

## Climate change and the spread of invasive species

Climate change is a natural process associated with the evolution of our planet. Historically, climate change patterns have lasted for thousands and even millions of years. This allowed the biosphere to gradually adapt to the changes and ultimately led to the present diversity of plants and animals.

However, due to the rapid development of industry, the earth's atmosphere has borne a great volume of pollution gases including green house gases such as CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs, and SF<sub>6</sub> that deplete the ozone layer and warm up the earth. According to scientists, the earth temperature has increased 0.5 degree since 1990 and this phenomenon is happening at an increasingly higher rate. This prevents the opportunity for the earth to adapt and subsequently leads to abnormal weather events leading to a rise in sea level, alteration in precipitation and evaporation patterns, drought and inundation etc.. As a result this brings about losses in human life, damage to the economy and the destruction of the sustainability of ecosystems.

The alteration in natural environment, in turn, provides opportunities for other negative phenomena to occur. One of them is the invasion of alien species (intentionally or unintentionally introduced) when the ecosystems are disturbed. The invasion of alien species brings about a number of consequences such as competition with local species, destroying the ecological balance, negatively affecting agriculture, fishery practices, and harming social-economic development. This article will discuss some examples of the explosion of alien species as a result of climate change.

### **Climate change and invasiveness of weeds in Asia: Examples**

#### ***Increasing temperature regimes and invasive behaviour of weeds***

*Prosopis juliflora* is a weed that is capable of assimilating and storing nutrients in root systems, leading to extraordinary enlargement in the root mass with rich food reserves. This helps the species regenerate rapidly and robustly after mechanical lopping and after revival of ecological stress conditions such as drought and inundation. Studies show that the root enlargement in *Prosopis* species is greatly influenced by the temperature regime of the locality. The annual increase in root bio-mass is greater in areas where the mean annual temperature is higher than that in areas of lesser mean annual temperature. The increase in root biomass largely contributes to the weed's ability to tolerate climatic extremes such as peak

summer associated with high temperature and water scarcity and peak monsoon winter with water inundation and flooding. This adaptation favours the weed to predominate over other native flora that are susceptible to any one of the two extremes.

Introduced from Central America as a drought tolerant species suitable for afforestation in arid and semi arid zones of India in 1877, *Prosopis juliflora* has invaded nearly 5.55 million hectares of land contributing for 1.8% of geographical area of the country. Remote sensing data has predicted the expansion of the species in Gujarat State of India at the rate of 25km<sup>2</sup> per year. Reports predict that by the year 2020, more than 56 percent of the area in Banni with rich bio-diversity and grassland ecosystem would be under *Prosopis*.

*Parthenium hysterophours* originated from the Gulf of Mexico and Central South America has been seen as an aggressively invasive weed due to ecological niches provided by frequent flooding and higher CO<sub>2</sub> resulting from global warming. The species are observed to possess periodicity of germination and phenology to evade environmental stress conditions. This species has invaded India, Pakistan and Srilanka.

Reported to have originated from tropical Africa, *Trianthema portulacastrum* possesses an important character responsible for its invasiveness, thermal induction of seed germination. Soil temperatures of around 35 degrees favours synchronised and mass germination of seeds, covering the soil as a green carpet. This accounts for invasiveness of the species in Australia, Africa and Asia. In Veeranum Ayacut in Tamilnadu, India

*T. portulacastrum* predominates as the dominant species in all the three crops viz., sugarcane, sunflower and gingelly

### ***Rainfall pattern and weed invasion***

Global warming directly reflects on rising sea levels, altering the water regime at coastal areas and wetlands, disturbing precipitation patterns and bringing about abnormal storms and hurricanes. Alteration in precipitation patterns and hydrology have disturbed habitats of local species that are not able to adapt to the changes and provided newly introduced species with opportunity to flourish. Studies in the tail end of Cauvery river, India have shown that the alteration in precipitation and hydrology regimes has favoured the establishment of *Leptochloa chinensis* and *Marsilea*

*quadrifolia* species in paddy fields. They dominate over the native weeds such as *Echinochloa* sp. by virtue of their amphibious adaptation to alternating flooded and residual soil moisture conditions prevalent during recent years.

*Leptochloa chinensis* owes its invasive behaviour to the longer life span that extends into the relay crop of mung bean after transplanted rice (moisture below 30%). *Marsilea quadrifolia* is tolerant to most of the grass killer herbicides used like butachlor. In addition frequent floods favours its perpetuation.

Studies in Wisconsin show that wetlands with a history of hydrological disturbance show more widespread invasions. Both increased and decreased run off will alter wetland water regimes and the floristic composition could be invaded by the floating weeds, like *Eichhornia crassipes* under inundation and *Ipomoea aquatica* under semi or complete dry situations.

### **Controlling the establishment of invasive weeds: A "how" question**

The above examples show that alien species will potentially flourish and become invasive once environment has been disturbed by various factors including global warming. Therefore, there is a need for measures to manage and control alien species. Useful means include prediction and prevention of the establishment of alien species. Several prediction models exist based on information on certain suspected species.

Managing invasive alien species include several components such as risk analysis, modelling the relationship between invasiveness and climate change, awareness raising etc. However, it is very important to maintain integrity of environment e.g. applying sustainable agriculture. Researches have proved that maintaining wetlands, mangroves and forests etc. can help to prevent the establishment of alien species.