

Quaternary Vegetational history in India

Palaeoenvironment deals with the environmental, climatic and ecological conditions of the geologic past. The plants of quaternary period, with very few exceptions, are still living resulting in close resemblance of plants of that period with those of the present day, thus facilitating the identification of fossil pollen types with consequent reconstruction and interpretation of depositional environment in terms of their known ecological status.

Changes in the ecological environment are characterized by differing floral elements, the frequency of occurrence of such elements, in turn, indicate the nature and existence of that particular environment.

Pollen analysis has now been accepted as an important method for the interpretation of palaeoecology with particular reference to Early and Late Quaternary deposits of India and other places. Spores and pollen grains have been of great help in the reconstruction of vegetational history with obvious reflection on the past environmental condition (Chanda, 1972).

Pleistocene Vegetational History of Kashmir Valley

Karewas of Kashmir (believed to be of Pleistocene age), pollen analytically investigated by Nair (1960), were constituted of arboreal, non-arboreal and aquatic plants. The Lower Karewa Formation was dated as first interglacial and Upper Karewa as second glacial period. Presence of arboreal plants like *Abies*, *Betula*, *Juglans*, *Larix*, *Pinus*, *Picea*, *Quercus* and some other broad leaved plants point out that the climate was relatively cool and moist as most of these plants now flourish in the humid temperate parts of the Himalayas. Moreover, presence of pollen grains of shrubs and herbs like *Viburnum*, *Vabriama* and members of Umbelliferae also confirm the above speculation. The aquatic vegetation consisted of *Jussiaea*, *Nelumbo* and *Trapa* followed by *Polygonum*. Such plants are now found in humid conditions. Occurrence of *Artemisia*, *Plantago*, etc. is suggestive of the deterioration of luxuriant broad-leaved forest,

perhaps due to an increase of temperature. Vishnu-Mittre et al. (1962) were of the view that the Pliocene climate was subtropical in nature, and towards the beginning of the Pleistocene, there was a marked lowering of the temperature leading to temperate condition.

The pollen analytical sequence dealt with by them showed that the climate during the deposition of Lower Karewas was temperate. This was corroborated by two Pines viz. *Pinus roxburghii* and *P. wallichiana*. The first one indicates subtropical and the second one specify temperate climates. They inferred that the Lower Karewa deposit can neither be referred to the first interglacial nor to the Pliocene.

Singh (1963) attempted to elucidate the post glacial vegetational history of Kashmir valley from four sites (Torhmaidan, Braman, Wallanwar and Damamsar) and suggested some major climatic fluctuations during the Quaternary.

In the beginning, the vegetation consisted of *Pinus wallichiana*, *Cedrus deodara*. Maximum representation of pollen grains of *Pinus* and *Cedrus* with occasional presence of pollen grains of *Abies*, *Picea*, *Betula* and *Quercus* with high value of NAP (Non-Arboreal Plants) like *Typha*. Increase of blue pine and decrease of oak and cedar indicate a cooler climate. This was followed by a gradual increase in AP (Arboreal Plants) with recorded occurrence of pollen grains of *Betula alnoides*, *Quercus*, *Alnus*, *Ulm*, *Juglans* etc. the vegetation indicates warmth and moisture demanding broad leaved elements. Emigration of *Rhus* indicates a climatic trend towards increasing warmth. With further rise of *Quercus*, a change to a rich warmer condition climatic optimum was established. This was also corroborated by the presence of aquatic floating elements like *Lemna* and *Nymphaea*. This was, in turn, followed by reestablishment of conifers pointing to return of cooler conditions.

In his reconstruction of the above vegetational succession, Singh (1963) found an additional support from the worldwide scheme of post glacial climatic change postulated by Von Post (1946) i.e. a period of increasing warmth is followed by a period of maximum warmth which, in turn, gives rise to a period of decreasing warmth and a temperate climate in the final stage.

Vishnu-Mittre and Sharma (1966) from their studies of Haigam Lake post-glacial deposit suggested a gradual warming up of climate as indicated by occurrence of thermophilus plants. They noted different stages of succession of vegetation beginning with broad leaved deciduous trees; the vegetation later was represented by conifer-mixed wood phase. With a subsequent amelioration of climate, a broad leaved conifer-mixed forest was established. Probably under the dual influence of climate and the biotic factor, the oak mixed wood declined and pine woods were reestablished. Associated with this succession of arboreal vegetation, changes were also noted in the occurrence of herbs, shrubs and aquatic plants like *Artemisia*, *Potamogeton* etc.

The vegetational picture indicated that there was a period of cool humid climate which gradually became warm and dry, finally changing into dry temperate condition. During this period, origin and progressive development of agriculture were evidenced.