectodeacaliginosa*, 10% were *A. trapezoides* and 5% were *Lumbricusrubellus*. The remaining 5% were *Octolasioncyaneum* and *A.rosea*. All five species were found under long-term pasture. Earthworm numbers and biomass showed a similar but more pronounced trend to that of microbial biomass. In mixed cropping rotations, earthworm populations varied greatly with cropping history (Bilal, 2021; Jawad *et al.*, 2023). Populations reached their maximum after about 3 years under agricultural crops.

Relative abundance was also documented for each genra to highlight their major distribution for pertinent suppositions among both fields (fishfarm and agro-field).From 1-6 layer of fishfarm, relative abundance was recorded extraordinary for genus*Alaus*15.53% (N = 34), followed by *Microcylloepus*9.13% (N = 20), *Camponotus* 9.13% (N = 20), *Platyarthrus*8.22% (N = 18),*Tinea*6.85% (N = 15), *Formica*5.48% (N = 12), *Gryllus*5.48% (N = 12) and *Armadillo*5.02% (N = 11). From 7-12 layer of fishfarm, relative abundance was recorded extraordinary for genus*Tinea* 18.92% (N = 35), followed by *Camponotus* 10.27% (N = 19), *Microcylloepus* 9.73% (N = 18), *Gryllus* 8.65% (N = 16), *Alaus*8.11% (N = 15), *Pheidole* 5.41% (N = 10). From 13-18 layer of fishfarm, relative abundance was recorded extraordinary for genus*Tinea*18.64% (N = 33), followed by *Armadillo*12.43% (N = 22), Porcellio 10.17% (N = 18), Platyarthrus 7.91% (N = 14), Alaus 7.91% (N = 14) and Pheidole 5.65% (N = 10).

From 1-6 layer of Agro-farm, relative abundance was recorded extraordinary for genus*Cylisticus* 12.21% (N = 16), followed by*Gonocephalum*6.87% (N = 9), *Melanotus* 6.11% (N = 8). From 7-12 layer of Agro-farm, relative abundance was recorded extraordinary for genus*Cylisticus*13.41% (N = 11), followed by*Monomorium*9.76% (N = 8) *Solenopsis*8.54% (N = 7) *Gryllus*6.10% (N = 5). From 13-18 layer of Agro-farm, relative abundance was recorded extraordinary for genus*Cylisticus*22.73% (N = 10), followed by *Solenopsis*13.64% (N = 6), *Gryllus*9.09% (N = 4) and

*Monomorium*6.82% (N = 3). Brussaard and Hemerik (2002) conducted the diversity of soil macro-invertebrates in grassland. It showed that plant community in nutrient-poor grasslands supports fewer macro-invertebrate individuals than richer grasslands. The lowest total number of individuals in different taxonomic groups of macro-invertebrates was found in the most impoverished field. however, the adult weevils, showed a clear relation with nutrient status of the grasslands.

Accordingly, for families, documentations were also accomplished. From total of 53 recorded families, 27 families were recorded from 1-6 layer of fishfarm. Relative abundance was recorded extraordinary for family Formicidae 17.35% (N = 38), followed by Elateridae 15.53% (N = 34), Elmidae 9.13% (N = 20), Platyarthridae 8.22% (N = 18), Tineidae 6.85% (N = 15), Gryllidae 5.48% (N = 12) and Armadillidae 5.02% (N = 11). From total of 53 recorded families, 27 families were recorded from 7-12 layer of fishfarm. Relative abundance was recorded extraordinary for family Formicidae 18.38% (N = 34), followed by Elmidae 9.73% (N = 18), Gryllidae 9.19% (N = 17), Tineidae 18.92(35) and Elateridae 8.11% (N = 15). From total of 53 recorded families, 23 families were recorded from 13-18 layer of fishfarm. Relative abundance was recorded extraordinary for family Tineidae 18.64% (N = 33), followed by Armadillidae12.43% (N = 22), Formicidae 12.43% (N = 22), Porcellionidae 10.17% (N = 18), Platyarthridae 7.91% (N = 14) and Elateridae 7.91% (N = 14).

From total of 53 recorded families, 30 families were recorded from 1-6 layer of agro-field. Relative abundance was recorded extraordinary for familyFormicidae 15.27% (N = 20), followed by Cylisticidae 12.21% (N = 16), Gryllidae 8.40% (N = 11), Tenebrionidae 8.40% (N = 11) and Elateridae 6.11% (N = 8). From total of 53 recorded families, 23 families were recorded from 7-12 layer of agro-field. Relative abundance was recorded extraordinary for familyFormicidae 25.61% (N = 21), followed by Cylisticidae13.41% (N = 11), Gryllidae 7.32 % (N = 6) and Scarabaeidae 6.10% (N = 5). From total of 53 recorded families, 14 families were recorded from 13-18 layer of agro-field. Relative abundance was recorded extraordinary for familyFormicidae 27.27% (N = 12), followed by Cylisticidae 22.73% (N = 10).

For Order level (Table 4-9), in case of 1-6 layer of fishfarm, from total of 16 orders, 11 orders were recorded and relative abundance was recorded extraordinary for order Coleoptera 34.70% (N = 76), followed by Hymenoptera 17.35% (N = 38) and Isopoda 17.35% (N = 38). However, least relative abundance (N ≤ 10) was recorded for order Araneae, Hemiptera, Lepidoptera, Orthoptera, Blattodea, Chilopoda, Pulmonata and Dermaptera. Wherein order Stylommatophora, Neuroptera, Thysanoptera, Diptera and Ephemeroptera were not recorded from 1-6 layer of fishfarm. In case of 7-12 layer of fishfarm, from total of 16 orders, 13 orders were recorded and relative abundance was recorded extraordinary for orderColeoptera 27.57% (N = 51), followed by Lepidoptera 21.08% (N = 39), Hymenoptera 18.38% (N = 34) and Orthoptera 10.27% (N = 19). However, least relative abundance (N ≤ 10) was recorded for order

Araneae, Isopoda, Hemiptera, Chilopoda, Pulmonata, Dermaptera, Stylommatophora, Neuroptera and Thysanoptera. Wherein order Blattodea, Diptera and Ephemeroptera were not recorded from 7-12 layer of fishfarm. In case of 13-18 layer of fishfarm, from total of 16 orders, 11 orders were recorded and relative abundance was recorded extraordinary for orderIsopoda 30.51% (N = 54), followed by Lepidoptera 19.21% (N = 34), Coleoptera 16.95% (N = 30) and Hymenoptera 12.43% (N = 22). However, least relative abundance (N ≤ 10) was recorded for order Pulmonata, Hemiptera, Orthoptera, Chilopoda, Dermaptera, Stylommatophora and Araneae. Wherein orderNeuroptera, Thysanoptera**,** Diptera**,** BlattodeaandEphemeroptera were not recorded from 13-18 layer of fishfarm. Bardgett and Cook (1998) explained the characterization of soil biodiversity and its function in agricultural grasslands. They highlighted information on selected groups of soil animals in grasslands, the factors influencing their abundance, diversity and community structure and their relationships to the functioning and stability of agricultural ecosystems. The impacts of agricultural managements on populations and communities of soil fauna and their interactions confirm that high input, intensively managed systems tend to promote low diversity while lower input systems conserve diversity. They suggested that low input agricultural farming systems are optimal for increasing soil biotic diversity and hence self-regulation of ecosystem function. Abbas *et al.* (2013) collected macro-invertebrates inside the fields of wheat and sugarcane agro-ecosystems by using sweep-nets from weeds. They recorded 2,468 and 2,963 specimens of macro-invertebrates including arthropods and pulmonates from wheat (62 species) and sugarcane (162 species) associated weeds. Both the edges of the fields were significantly rich and diverse (S = 60, H= 3.16), (S = 149, H= 4.05) than the centers (S = 38, H= 2.93), (S = 79, H=3.56), respectively. Hymenoptera, Diptera, Orthoptera, Araneae and Hemiptera were the most abundant taxa.

In case of 1-6 layer of agro-field, from total of 16 orders, 10 orders were recorded and relative abundance was recorded extraordinary for orderColeoptera 26.72% (N = 35) followed by Isopoda 19.08% (N = 25), Hymenoptera 15.27% (N = 20), Araneae 12.98% (N = 17) and Orthoptera 11.45% (N = 15). In case of 7-12 layer of agro-field, from total of 16 orders, 10 orders were recorded and relative abundance was recorded extraordinary for order Hymenoptera 25.61% (N = 21), followed by Isopoda 19.51% (N = 16), Araneae 19.51% (N = 16) and Coleoptera 18.29% (N = 15). In case of 13-18 layer of agro-field, from total of 16 orders, 10 orders were recorded and relative abundance was recorded extraordinary for order Isopoda 31.82% (N = 14), followed by Hymenoptera 27.27% (N = 12), Coleoptera 11.36% (N = 5) and Orthoptera 11.36% (N = 5). Sharon *et al.* (2001) compared the taxa, specimen richness and biodiversity in the forest floor. The study sites had similar tree species composition, similar climatic and micro-climatic conditions, but different soil physical texture. The fauna was extracted from samples of leaf litter and top soil. climatic conditions (precipitation, air and forest floor temperature, leaf litter and top soil water content) were measured. Thus, oligochaetes were more abundant in the Golan whereas diplopods, isopods and hymenopterans were more abundant in the Galil, and gastropods were

found exclusively in the Galil. In both forests, climate affected the dynamics of taxal vertical movement. Moreover, in both forests, (leaf litter and top soil), specimen richness and biodiversity index were low during the dry season and high during the wet season. The influence of climatic changes on the taxa composition and vertical movement, were similar in the two forests. They concluded that in similar forest types under similar climatic conditions, the soil composition and texture do not directly affect biodiversity and fauna richness. The soil texture has a direct influence on the relative abundance of certain animal taxa.

Diversity (H′) was recorded highest (2.0328) from 1-6 layer of agro-field as compared to 1-6 layer of fishfarm (2.0292). Diversity (H′) was recorded highest (2.0463) from 7-12 layer of fishfarm as compared to 1-6 layer of agro-field (2.0205). Diversity (H′) was recorded highest (2.0443) from 1-6 layer of fishfarm as compared to 1-6 layer of agro-field (2.0110). $Diversity_{Maximum}$ (H_{max}) was recorded high from 1-6 layer of agro-field (2.1173) and minimum from 1-6 layer of fishfarm (2.0667). $Diversity_{Maximum}$ (H_{max}) was recorded high from 7-12 layer of fishfarm (2.2672) and minimum from 7-12 layer of agro-field (1.9138). $Diversity_{Maximum}$ (H_{max}) was recorded high from 13-18 layer of agro-field (2.2480) and minimum from 13-18 layer of fishfarm (1.6435); while highest evenness value was again recorded from 1-6 layer of agro-field (1.6435) and least from 1-6 layer of fishfarm (0.0141). Highest evenness value was again recorded from 7-12 layer of fishfarm (0.0204) and least from 7-12 layer of agro-field (0.0107). Highest evenness value was again recorded from 13-18 layer of fishfarm (0.0197) and least from 13-18 layer of agro-field (0.0067). Whereas, dominance was also recorded highest from 1-6 layer of agro-field (1.0155) and least from 1-6 layer of fishfarm (1.0141). Dominance was also recorded highest from 7-12 layer of fishfarm (1.0204) and least from 7-12 layer of agro-field (1.0107). Dominance was also recorded highest from 13-18 layer of fishfarm (1.0197) and least from 13-18 layer of agro-field (1.0067). Similarly, richness (R) was recorded maximum in 1-6 layer of agro-field (13.5246) and least from 1-6 layer of fishfarm (10.3160). Richness (R) was recorded maximum in 7-12 layer of agro-field (10.5247) and least from 7-12 layer of fishfarm (10.3160). Richness (R) was recorded maximum in 13-18 layer of fishfarm (10.2057) and least from 13-18 layer of agro-field (6.6468).

Yang *et al*., (2016) and Yin *et al.* (2017) studied the patterns of vertical variation and diversity of flora and fauna along elevational change. Soil macro fauna was extracted in May, July, and September of 2009. In each season, the abundance and richness of the soil macrofauna decreased with the ascending elevation. The Shannon–Wiener diversity indices of the soil macrofauna were higher in the vegetation zones of lower elevation than of higher elevation (Bilal and Ullah, 2021; Ali *et al*., 2021; Siddaraju *et al*., 2010). Significant differences were observed in the abundance, richness, and Shannon–Wiener diversity index for the studied vegetation zones. Soil macrofauna congregated mainly to the litter layer in the low-elevation areas and in the 0–5 cm soil layer of the higher elevation areas. The results emphasized that the diversity of soil macrofauna communities decreased as the elevation increased and possess the distinct characteristics of zonation in the mountain ecosystem. The diversity and distribution of soil macrofauna

communities were influenced by mean annual precipitation, altitude, annual radiation quantity, and mean annual temperature.

CONCLUSIONS

It was concluded from the above all discussion that rather than permanent moisture maintaining in soil, regular but suitable moisture level in soil may enhance the upper and downword existence and abundance of soil fauna wthich results in healthy soil, its turn over and triger the sustained the ecological outcomes.

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