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# GENETIC EROSION: A THREAT TO BIODIVERSITY DEPLETION

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**ABSTRACT**
**Genetic erosion in crop biodiversity is the loss of genetic diversity, including the loss of individual genes, and the loss of particular combination of genes (or gene complexes) such as those manifested in locally adapted landraces of domesticated plants adapted to the natural environment in which they originated. The term genetic erosion is sometimes used in a narrow sense, such as for the loss of alleles or genes, as well as more broadly, referring to the loss of varieties or even species. The major driving forces behind genetic erosion in crops are: variety replacement, land cleaning, over exploitation of species, population pressure, environmental degradation, overgrazing, and changing agricultural systems. Genetic erosion can be prevented by four ways, *viz.* on farm or *in-situ* conservation, off farm or *ex-situ* conservation and complementary conservation.**

## Introduction

World population is expected to reach 10 billion in 2050 by feeding them will require a boost in crop productivity. The world needs astonishing increase in food production to feed this population. Plant genetic resources (PGR) constitute the base upon which agriculture and world's food security is depending. The genetic diversity in the plant germplasm collections is critical to the world's combat to the hunger. They are the primary source of genetic material for breeding new plant varieties and are a reservoir of genetic diversity. Inherent genetic diversity response to selective forces for genetic adaptation and evolution at the time a species experiences threats to its survival. Genetic diversity enables a plant species to adapt the changing environments i.e. new pests and diseases and natural calamities including various abiotic stresses. Traditional farmers provided valuable heritage of genotypes of major and minor crops which adapted locally and have evolved due to natural and artificial selection forces over the millennium (Myers, 1994).

The future breeding is based on genetic base of landraces, wild and weedy relatives have been threatened by various factors of genetic erosion. Genetic erosion (Loss of genetic variation) of these genetic resources could also pose a severe threat to the world's food security in the long term and may decrease the potential of species to persist in the face of abiotic and biotic stresses as well alter the ability of a population to cope with short-term challenges of climate change. Detecting and assessing genetic erosion has been suggested as the first priority in any major effort to protect the loss of genetic diversity.

## Causes of Genetic erosion

It refers to the gradual reduction in genetic variability, in the population of a species, due to elimination of various genotypes. In other words, the loss of genetic diversity caused by either natural or man-made processes is referred to as genetic erosion. Thus, genetic erosion is more in endangered species. Genetic erosion occurs because each individual genotype has many unique genes which get loss when it dies without reproduction. Low genetic diversity in wild species of plants leads to a further reduction in the gene pool. Inbreeding and a weakening of immune system lead to eventual extinction of a species. There are five reasons of genetic erosion, *viz.*

***Replacement of land races by modern cultivars:*** It is main factor for genetic erosion is the replacement of local varieties of domestic plants by high yielding or exotic varieties or species. Land races are primitive cultivars which are being grown by farmers generation after generation. Land race have genetic diversity, wider adaptability, broad genetic base and high degree of resistance to biotic and abiotic stresses. On the other hand, modern cultivars are high yielding but have narrow genetic base as they do not have genetic variability and are highly uniform.

***Industrial Agriculture:*** Genetic uniformity is the prime requirement for it. Major cultivated areas are planted to a single, high-yielding variety or genetically similar cultivars (Monoculture) using high capital intensive inputs like pesticides, weedicides, irrigation and fertilizer to maximize production. A uniform crop is a breeding ground for disaster because it is more vulnerable to epidemics of pests and diseases. Mechanization of farms requires uniform crop types, structures, and management practices such as; planting and harvesting dates. As a result, crop diversity has declined on most farms over the last century.

***Farming into wild habitat:*** The maximum genetic diversity of all agricultural crops lies within the centres of genetic diversity where crops first domesticated. In these regions wild relatives of crop species grow amongst farmer's fields and in the margins of fields and there is a constant recycling of genes. These regions are under threat from the introduction of modern agricultural practices and population pressure in many countries.

***Clean Cultivation:*** The modernization of agriculture and clean cultivation resulted in elimination of wild and weedy forms of many crops leading to reduction in genetic diversity. The exchange of genes between cultivated and wild species enhanced the genetic variability in a population.

***Developmental Activities:*** various developmental activities such as development of national highways, towns, cities, airports, seaports have resulted in the elimination of valuable wild and weedy form of cultivated species.

## Consequences of genetic erosion

Genetic uniformity leaves a species vulnerable to new environmental and biotic challenges and causes heavy damage to the society. The Potato famine of 1845 in Irish was a drastic illustration of the dangers of genetic uniformity. Farmers came to rely almost entirely on one very fertile and productive variety known as 'Aran Banner'. Unfortunately, this particular variety was highly sensitive to the fungal disease late blight (*Phytophthora infestans*) which destroyed the potato crop. Consequently, the Irish Famine took about one million lives from hunger and disease, and changed the social and cultural structure of Ireland in profound ways. Another dramatic example seen in 1970 as roughly three-quarters of the corn acreage in the US was planted in "Texas T cytoplasm" corn. The Texas 'T' cytoplasm results in individuals that are male-sterile. This makes production of hybrid corn far less labour intensive, as there is no need of de-tasseling. However, this maize is highly sensitive to host selective toxin ('T' toxin) produced by race 'T' of *Cochliobolus heterostrophus*, the casual organism of southern corn leaf blight. This blight swept through fields of "Texas T cytoplasm" corn and yield was reduced severely. Similarly, the loss of Asian rice crop to grassy stunt virus also illustrates the same point. The catastrophic outbreak of coffee rust in 1970 caused great losses in Brazil with higher coffee world market prices as a consequence. Other examples include the coffee rust epidemic in Ceylon in the 1870s, the tropical maize rust epidemic in Africa in the 1950s and the blue mould epidemic on tobacco in the USA and Europe in the 1960s (Marshall, 1977).

## Prevention of genetic erosion

Genetic erosion gets compounded and accelerated by habitat fragmentation. Today most endangered species live in smaller and smaller chunks of fragmented habitat interspersed with human settlements and farmland making it impossible for them to naturally meet and breed with others of their kind, many die off without getting a fair chance to breed and pass on their genes in the living population.

The world's endangered plant species are plagued by varying degrees of genetic erosion and most of them need a human intervention to keep their population viable and to save them from extinction.

The loss of biodiversity poses a serious threat to agriculture and the livelihoods of millions of people. Conserving biodiversity and using it wisely is a global necessity. Biodiversity provides the foundation for our agricultural research systems. It provides the sources of traits to improve yield, quality, resistance to pests and diseases and adaptation to change environmental conditions, such as global warming. The protection of plant diversity is essential for food security and ecological well – being. Biodiversity is also a direct source of food for many people and is an essential part of our life support system. Without biodiversity, our ecosystems and the planet's entire biosphere cannot function.

Conservation refers to protection of genetic diversity of crop plants from genetic erosion. The biodiversity can be conserved in four main ways, *viz.*

**On farm conservation:** It involves the maintenance of crop species on the farm or in home gardens. The effectiveness of strategies to maintain and use crop or livestock diversity on farms depends on the extent to which local varieties continue to meet the needs of farmers and communities.

***In-situ* (onsite) conservation:** conservation and use refers to the maintenance and use of wild plant populations in the habitats where they naturally occur and have evolved without the help of human beings. The maintenance of the genetic diversity of the wild species and wild relatives of crop plants in the protected areas (national parks and nature reserves).

***Ex-situ* (offsite) conservation:** conservation of germplasm takes place outside the natural habitat or outside the production system, in facilities specially created for this purpose. Depending on the type of species to be conserved, different ex-situ conservation methods may be used. The gene banks are used for ex-situ conservation of biodiversity. In gene banks, biodiversity is conserved for its sustainable use by breeders, farmers and researchers for agricultural development.

**Complementary conservation:** It involves a proper combination of different conservation approaches for the sustainable use (in present and future) of genetic diversity existing in a target gene pool. The main objective of any plant genetic resources (PGR) conservation programme is to maintain the highest possible level of genetic variability present in a gene pool of a given species or crop both in its natural habitat and in a germplasm collection. It is dynamic, and lends itself to meet the challenges of changes that are occurring in the field of genetic resources as it is open to new technologies and new needs.

## Conclusion

With genetic erosion it is not only genetic resources that are under threat of disappearance but also the indigenous knowledge of selecting, utilizing, and conserving these materials that has been accumulated for thousands of years. Erosion of crop genetic resources could pose a severe threat to the world's food security in the long term since loss of genetic variation may decrease the potential for a species to persist in the face of abiotic and biotic environmental change as well alter the ability of a population to cope with short term challenges such as pathogens and herbivores. It is also threatening the genetic base of many important crops in which future breeding is based.

## References

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