Plant Succession and its Role in Practical Forestry

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Nature in all its forms and facets has been of immense interest for the human race. Evolution in itself has been a mystery throughout and has been a matter of interpretation. Famous theories of evolution like that of Darwin have been topics of considerable interest and differences of opinion. Like the human evolution, the evolution and progression of the forest flora is of considerable importance. Even today a practical forester has to come across numerous problems such as problems of natural regeneration, formulation of land policies, classification of forests, selection of species—(exotic or indigenous) for plantations, where slight ignorance of the ecological environments tells highly upon the success of the whole effort. Examples are numerous and will be dealt with later on. In short it is not only helpful but essential to be aware of the ecological necessities of forests.

While considering the improvement of natural regeneration or maintenance of site quality, the forest must be regarded as a biological entity composed of innumerable organs together with its environments, which is the resultant of all the external influences. It is not only a mechanical aggregation of various tree species but a result of various actions and adjustments of soil and vegetation, natural agencies like temperature, moisture; and biotic factors like grazing, fires, felling and lopping influencing it all the while.

The modern concept of vegetation is to consider it as a dynamic process starting from the first greenery on bare mineral soil at the banks of rivers to the evergreen forests in their fully stocked form with innumerable species. The dynamic concept of vegetation is widely accepted by different schools of thought. The dynamic schools consist of—

1. The Scandinavian school which is interested in quantitative and statistical side of ecology.
2. The Zurich Montpellier school led by Braun Blanquet.
3. The English school-led by Tansley.
4. The American school-led by Clements.

The dynamic concept has recently been challenged by an American ecologist Greason who still reaffirms that forest is only a mechanical aggregation of trees competing with each other and inter-dependent upon each other.

Though Clements' theory of mono-climax has been widely accepted, it cannot be rigidly applied everywhere. In India, with various geological and edaphic variations, various edaphic climaxes are developed. Even in a small division like Saharanpur where climatic conditions are more or less the same we get two distinct edaphic climaxes depending upon the nature of parent rocks and the resulting soils formed from them.

It is said that nature knows no vacuum. A bare area is rapidly covered by vegetation composed of small simple species with low moisture and nutrient requirements. These species after their prolonged stay at the given site form a microclimate and by modifying the environment conditions make ground for more exacting species which afterwards follow. This change starting from the invasion on the bare mineral soil and land slips up to to the final species which set themselves in harmony with the environments is known as

succession. The species which settle first are known as pioneers or colonizers and the final stage in harmony with the climate is known as climatic climax. The stages in between the appearance of pioneers and climatic climax are known as seral stages.

Different kinds of successions:—Successions are denominated after the nature of soil which is colonized and the conditions in which successions take place.

Primary succession. — When succession starts from bare mineral soil such as new alluvial sites, sand dunes, land slips and screes, succession is called primary. In the primary succession denomination may vary with the kind of soil. Thus we may have:

Psammosere.—where sere begins on loose sand.

Lithosere.—where sere begins with bare rock.

Secondary Succession:—When succession starts on prepared soil after the primary succession has stopped due to disturbance such as felling, fires etc. This is known as subsere also.

Hydrosere:—A sere beginning on a site too wet for the locality, for example on a silted up lake.

In primary succession, as it starts over bare mineral soils, mostly silicious, devoid of soil manures and nitrogen, with lack of moisture retaining capacity and with excessive overhead light, the pioneers have necessarily the following characteristics:

(1) They are with long tap roots by which they can take moisture from lower strata.

(2) They adapt themselves to dry localities with less or no nutrients.

(3) They germinate and progress in excessive overhead light and so are strong light demanders.

(4) They have nitrogen fixing nodules in their roots, e.g. in "sissoo," *Albizza, Acacia, Alnus* and *Casuarina.*

(5) They are frost and draught hardy, e.g. "Kher," Sissoo.

(6) They have wind or water disseminated light seeds on account of which they are capable of wide dissemination. Thus Kher and Sissoo are found on the river banks.

Different climaxes.—With different types of soil the various stages are different.

On alluvial deposits.—Kher, Sissoo—*Albizzia, procera, Holoptelia, Adina, Lagerstroemia, Bombax, Terminalia baleica. (finally) Shorea, Legerstroemia, Terminalia* and *Adina.*

In a more moist climate *Trewia nudiflora* and *Cedrella toona* are added with *Bombax* and *Terminalia* canopy. In the final stage a fair percentage of *Eugenia jambolana* is present.

Examples of this type may be seen in various compartments in Dehra Dun Division (Lachhiwala 14 B).

Muddy places and tidal estuaries.—Here succession has another form as in such conditions ordinary tree roots fail to take moisture from saline water. Pioneers here are equipped with special process capable of extracting moisture from saline water. There the succession is as follows:—

Mangrove scrub-mangrove tree-slow growing *Heritiera*—Fresh water *Heritiera*—Fresh water species without *Heritiera.* Climax of evergreen and semi-evergreen species.

Hilly places (above 8000')—In the North West Himalayas where mixed fir, spruce, deodar is the climatic climax, succession starts with *Pinus excelsa* and passing through mixed deodar, spruce and blue pine stage reaches the climax.

It may not be out of place to mention that even other species could start as pioneers in changed environments and pioneers of one site may be climaxes of others. Thus the pioneers of alluvial deposits like Kher, Sisoo of U.P. are climatic climaxes of Punjab and Sind. Deodar which is a climatic climax in Kashmir appears to be seral in the Chakrata Division of U.P. as evidenced by the failure of natural regeneration of this species.

From the above we have seen that at plac-

es colonizers and the stages of development may be different with difference in climatic and edaphic conditions.

Irrespective of the species that may come, the process of action and reaction between the vegetation and environment is more or less the same.

With the advent of the first colonizers on the site, a change in moisture and soil conditions starts. The shade as created by the colonizing species reduces the rate of evaporation from the ground and the leaf litter as it falls from the trees adds to the nutrient contents of the soil in the form of humus. Soon in the improved conditions of moisture and soil the canopy closes and it becomes practically impossible for species with light requirements to regenerate under their own shade. We seldom find Kher and Sisso which are colonizers and strong light demanders regenerating themselves under their own shade.

In increased shade conditions, more shade bearing species come in and a competition for light and moisture starts. Thus with the start of reaction the evolution of species and site begins. With the evolution of shade bearers the competitions for light conditions becomes more acute and in the long run, shade bearing species get the upper hand. Some dominant trees find place in the top canopy while others are suppressed. These suppressed trees die out and add to the humus contents of soil. In increased shade and moisture conditions many animals find shelter and are responsible for the transference of many heavy seeded species which form their food material. Examples may be many such as mulberry seeds which are brought by birds. Ber and guava are eaten by animals and their seeds passed out in excreta. Striking examples of accelerated germination are shown by the seeds of *Podocarpus falcatus* the germination period being reduced in animal voided seed from 24-48 months to 6 to 12 months. The more advanced trees have certain other mechanisms also by which their seeds are transferred to distant places.

Thus in the actions and reactions more exacting species go on occupying the site till a stage is reached when further progression is not possible and the vegetation is in equilibrium with the environments. This stage is stable as opposed to the seral or transitional stage.

Tests for climax and seral stages:—

(1) Climax stage species have long developed boles with distinct normal crowns.

(2) Owing to the free regeneration of the species all the age classes are normally represented distributed throughout the area. The number of stems per unit area against diameter or age class is a normal hyperbolic curve.

Seral Stage:

(1) The trees have short boles and low spreading crown.

(2) Lower age classes are few and the curve falls sharply for younger age classes.

Different climaxes: The normal succession takes place only till it is unobstructed by biotic factors and as such true climax is only reached where the sere is not disturbed by human agencies. But as this is generally not possible true climaxes are commonly absent. Yet in certain parts we have more or less climax stages, e.g.

Sal is a climatic climax in Bihar & C.P.

Teak with fair quantities of Bamboo in C.P.

Deodar in Kashmir.

Fir in U. P.

In climaxes, though climax species are predominating, still seral species may be present in certain proportion.

Views about the stabilities of climax vegetation:—Even about the perpetuality of climax type when the forest is left to itself there are two schools of thought. According to one the climax type should be capable of standing over a given site indefinitely.

According to the other view there is cyclic change of climax. That is the vegetation on a given area is replaced by different climaxes.

Conclusions regarding the ecological status of a species must be based on data extending over three generations, according to evidence forthcoming from Nigeria.

Retrogression: It is seldom possible that the forest may remain undisturbed by biotic factors like fire, grazing, lopping and felling. Natural factors like rainfall and insolation may also change. This disturbs the balance between the vegetation and environments. Thus the sere is pushed back and the process is known as retrogression.

Retrogression may be caused by two agencies:

(1) Natural: such as the Dry Gangetic alluvial sal of U.P. due to climatic change.

(2) Biotic & human: There are umpteen examples throughout India of retrogression caused by human and biotic factors.

If the edaphic changes are favorable the sere goes ahead of the climax stage and we get other species which are often of comparatively less value as our most economical species like teak and sal are generally found in the sub-climax stage.

Examples of *Post climaxes* may be:

(1) Broad leaved species like Aesculus, Acer, Ulmus, Fuglans, Corylus, Prunus etc., in moist hollows and depressions in the coniferous zone in the Himalayas between 6000-9000 feet.

(2) Teak with dense growth of bamboos (*Dendrocalamus strictus*) forms a post climax and in such conditions the regeneration of teak is not possible. This association represents very moist conditions where teak regeneration is inadequate. In Bengal, Orissa, Bihar and Assam and many parts of U.P. cane brakes from an edaphic climax.

Pre-Climax.—If the edaphic conditions are not favorable the sere may be held before the climax. This stage is called the pre-climax. Examples of such climaxes are:

(1) *Cuperssus torulosa* on lime-stone and calcareons soils in the Himalayas in the *Quarcus dilatata* zone.

(2) *Xylia xylocarpa* on laterites in Western ghats and Orissa.

When retrogression is caused by biotic factors the existing retrogressed stages are known as sub-climax stages.

Such stages are most common and it is surprisingly true that most economic forests of India are in this stage. But still it is equally true that excessive denudation and erosion are the results of the haphazard working, fires, lopping and grazing.

Excessive grazing and lopping of fir in the Chakrata General Working Circle have brought about failure of fir regeneration.

The effect of all these biotic influences is most conspicuous in Punjab where large tracts of land once supporting rich vegetation are not only deprived of the vegetation but have become chos (eroded beds) looking like the beds of rivers.

Secondary succession. — The subclimax stage remains only till the disturbing factors are present. Nature opposes any disturbance against its course violently and thus as soon as the retrogressing factor is removed vegetation tends to proceed towards climax type.

Example.—Sal in the burnt areas where grasses formerly prevailed thins out the grasses and forms a gregarious community.

This change climax after removal of biotic factors is known as secondary succession.

In some places colonizers both in primary and secondary succession are the same, e.g. blue pine, *Trema* and *Anthocephalous cadamba*. In moist sal forest *Macaranga* is typical of secondary succession.

Telescopic succession.—In very favorable conditions the succession may reach climax stage much earlier. Thus *Pinus excelsa* appears with deodar in Kulu as a pioneer while under ordinary conditions, blue pine appears as the first colonizer of alluvial soils. This type of short circuit of the succession is known as telescopic succession.

After discussing in details the succession and its various phases we may see how it can

help the forester in solving various problems of forestry and management.

Primary survey of New Regions.—In finding whether a new site will be suitable for a certain species, the area must be thoroughly surveyed and stock mapped. Supposing a land was deforested long ago and since then it was constantly disturbed, the area will not be suitable for new work as it would have lost not only its vegetable cover but also soil qualities. Thus provided there has been no repeated disturbance of the vegetation and thus of the aerial or soil factors, forest long since disturbed is likely to present better habitat conditions for regeneration, natural and artificial, than forest severely disturbed more recently. A progressive policy would provide for setting aside for forestry purpose of tracts being in any successional stages of development.

Classification of forest types: For a scientifically managed forest its proper distribution to various types is essential. Though the floristic difference is always present in different sites, still it is not conclusive. This floristic difference in the different sites is not much in places where the flora is limited. For such places Cajander propounded his theory of forest types.

Knowing of the forest type is important because knowing the successional stages and natural conditions for a type one is forced to believe that a particular treatment is essential. The examples of this could be easily seen where proper steps were not taken and the whole type was changed. In the moist regions teak, sal and deodar forests were replaced by less valuable species following a policy of rigid fire protection from the 80's of the last century.

Each successional stage is a three-fold indicator and tells about the past of the particular site, indicating what kind of site preceded. It also shows the present physical condition and suggests the controlling factors within the site. It gives a clue to the future also. Thus if we find regeneration in the places where biotic disturbances are at work it indicates that retrogressive methods may be introduced in solving the problem of natural regeneration.

Selection of species: It helps in the selection of right species for a given site and correct method of preparation of soil of a site. Though it is practically not possible to extend the limits of a species beyond its natural habitat but still the knowledge of requirements and law of distribution checks committing of serious mistakes in the choice of species. An example of this selection could be had in experiments at Laguna plantations where deodar was tried in the zone of spruce and silver fir. The experiment failed not only due to the mistakes of lack of weeding and improper care, but it was against the ecological concept to replace a shade bearer by a light demander in a zone not normally its own.

Similarly it would be unwise to plant climax species like sal or teak as pioneers or in the secondary stage of site evolution.

In deciding the exotics also, we should see what economic species occur in similar habitat all over the globe. After finding this, we may try them on an experimental scale.

Regeneration of forests: A forester must know in what stage his forest will give maximum value. Thus while deciding the method of regeneration the causes may be studied. In Bengal and Assam evergreen forest is the climatic climax but sal could be had by retrogression to a sub climax stage. In Chakrata also where deodar has stopped regenerating due to more moisture conditions and dense weeds, regeneration could be had by controlled burning, controlled sheep grazing and proper manipulation of the canopy during regeneration fellings.

Teak with fair quantity of *Dendrocalamus strictus* is the climax in C. P. But when the proportion of bamboo increases owing to moisture conditions, regeneration of teak stops. Thus to get teak regeneration in such damp

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Forest Resources of Lanao Province

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The actual forest resources of the province of Lanao as of July, 1948 turns annually to our national coffers no less than ₱92,614.50. Its commercial forest comprises 101,560 hectares of potential agricultural land; 116,786 hectares of production forest and 98,509 hectares of protection forest. The timber stand available for commercial exploitation inside potential agricultural land is approximately 12,187,200 cubic meters; 14,015,520 cubic meters in production forest and 11,821,080 cubic meters in protection forest. There are approximately 1,520,952 cubic meters of first group timber; 12,928,092 cubic meters of the second group; 17,110,710 cubic meters of the third group and 6,464,046 cubic meters of the fourth group.

The forest revenue that may be derived from forest charges alone will amount to ₱5,323,286 for first group; ₱25,856,184 for second group; 21,388,387 for third group and ₱3,876,428 for fourth group with corresponding Reforestation Fund (Rep. Act 115) of ₱760,476 for first group; ₱6,464,046 for second group; ₱6,844,284 for third group and ₱2,585,618 for fourth group.

There were 9,837,648 board feet of lumber sawed by the Misamis Lumber Company, Inc., Kiwalan Lumber Company, Inc., and Iligan Lumber Company, Inc. during the period.

The lumber industry in the province of Lanao affords labor to about one thousand families and helps in the opening up of new regions with roads for landless people.

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areas retrogressive measures are essential.

By directing the silvicultural operations properly, the valuable species can be increased which is the main aim of management of any forest.

Site maintenance: With the evolution of species, evolution of site follows. But conifers are exception to this rule as they degrade the soil conditions. In other words conifers bring about their own destruction. Thus it is essential that a proper under-story of broad leaved species be kept to prevent the wholesale extinction of the vegetation.

In Mundali where such a stage has been reached an under-storey is essential otherwise spruce will perish from its own home.

Inter-relation of animals and vegetation: Fauna is equally helpful for the propagation of species. Certain species are dependent on insect pollinators such as *Bombax, Anthocephalous,* etc. Dispersal of seeds and fruits for many species by squirrels and birds is of importance, eg. Mulberry seeds are carried by birds.

Trampling and other disturbances of forest soil by pigs, elephants, antelopes, ground birds, etc., is frequently beneficial as they provide increased aeration and improved soil permeability for germinating seeds.

Thus the relation of animals and plants would teach the forester the necessity of looking whether that particular animal should be protected, reduced or destroyed.

Study and assessment of the correct ecological status of the forests is, therefore, an essential preliminary to the pra ctice of sound silviculture in the forests. In fact modern forestry may be regarded as applied ecology.