Summary

Diversity and distribution pattern of earthworm communities of Kashmir valley is investigated. A total of eight earthworm species belonging to three different families—Moniligastridae, Megascolecidae and Lumbricidae—were recorded. Out of eight species, three species: *A. c. caliginosa*, *O. cyaneum* and *E. fetida* are reported for the first time from Kashmir Valley. *A. r. rosea* and *A. c. trapezoides* exhibited a wide distribution range whereas *O. cyaneum*, *A. c. caliginosa*, *A. parva* showed restricted distribution. The number of species of earthworms was positively correlated with soil organic carbon, organic nitrogen and moisture, suggesting that more number of earthworm species is found in those sites where organic carbon, organic nitrogen and moisture are higher. Hierarchical cluster analysis grouped 20 earthworm collection sites into three clusters—earthworm absent sites (EAS), low earthworm diversity sites (LEDS) and moderate earthworm diversity sites (MEDS). Factor analysis/principal component analysis assisted from the data set of 20 sites, resulted in four latent factors affecting earthworm communities as mainly related to physical habitat factor, chemical factor, soil texture factor and growth factor.

The status of water quality in Anchar Lake, Khushalsar Lake and Dal Lake was examined where 13 water quality parameters from 10 sampling stations of these three lakes were measured and interpreted using multivariate statistical methods including factor analysis and cluster analysis. Water quality parameters varied significantly among and within the sampling sites. Hierarchical cluster analysis grouped 10 sampling sites into three clusters i.e., less polluted (LP), moderately polluted (MP) and highly polluted (HP) sites, based on similarity of water quality characteristics. From the dendrogram of
cluster analysis it is clear that Khushalsar Lake is a highly polluted Lake and Anchar Lake is moderately polluted, whereas Dal Lake is less polluted. However the station 7 of Dal Lake is moderately polluted, since the station receives domestic wastewaters in addition to agricultural runoff and hence subjected to more distribunces. Principal components (PCs) obtained from factor analysis indicated that the factors responsible for accelerated eutrophication of the three lakes are domestic waste waters, agricultural runoff and to some extent catchment geology. Thus the analysis and interpretation of the data sets assists to identify pollution sources/factors and helps to design effective management strategies fot these lakes.

Epigeic earthworm species *E. fetida* exhibited higher macrophyte recycling potential than endogeic species- *A. c. trapezoides* and *A. r. rosea* when tested during 60 days experiment period. *E. fetida* also indicated higher rate of population and biomass built-up along with higher cocoon production. Analysed data provided sound basis to state the vermicast of *E. fetida* as superior in terms of their nutritive value when compared to that of other two species. The observed differences among the three earthworm species in terms of growth, reproduction characteristics and composting/recycling potential could be species-specific character or it could be related to their feeding preferences. Weight gain as well as good reproductive performances is the best indicators to evaluate the recycling potential of earthworm species, based on which *E. fetida* emerges as a potential species among these three earthworm species for vermicomposting of macrophytes.

Management of macrophytes by environmentally acceptable means is a serious problem. However their use as substrate in the vermicomposting systems can be
potentially helpful in their management vis-a-vis to convert them into value-added product such as vermicompost/vermicast. The cluster analysis clearly showed that *Azolla pinnata* reactor or the reactor having *A. pinnata* (as part of the substrate) acts as an excellent vermicompost substrate for vermicompost. Further the quality of poor/moderate vermicompost substrate can be improved by addition of *A. pinnata*. PCA classified macrophytes into different types that affect growth and reproduction in *E. fetida*. It resulted in varied earthworm population characteristics in different macrophytes (reactors) based on the macrophyte’s physical and chemical characteristics. The results indicate economic utilization of macrophytes by vermicomposting technology and also a model for ecological engineering and sustainable agriculture. As the end product is enriched with many essential plant nutrients, its horticultural/agricultural application will help in restoration of soil fertility.

Application of vermicompost resulted in increased germination rate, enhanced plant growth, overall increase in yield with more marketable fruits in both *L. esculentum* and *S. melongena* crops. Vermicompost influenced the moisture retention and aeration of the soil thereby potentially improved seed germination. Different doses (2t/ha, 4t/ha and 6t/ha) of vermicompost application resulted in different responses but dose of 6t/ha yielded better plant growth and higher yield with more marketable fruits in both the crops. This could be attributed to ‘balanced nutrition release pattern’ of vermicompost, in particular in terms of release of plant available nitrogen, phosphorous and potassium. However the effect of vermicompost application was more pronounced in *S. melongena* as compared to *L. esculentum* in terms of germination rate and yield parameters could be due to differences in their genotype since genotype plays a key role in response to
vermicompost application (Donald and Visser, 1989). The early maturation of yield with more marketable fruits makes their availability early in the market and consequently with more market value. Since it is beneficial for farmers, it can encourage them for macrophyte vermicompost based organic farming.

Thus it is concluded that collection of macrophytes from lakes helps in solving their menace and at the same time reducing nutrient load of the water bodies, besides improving on their aesthetic value. Further the use of macrophytes as substrate for vermicomposting by locally available (endogenous) earthworm species and its end product (vermicompost) can be an important component for sustainable agriculture as the overall process is economically viable, resource conserving, socially supportive, commercially competitive and environmentally sound.