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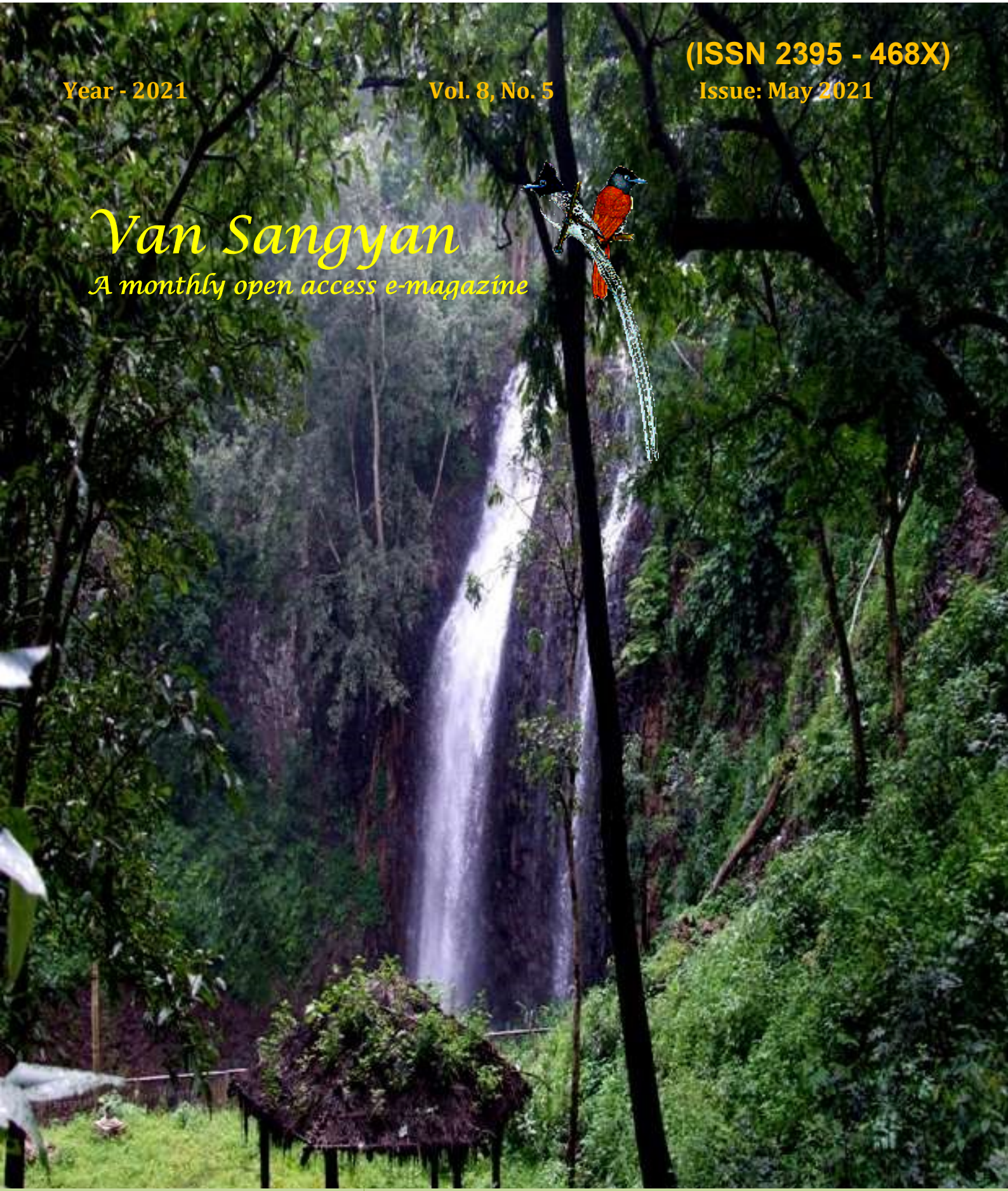

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Van Sangyan

Note to Authors:

We welcome the readers of Van Sangyan to write to us about their views and issues in forestry. Those who wish to share their knowledge and experiences can send them:

by e-mail to vansangyan_tfri@icfre.org

or, through post to The Editor, Van Sangyan,
Tropical Forest Research Institute,
PO-RFRC, Mandla Road,
Jabalpur (M.P.) - 482021.

The articles can be in English, Hindi, Marathi, Chhattisgarhi and Oriya, and should contain the writers name, designation and full postal address, including e-mail id and contact number. TFRI, Jabalpur houses experts from all fields of forestry who would be happy to answer reader's queries on various scientific issues. Your queries may be sent to The Editor, and the expert's reply to the same will be published in the next issue of Van Sangyan.

Cover Photo: Panoramic view of Achanakmar-Amarkantak Biosphere Reserve
Photo credit: Dr. N. Roychoudhury and Dr. Rajesh Kumar Mishra, TFRI, Jabalpur (M.P.)

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From the Editor's desk

Deforestation and forest degradation can happen quickly, such as when a forest is clear-cut to make way for a palm oil plantation or a new settlement. It can also happen gradually as a result of ongoing forest degradation as temperatures rise due to climate change caused by human activity. The most common pressures causing deforestation and severe forest degradation are agriculture, unsustainable forest management, mining, infrastructure projects and increased fire incidence and intensity. Deforestation is the mass destruction of trees. Forests account for about 30 percent of the world's land, but human activities are contributing to massive forest loss. Between 1990 and 2016, about 1.3 million square kilometers of forest cover was lost — an area larger than the size of South Africa. The majority of the world's forest loss has occurred in the tropics.

As trees grow and forests expand, so does the amount of carbon dioxide stored in them. The destruction of forests leads to the release of carbon dioxide stored in trees and soils into the atmosphere. Currently, the world's forests absorb about a third of man-made carbon emissions. Net emissions from deforestation are the balance of carbon dioxide released and absorbed by forest destruction and expansion. According to the Intergovernmental Panel on Climate Change (IPCC) report on land and climate change, from 2007 to 2016, net carbon dioxide emissions from land use and land-use change were about 5.2 ± 2.6 GtCO2 yr-1 — about a quarter of global carbon emissions released from human activities in 2018. The majority of these emissions were due to deforestation, partially offset by afforestation or reforestation, and emissions and removals by other land use activities.

Forest degradation occurs when some trees are removed but the forest remains. According to published research, carbon emissions from tropical forest degradation account for about one-third of emissions from deforestation. Interestingly, for a third of the countries included in the analysis, emissions from forest degradation were even higher than those from deforestation. Research also suggests that the figures for forest degradation may be underestimated, and if taken into account, could double the emissions from deforestation.

Countries will need to prioritise their monitoring efforts depending on the significance of the degradation, balanced against available resources. A better understanding of the drivers and impacts of degradation will help guide monitoring and restoration efforts. Ultimately we want to restore ecosystem service and function in degraded forests before the change is irreversible.

In line with the above this issue of Van Sangyan contains an article on Deforestation and forest degradation – causes, effects and sustainable solution. There are also useful articles viz.. जैविक खेती के टिकाऊपन में केंचुआ खाद का महत्व, कोविड संक्रमण के दौरान गृह वाटिका का महत्त्व, Indian gypsy moth, Lymantria obfuscata and its control measures, Impact of solar radiation on plant growth and Biodiversity and traditional medicinal wealth.

I hope that readers would find maximum information in this issue relevant and valuable to the sustainable management of forests. Van Sangyan welcomes articles, views and queries on various such issues in the field of forest science.

Looking forward to meet you all through forthcoming issues

Dr. Naseer Mohammad

Chief Editor

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Deforestation and forest degradation – causes, effects and sustainable solution

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Abstract

Forests play a vital role in protecting our environment in several ways. Forests harbor the majority of species on Earth and provide valuable goods and services, maintain the climate by regulating atmospheric gases and stabilize rainfall, protect land against flood and desertification and provide numerous other ecological functions. Healthy forests support the livelihoods of a large number of people globally majority of whom are amongst the worlds poorest. But the combined effect of overexploitation of timber, deforestation of arable land and pasture, industrialization, construction, urbanization, mining etc. have resulted in the dwindling and degradation of forest resources and many of the plant resources are threatened today. Moreover, industrial logging, conversion of forest land to agriculture, forest fire etc. is also responsible for the bulk of global deforestation and forest degradation today. Destruction of forest changes the reflectivity of the Earth's surface affecting global weather by altering wind and ocean current patterns and changing rainfall distribution. In the present review, it is critical to first explain what is considered forest and what is meant by deforestation and forest degradation and finally the sustainable solutions for the protection of these valuable natural resources have been discussed in length.

Key Words: Agriculture, biodiversity loss, climate change, deforestation, forest degradation, population expansion

Introduction

A forest is a large area of land covered with trees, plants or other woody vegetation such as brushwood and jungles. However, there is no universally recognized precise definition, with more than 800 definitions of forest used around the world (UNEP 2010). Food and Agricultural Organization of the United Nations has been assessing the world's forest resources at regular intervals based on an agreed global definition of forests (FAO 2000) which includes a minimum threshold for the height of trees (5m), at least 10 per cent crown cover and a minimum forest area size (0.5 hectares). According to this definition, forests cover 31 per cent of the world's land surface (FAO 2015) and an area of 3999 million hectares (Table 1). Urban parks, orchards and other agricultural tree crops (i.e. fruit tree and oil palm plantations) are excluded from this definition – as are agro-forestry systems used for agriculture. UNEP (2010) uses 40 per cent cover as the threshold for "closed forest" and 10 – 40 per cent cover

for "open forest". However, for the present review we follow FAO convention.

Forests contain 80% of the Earth's plant biomass and contain more carbon in biomass and soils than is stored in the atmosphere (Pan *et al.* 2013). Soils store about 3 times as much carbon as does terrestrial vegetation and double the amount of carbon is floating in the atmosphere (FAO 2006). The primary way that carbon is stored in the soil is as soil organic matter (SOM). Forests also harbor the majority of species on Earth and provide valuable ecosystem goods and services to humanity, including contributions to the overall economy and hosting and protecting of sites and landscapes of high cultural, spiritual and recreational value (Jackson *et al*. 2005, McKinley *et al.* 2011). The forests reduce flooding and low flow events by intercepting runoff and encouraging infiltration. They also improve water and air quality. Moreover, forests are home to a large number of tribes and world's poor who rely directly on forests for energy, shelter, and their livelihoods (SCBD 2010), and are a major carbon sink for regulating global climate (Lugo and Brown 1992, Brown *et al.* 1993, Brown 1996). Over 1.6 billion people worldwide depend on forest resources for their livelihood and many rely on forests for food, shelter and water (Arnold 1998, Byron and Arnold 1999). In India, the poverty-stricken areas coincide with the natural forest areas, in which nearly 400 million people derive livelihood benefits from forests (Lynch and Talboot 1995, FAO 1998). Forests and forest resources have also long been meeting the needs of communities in urban areas in the form of timber, raw material, forest based industries and recreation (Mathur and Sachdeva 2003). The varied user profile and further inequity of distribution and the growing demand has created a pressure on the forests. The combined effects of over exploitation of timber, deforestation of arable land and pastures, industrialization, construction, urbanization etc. has resulted in the dwindling and degradation of forest resources and many of the plant resources are threatened today (Aggarwal *et al.* 2009, Davidar *et al.* 2010, Ravindranath *et al.* 2012). Human society and forests influence each other in both positive and negative ways (Gray and Bond 2013, Ratajezak *et al.* 2012, Parr *et al.* 2012, Wilcox and Ellis 2014). Forests provide ecosystem services to humans and serve as tourist attractions. Forests can also impose costs, affect people's health, and interfere with tourist enjoyment. Human activities, including harvesting forest resources, can negatively affect forest ecosystems.

Forests at different latitudes form distinctly different eco-zones: Boreal forests near the poles tend to consist of evergreens, while tropical forests near the equator tend to be distinct from the temperate forests at mid-latitude. The latitudes 10° north and south of the equator are mostly covered in tropical rainforest, and the latitudes between 53°N and 67°N have boreal forest. As a general rule, forests dominated by angiosperm (broadleaf forests) are more species-rich than those dominated by gymnosperms (conifer, montane, or needle leaf forests), although exceptions exist. The amount of precipitation and the elevation of the forest also affect forest composition.

Thirty-one percent of Earth's total forest area is found in Asia (including Asian Russia), followed by 21% in South America, 17% in Africa, 17% in North and Central America, 9% in Europe, and 5% in

Oceania (FAO 2010). Globally, 5% of forests are plantations generally used for commercial purposes. There is a net decrease in global forest area of 3% between 1990 and 2015 from 4128Mha to 3999 Mha (FAO 2015) (Table 1). This is a change from 31.6 per cent of global land area in 1990 to 30.6 per cent in 2015. Meanwhile, the net annual loss has slowed down from 0.18 per cent in the early 1990s to 0.08 per cent during the period 2010 – 2015.

Forests cover nearly 1/3 of land globally, of which more than half (54 per cent) of the world's forests are in only five countries – the Russian Federation, Brazil, Canada, The United States of America and China (FAO FRA 2020). Forests are home to most (80%) of Earth's terrestrial biodiversity containing high array of trees, plants, animals and microbes. Three quarters of the Earth's fresh water comes from forested water shades. Over half of the world's population relies on forested watersheds for their drinking water and other domestic uses.

Table 1. The trend in forest area (Mha) from 1990 – 2015 (FAO 2015)

Sub-region	1990	2000	2005	2010	2015
Central America	26,995	23,448	22,193	21,010	20.250
Caribbean	5,017	5,913	6,341	6,745	7.195
East Asia	2098,198	226,815	241,841	250,504	257.047
East-Southern Africa	319,785	300,273	291,712	282,519	274.886
Europe	994,271	1,002,302	1,004,147	1,015,482	1015.482
North Africa	39,374	37,692	37,221	37,055	36.217
North America	720,487	719,197	719,419	722,523	723.207
Oceania	176,825	177,641	176,485	172,002	173.524
South America	930,814	890,817	868,611	852,133	842.011
South-Southeast Asia	319,615	298,645	296,600	295,958	292.804
West-Central Africa	346,581	332,407	325,746	318,708	313.000
West-Central Asia	39,309	40,452	42,427	42,944	43.511
Total	**4,128.269**	**4,055.602**	**4,032.743**	**4,015.673**	**3999.134**

Forest of India

India is not only famous for its diverse wild life, architectural marvels and culture, but also to its dense and vast forest cover. Forest is the second largest land use in India next to agriculture. India is one of the 12- mega diverse countries having a vast variety of flora and fauna ranging from evergreen tropical rain forest in the Andaman and Nicobar Island, the Western Ghats and the north-eastern states, to dry alpine scrub high in the Himalayas to the north. Between these two extremes, the country has semi evergreen rain forest, deciduous monsoon forests, thorn forest, subtropical pine forests in the lower montane zone and temperate montane forests (Lal 1989, Banerjee and Jain 2011). In addition, India has a mangrove forest cover of 4975 sq km. occupying only 3.2 per cent of global mangrove forest. In India, though the National Forest Policy envisaged 33 percent forest cover for a healthy tomorrow, Indian forests (total forest and tree cover) account for only 24.56 per cent of total geographical area

(FSI 2019) covering 80.73 Mha (Table 2) compared to 80.02 Mha (24.39%) in 2017 assessment. The recent report (FSI 2019) highlights that although there is an increase in total forest cover; North-East India continues to lose when compared to ISFR 2017 and previous report.

The land area of India includes regions with some of the world's highest rainfall to very dry desert, coastal line to alpine regions, river deltas to tropical islands. India's forest types include tropical evergreens, tropical deciduous, swamps, mangroves, sub-tropical, montane, scrubs, sub-alpine and alpine forests. However, India has a diverse range of forests. On further sub-division, there are 16 types of forest that are identified in India. These forests support a variety of ecosystems and play a vital role in harboring more than 45000 floral and 81000 faunal species of which 5150 floral and 1837 faunal species are endemic.

Table 2. Forest cover in India (FSI 2019)

Class	Area (sq. km)	Percentage of geographical area
Very dense forest	99,278	3.02
Moderately dense forest	3,08,472	9.38
Open forest	3,04,499	9.26
Total forest cover*	7,12,249	21.67
Tree cover	95,027	2.89
Total forest and tree cover	8,07,276	24.56
Scrub	46,297	1.41
Non-forest	25,28,923	76.92
Total geographical area	32,87,469	100

- Include 4,975 sq.km under mangrove cove

Concept of deforestation and forest degradation

Deforestation is the removal or clearing large areas of forest lands and related ecosystems for non-forest use. In simple terms, it means the felling and clearing of forest cover or tree plantation to accommodate agricultural, industrial and urban use. It involves the permanent end of forest cover to make the land available for non-forestry purposes. In these cases, trees are never re-planted (Van Kooten and Bulte 2000). In other words deforestation refers to change of land cover with depletion of tree crown cover to less than 10 per cent. Since the industrial age, about half of world's original forests have been destroyed and millions of animals and living things have been endangered.

Forest degradation is different from deforestation. Degradation is used to mean the destruction or reduction in quality of specific aspects of forests. It is a process in which the biological wealth of a forest area is permanently diminished by some factor or by a combination of factors (Conacher and Conacher 1995). It occurs when forest ecosystems lose their capacity to provide important goods and services to people or nature. Prolonged degradation can wipe out a forest. Degradation can result in a decrease in tree cover, changes in their structure or a reduction in the number of species that can be found there. It may start and go on without showing clear

effect. If acid rain destroys trees in a vast area, it can be called forest degradation. Similarly, forests fires wipe out many thousands of acres each year all over the world. Extreme climates can also cause degradation. Over half of the tropical forests worldwide have been destroyed since 1960s and every second more than one hectare of tropical forest is destroyed or drastically degraded. When a forest is degraded it still remains forest and exists, but it can no longer function well. It becomes a shell of its former self, its health declines until it can no longer support people and wild life, for example, filtering the air we breathe and water we drink or providing animals with food and places to live.

Deforestation occurs around the world, though tropical rainforests are particularly targeted. Deforestation is much worse than forest degradation; but it is clear and visible. Countries with significant deforestation include Brazil, Indonesia, Thailand, the Democratic Republic of Congo and other parts of Africa, and parts of Eastern Europe.

The actual rate of deforestation is difficult to determine. Sufficient evidence is available that the whole world is facing an environmental crisis on account of heavy deforestation. Deforestation is primarily a concern of the developing countries of the tropics as it is shrinking areas of the tropical forests (Barraclough and Ghimier 2000) causing loss of biodiversity. On the other hand, most developed countries with temperate and boreal forest ecosystem – and more recently countries in the Near East and Asia – are experiencing stable and increasing forest area.

The FAO estimated the total area of the world's forests in 2005 to be just over 4.0 billion hectares (Table 1) or 30% of the global land area (FAO 2012). According to FAO, the global rate of deforestation is reported to be 0.7% per year from 1990 to 1995 (FAO 1997). The net rate of forest loss in the tropics is 21 Mha, which means that about 1.2% of all remaining tropical forests were cleared annually (Myers 1993). Nearly 1.8% of the forests are estimated to be degraded every year, the major cause being deforestation (Skole and Tucker 1991).

South America – where large tracts of the Amazon rain forest are being cleared for cattle ranches and soybean plantations – suffered the largest net loss of forests between 2000 and 2005 around 4.3 million hectares per year. Africa suffered the second largest net loss in forests with 4.0 million hectares cleared annually. Nigeria and Sudan were the two largest losers of natural forests during the 2000-2005 periods. At 11.1 per cent Nigeria's annual deforestation rate of natural forest is the highest in the world (FAO 2006).

The Amazon forest is the largest, and one of the most bio- diverse rainforests in the world. It covers an area of 550 million hectares and is shared by nine countries including Brazil with the largest share at 68%; then Peru at 13%; Bolivia at 11% and Colombia at 6%. Venezuela, Ecuador, Guyana, Suriname and French Guiana also hold a small part of the forest. Deforestation of the Amazon rain forest accelerated significantly between 1991 and 2004 reaching an annual forest loss rate of 2777200 hectares in 2004.

Mangroves are commonly found along the sheltered coastlines in the tropics and sub-tropics where they fulfill important socio-economic and environmental functions such as the coastal protection of a large variety of wood and NWFPs against the effects of wind, waves, and water currents,

conversion of biological diversity; protection of coral reefs, sea grass siltation; and provision spawning grounds and nutrients for a variety of fish and shellfish, including many commercial species. High population pressure in coastal areas has, however, led to the conversion of many mangrove areas to other uses including infrastructure, aquaculture, rice and salt production (FAO 2007a).

Causes of deforestation and forest degradation

From the dawn of civilization, human activity is the main driver for deforesting the Earth for thousands of years, though natural disasters do play a role. In order to save forests, one should know why they are being destroyed. It may be mentioned here that the factors responsible for deforestation and forest degradation are different in different continents and it will be difficult to generalize the most important factors. However, the most common pressures causing deforestation and severe forest degradation are illegal logging, agriculture, unsustainable forest management, infrastructure projects, mining, increased fire incidence and intensity.

Illegal logging threatens some of the world's most vulnerable forests – from the Amazon to the Russian Far East. It is an ecological trauma that has no precedent in nature except from volcanic eruption (NRDC 2000). Wood is being used in construction or manufacturing, and the practice of logging prepares the trees for those purpose and it is seen in all types of forests and all over the world, but the most devastated forest areas are in the tropics. In tropical forests, as well as forests farther away from the Equator, one of the main causes of deforestation is to make room for agriculture. Whether the farming is by individuals who wish to grow only enough food for their own use or performed commercially, agriculture is often cited as the leading cause of deforestation and it is estimated to be the direct driver for around 80% of deforestation worldwide (Morton *et al* 2006). Expanding agriculture due to an increased population is responsible for most of the world's deforestation. In addition agricultural products, such as soy and palm oil, are used in an ever increasing list of products from animal feed to lipstick and biofuels. Rising demand has created incentive to convert forests to farmland and ranch land. Once a forest is lost to agriculture it is usually gone forever – along with many of the plants and animals that once live there. Cattle ranching are another cause of deforestation. Much like farmers, cattle ranchers clear forests to make room for grazing cattle.

While agriculture is often the direct cause of deforestation and forest degradation, growing and expanding populations are often the driver. The world's population has exploded from an estimated maximum of 15 million people in prehistory, to more than 7 billion humans of today. Such large population numbers and densities make people very dependent upon agriculture for survival, and also importantly dependent upon expansion. With increased population numbers also cause increased urbanization resulting deforestation. Therefore, deforestation and population growth are directly related to each other in such a manner that the rise in population invariably results in a rise in the rate at which deforestation occurs.

Forest fire is another driver of deforestation. Each year, fires burn millions of hectares of forest worldwide.

Fires are a part of nature but degraded forests are particularly vulnerable. The resulting loss has wide reaching consequences on biodiversity, climate and economy. The immediate removal of forest canopy due to fire destroys the habitat for many rainforest dependent insects. Moreover, fire removes forest carbon sinks leading to global warming through the carbon dioxide build-up in the atmosphere.

Degradation of forest means a decrease in quality of forest, and is over 70% of cases caused by commercial timber extraction and logging activities, fuel wood collection, charcoal production, and, to a lesser extent, livestock grazing in forests are the most important drivers of degradation. There are also some drivers of degradation of forests. One is climate change: higher temperature and unpredictable weather patterns increase the risk and severity of forest fires, pest infestation and disease. But the main cause of forest degradation is unsustainable and illegal logging. Other causes of degradation are acid rains, air pollution and forest fragmentation, land pollution and soil erosion and sedimentation.

Paper products are crucial to society, as they have enabled literacy, and cultural development. However, without changing current paper production and consumption practices, growing demand for paper adds pressure on the Earth's last remaining natural forests. Even in this digital era, it is rare that a day goes by without us interacting with a product made from wood pulp: a paper cup, a cereal box, tickets, tissues, fancy shopping bags, sticky notes, newspaper, books, magazines etc. 14% of the deforestation is done to satisfy our huge appetite for paper goods (Union of Concerned Scientist 2016. Wood Products). This amounts to the destruction of around 4.1 million hectares of forest each year in the name of our paper obsession. The process of manufacturing paper releases nitrogen dioxide, sulphur dioxide and carbon dioxide into the air contributing to pollution such as acid rain and greenhouse gases.

Shifting cultivation is a primitive form of agriculture practiced in the humid hilly areas of the tropics of the world. It is responsible for about one half of tropical deforestation and some put it to two-thirds. In India, particularly in the north-eastern hill region and in Orissa this is called *Jhuuming* or *Jhum* cultivation. It has a substantial impact on reduction of land cover vegetation, on promotion of erosion, on reduction of soil fertility and productivity, and on the decrease of water resources (quality and quantity). The most severe deforestation by shifting cultivation can occur in two ways. Firstly, the shifting cultivators who left their land fallow after cultivation then continue clearing forests for further cultivation. Secondly, forest fires are caused by uncontrolled burning during land clearance for shifting cultivation. It was greater in Asia (about 30 per cent) but only about 15 per cent over the whole tropical world (Wikipedia 2015).

Mining has been recognized as one of the vital industry for not only economic but also all round growth of the country. But of all the activities of the man that affect land, plants and animals, mining is reckoned to be the most destructive. Hazardous activities start right from clear felling of forests for mining and ancillary activities and accentuate as the operations increase their intensities. Loss of productivity and biological diversity,

health and environmental hazards due to air, water and noise pollution, loss of fertility, microclimate changes, changes of the hydrology of the area, siltation etc. are some of the associated problems. Glossy green coloured leaves of trees are laden with black coal particles in coal areas and red iron ore particles in iron mined areas. The photosynthetic activities are reduced. Stomatal openings are blocked and the life supporting oxygen-generating capacity is reduced. Large scale mining operation especially open-cast mining can result in significant deforestation through forest clearing and the construction of roads which open remote forest areas to transient settlers, land speculators, and small scale miners. These settlers and miners are probably a great threat to the forest environment than industrial mining operations.

While population growth contributes to increasing deforestation, the effects of deforestation on population are also becoming pretty obvious in the form of climate change and relate environmental issues which we are facing today. It is estimated that deforestation is directly responsible for around 20% of the world's greenhouse gas emissions currently. Indirectly, it contributes even more, via the mechanism of reducing carbon dioxide uptake by plants/trees. As it stands, an estimated 1.5 billion tons of carbon is released every year by tropical deforestation (IPCC 2007).

Clearing of forests by migrant families has been generally found to be primary cause of deforestation especially in forest frontier areas (Geist and Lambin 2002). However, while migration has a large impact, urbanization is becoming the most important driver of deforestation in the 21st. Century (Defries *et al.* 2010, Lambin and Meytroidt 2011). Demand for forest and agricultural products to feed growing rural and urban populations will continue to put pressure on forests. Moreover, urbanization produces some of the greatest local extinction rates and frequently eliminates the large majority of native species (Marzluff 2001).

According to a report compiled by the United Nations Framework Convention on Climate Change (UNFCCC), approximately 80 per cent of the deforestation in the world today is attributed to agriculture (Morton *et al.* 2006). Of the remaining 20 per cent, around 14 per cent is attributed to logging, 5 per cent to the use of fire wood and remaining is utilized for other purposes. All these human activities which are the causes of deforestation invariably rise with the rise in population as the population growth is directly related to increase in the demand of food for which we have to produce more crops requiring more land and to get more land for cultivation, we will have to start encroaching upon the forest land, cutting down trees and turning vast tracts of green forests into large fields (Geist and Lambin 2002).

Consequences of deforestation

Deforestation, which is the loss of wild forest habitats due to human activity, has grown into a global problem as demand for wood climbs. Shrinking forests can cause wide-reaching problems, including soil erosion, water cycle disruption, greenhouse gas emissions and biodiversity losses. Combined, these four issues affect not only wild plants and animals but human beings as well. Millions of indigenous people depend on forests for their livelihood as well as for food and shelter. Rural communities live in and near forests, particularly; the tribal

communities have been traditionally dependent on forests for food, fodder, fuel-wood and other requirements.

Soil erosion: It's easy to think of soil as compact and unmoving, but that is not always accurate. Soil can be surprisingly loose, and it does not always stay in the same place. It can be washed away by rain or blown away by wind if it is not properly anchored. What anchors the soil in place? The roots of plants, mostly. This is especially true of trees, which have roots large enough to anchor large swaths of soil. When humans clear large forests, soil erosion can become a serious problem. In some areas, eroding soil can lead to disastrous mudslides. Large amounts of soil can wash into local streams and rivers, clogging waterways and causing damage to hydroelectric structures and irrigation infrastructure. In certain areas, soil erosion issues caused by deforestation lead to farming problems and loss of reliable electric power. The rate of increase for soil loss after forest clearing is astonishing; a study in Ivory Coast found that forested slope areas lost 0.03 tonnes of soil per year per hectare; cultivated slopes annually lost 90 tonnes per hectare, while bare slopes lost 138 tonnes per hectare (Butler 2012).

Water Cycle Disruption: The water cycle is the process by which all water on earth is distributed. Water from Earth's oceans as well as from the surface of bodies of fresh water evaporates and condenses into clouds. Trees and other plants also extract groundwater and release that water into the atmosphere during photosynthesis. Evaporation and evapo- transpiration processes from the trees and plants return large quantities of water to the local atmosphere, promoting the formation of clouds. Clouds then produce rain, which becomes both groundwater and – eventually ocean water again. However, when large numbers of trees are cut down, the water they usually extract, store and release into the atmosphere is no longer present. This means that cleared forests, which once had moist, fertile soil and plenty of rain become barren and dry. This kind of change in climate is called desertification. Such dry conditions can lead to an increased risk of fire on peat land and great loss of life for the plants and animals that once lived in the forest.

Greenhouse gas emissions: Forests are vital in the fight against climate change. Forests and forest soils are the largest terrestrial store of carbons and deforestation is the third largest source of greenhouse gas emissions after coal and oil and forests also play a vital role on the global carbon cycle. Carbon notably CO_2 is cycled between atmosphere, oceans and terrestrial biosphere. Greenhouse gases such as methane and carbon dioxide are gases that trap heat in Earth's atmosphere, leading to global climate change. Fortunately, in addition to releasing oxygen and water into the atmosphere, trees also absorb carbon dioxide. While trees are still living, they function as efficient greenhouse gas filters. The moment they are cut down, the carbon dioxide that was stored in their trunks and leaves is released into the atmosphere, further contributing to the build up of greenhouse gases. After trees are removed from a large piece of land, the carbon dioxide in that area can no longer be absorbed as it was before. Global climate change, brought on by a build up of greenhouse gases in Earth's atmosphere, affects wild animals, plants and humans via weather changes and increased likelihood of natural disasters. It is

estimated that deforestation contributes as much as 30 percent to global greenhouse gas emissions each year. So deforestation is a tragic double whammy for global warming – because not only do we decrease the amount of carbon our forests are absorbing, but we release a whole lot more that has been stored up for decades. Trees and forest balance the amount of carbon in the atmosphere through the process of photosynthesis in which plants make their own food with carbon dioxide. When there is an excess amount of carbon dioxide in the atmosphere a 'blanket' of carbon dioxide is created and this blanket traps heat and prevents it from leaving the Earth surface in the atmosphere. This excess heat warms the Earth. If there is too much of it, this causes global warming and the heating of the Earth.

Biodiversity losses: Forests are home to 80% of the world's biodiversity. Deforestation not only hurts different climates around the world, it also poses a big threat to the plants and animals within the forest. As forests decline, wild life is squeezed into an ever-diminishing area, with many species unable to relocate and thrive. Living things have mastered the art of adapting to new environments. This is how life on Earth manages to thrive from the Arctic tundra to burning hot deserts. However, it takes time for life to adapt. Deforestation alters land too quickly for plants and animals to cope, which means that many of them do not survive. If enough deforestation occurs, entire species can be wiped out. This loss of life is known as biodiversity loss.

Biodiversity losses affect ecosystems. For example, if a small species of frog becomes extinct, it could affect populations of predators such as birds who rely on the frogs for food. Certain plants might rely on the birds to spread their seeds and might also suffer population losses. Because each piece of an ecosystem relies upon other pieces, one species loss can have far-reaching consequences for other species. It is worth noting that biodiversity losses can lead to what some would argue is deforestation's worst consequence of all – a loss of natural beauty and wonder. Wild forests are incredible places, filled with all sorts of life. In places like the Amazon, new species are discovered almost every year. This life is beautiful to behold and amazing to learn about, but it can only be protected if people work to put a stop to rampant deforestation.

Acidic Ocean: The increased level of carbon dioxide in the atmosphere due to deforestation and burning of fossil fuels make our oceans more acidic. Since Industrial Revolution, beaches are already 30% more acidic, posing ocean species and ecosystems are at extreme risk. Ocean acidification reduces the amount of carbonate, a key building block in sea water. This makes it more difficult to marine organisms, such as coral and some plankton to form their shells and skeleton and existing shells may begin to dissolve (Feely *et al*. 2006)

Sustainable solutions

There are many solutions to the deforestation of our earth's forests. Green business concerns re-use and recycling. Green methods of production and utilization of resources can immeasurably reduce deforestation. Particularly, it is the focus on re-using items, reducing the use of artificial items and recycling more items. Paper, plastics and wood are linked to the destruction of forests and other natural resources. By focusing on

recycling paper, plastics and wood products as well as adopting responsible consumerism, it means there will be less dependence on the natural resources and trees. Specifically, we need world leaders to embrace ambitious domestic and international forest policies based on the latest science. And globally, we urgently need commitments to reduce greenhouse gas emissions from deforestation in tropical forest developing nations. Forests for climate are one way to make that happen. Forests for Climate are a landmark proposal for an international funding mechanism to protect tropical forests. Reducing Emissions from Deforestation and Forest Degradation (REDD) is an effort to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development. "REDD+" goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks (Van der Werf 2009). The decisions on REDD+ enumerate five "eligible activities" that developing countries may implement to reduce emissions and enhance removals of greenhouse gases:

(a) Reducing emissions from deforestation.
(b) Reducing emissions from forest degradation.
(c) Conservation of forest carbon stocks.
(d) Sustainable management of forests.
(e) Enhancement of forest carbon stocks.

Under this initiative, developing countries with tropical forests can make commitments to protecting their forests in exchange for the opportunity to receive funding for capacity-building efforts and national-level reductions in deforestation emissions. This provides a strong incentive for developing countries to continually improve their forest protection programs. REED+ offers financial incentives to more than 50% developing countries for developing the strategies which include many activities that have been the conservation tool box for years: creating net works of protected areas expanding the use of responsible forest management practices, preventing illegal logging, developing management practices that keep agricultural production away from forests, and more.

The best solution to deforestation is to curb the felling of trees**,** by employing a series of rules and laws to govern it**.** Clear cutting of forests must be banned**.** This will curb total depletion of the forest cover. It is a practical solution and is very feasible. Also the cutting must be replaced by planting young trees to replace the older ones that were cut**.** Trees are being planted under several initiatives every year, but they still don't match the numbers of the ones we've already lost.

If we are going to stop deforestation laws and rules help prevent deforestation and for that we need the help of the government to do its part. Specially, we need world leaders to embrace ambitious domestic and international forest policies and globally, we urgently need commitments to reduce greenhouse gas emission in tropical forest developing nations. The way we use our planet's forested ecosystems and agricultural land can have a big impact on climate change. Currently, inefficiencies in food and farming systems threaten tropical forests by increasing the demand for the drivers of deforestation. To help stop deforestation—and to reduce the heat-trapping emissions that cause global warming—we need to

make smart decisions that shift consumption and land use patterns in less wasteful directions.

Selective logging of mature trees ensures that the rainforest canopy is preserved. This method allows the forest to recover because the younger trees gain more space and sunlight to grow. Planned and control logging ensures that for every tree logged another is planted.

Nature based solution such as forest landscape restoration (FLR) can help countries reverse the effects of deforestation and degradation and regain the ecological, social, climatic and economic benefits of forests. FLR brings people together to identify the most appropriate restoration interventions in a landscape. It seeks to accommodate the needs of all land uses and multiple land uses.

For an individual:

1. Plant as many trees as possible
2. Stop printing and go paper less at home and in the office
3. Buy recycled products
4. Cut down on meat intake and eat as many vegetarian meals as possible
5. Do not buy meat products sourced from a land where forests have been cleared.
6. Buy certified wood products. Read the levels and look for FSC (Forest Stewardship Council) mark
7. Support the products of companies that are committed to reducing deforestation. It is all about business
8. Raise awareness in your circle and in your community
9. Buy only what you will use
10. Do not use palm oil or products with palm oil
11. Practice eco-forestry

Healthy forests absorb tremendous amounts of carbon dioxide, which will be helpful for our survival. But due to deforestation and forest degradation, forests become sources of harmful gases instead of serving as important carbon sinks. However, considerable progress has been made towards reversing the overall trends of forest area loss in recent years and most of the net loss of forest still happens in countries in the tropical region while most of the net gain takes place in the temperate and boreal zone and in some emerging economics such as India and Viet Nam (FAO 2010).

Conclusion

Deforestation and forest degradation are happening everywhere on the planet for many different reasons that vary from region to region. Vast areas of rainforests in a number of tropical countries have been destroyed to make room for palm oil, soy plantation and cattle ranching. The increasing global demand for the wood products threatens many ancient forests around the globe, whether it is for paper, furniture and fuel. Ending deforestation is the best chance to stabilize our climate, save wild life and protect our well being. Healthy forests support the livelihood of a large number of poorest people globally. Protecting forest is our mutual responsibilities, no matter how far away we live from the nearest one.

Stop the cutting of forests (stop deforestation), establishing new forests (afforestation) and reestablish old trees. Sustainable forestry, changing farming practices, forest stewardship and economic incentives are all working to solve this problem. Protecting the world's forests

should be our very first priority in fighting global warming and climate change. The death of the forests is the end of the life. We need our forests and our forests need us.

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जैविक खेती के टिकाऊपन में केंचुआ खाद का महत्व

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खाद्य उत्पादन में आत्मनिर्भरता पाने के उद्देश्य से भारत में हरित क्रांति को 1965-66 में अपनाया गया ताकि दुनिया की दूसरी सबसे बड़ी आबादी वाले इस देश में खाद्यान्नों की बढ़ती मांग की पूर्ति की जा सके। प्रारम्भिक सालों में हरित क्रांति सफल नज़र आने लगी क्योंकि साल-दर-साल भरपूर खाद्यान्न पैदावार हुई और सरप्लस खाद्यान्न की स्थिति बन गई। लेकिन, रासायनिक उर्वरकों और कीटनाशकों के अत्यधिक इस्तेमाल की वजह से पर्यावरण, स्वास्थ्य और खेती के भूमि पर भारी दुष्प्रभाव पड़ने की समस्याओं उभर कर सामने आने लगीं। देश के अनेकभागों में छोटे एवं सीमांत किसानों में लगातार बढ़ती गरीबी और उनकी कर्जग्रस्तता आम बात होने लगी।यही कारण है कि किसानों को रसायनों से बचाव के लिए प्राचीन खेती पद्धति की ओर मुंह ताकना पड़ रहा है। किसान फिर से अपनी पुरानी खेती पद्धति की ओर लौट रहे हैं। इस प्राचीन खेती पद्धति को हम जैविक खेती व कुदरती खेती आदि नामों से भी जानते हैं।

खाद शब्द की उत्पति संस्कतृ के "खाद्य"शब्द से हुई है और जिसका शाब्दिक अर्थ है - भोजन। अर्थात - फसल अवशेष और अपषिष्ट पदार्थो के अपघटन से प्राप्त होने वाले वे पदार्थ जिनका प्रयोग पौधो के लिए आवष्यक पोषक तत्वो की आपूर्ति के लिए किया जाता है । केंचुआ मिट्टी में पाये जाने वाले जीवों में सबसे प्रमुख एवं महत्वपूर्ण जीव है। इसकी महत्ता इस बात से भी पता चलती है कि इसे प्राकृतिक हलवाहा, जय गोपाल एवं किसान का मित्र भी कहा जाता है। केंचुआ नमी युक्त मिट्टी में पाया जाता है। केंचुए का मलमूत्र मिट्टी में पोषक तत्व प्रदान करता हैं। केचुँए मृदाको सुधारने एवं उत्पादकता वृद्धि में सहायक होतेहैं इसके साथ सूक्ष्म जीवाणु एवं ह्यूमस में वृद्धि भी इनका महत्वपूर्ण कार्य है। भूमि में पाये जाने वाले केंचुए खेत में पडे हुए पेड़-पौधों एवं फसलों के अवशेष तथा कार्बनिक पदार्थों को खा कर छोटी-छोटी गोलियों के रूप में परिवर्तित कर देते हैं जो पौधों के लिए खाद का काम करती है। केंचुओं द्वारा भूमि की उर्वरता एवं उत्पादकता और भूमि के भौतिक, रासायनिक व जैविक गुणों को लम्बे समय तक अनुकूल बनाये रखने में मदद मिलती है।

वर्मीकम्पोस्ट

वर्मी कम्पोस्ट को wormi-culture या केंचुआ पालन (Earth worm rearing) भी कहा जाता है। केंचुआ भोजन के रूप में प्रायः अपघटनशील व्यर्थ फसलों के अवशेष का ही उपयोग करता हैं।

भोजन के रूप में ग्रहण की गई इन कार्बनिक पदार्थों की कुल मात्रा का 5 से 10 प्रतिशत भाग शरीर की कोशिकाओं द्वारा अवशोषित कर लिया जाता है और शेष मल के रूप में विसर्जित हो जाता है जिसे वर्मीकास्ट कहते हैं। नियंत्रित परिस्थिति में केंचुओं को व्यर्थ फसलों के अवशेष खिलाकर पैदा किए गये वर्मीकास्ट और केचुओं के मृत अवशेष, अण्डे, कोकून, सूक्ष्मजीव आदि के मिश्रण को केंचुआ खाद कहते हैं। नियंत्रित दशा में केंचुओं द्वारा केंचुआ खाद उत्पादन की विधि को वर्मीकम्पोस्टिंग और केंचुआ पालन की विधि को वर्मीकल्चर कहतेहैं।

केचुँआ खाद तैयार करनेका तरीका

वर्मीकम्पोस्ट जमीन पर एक ढेर के रूप में या खड्डे में तैयार किया जा सकता है, जिसका खड्डा एक मीटरगहरा हो। यह एक मीटर ऊंची दीवारों से घिरे बाड़े में, जिसे मिट्टी या पत्थरों या सीमेंट से तैयार किया गयाहो या सीमेन्ट के छल्लों में भी वर्मीकम्पोस्ट बन सकता है। छायादार इलाकों में वर्मीकम्पोस्ट तैयार कियाजाना चाहिए।

केंचुओं का चयन

वर्मीकम्पोस्ट तैयार करने के लिए केंचुओं की गैर-छिद्रिल किस्म (लाल या बैंगनी, जोमिट्टी की सतह पर रहते हैं और 90 प्रतिशत जैविक अवशिष्ट सामग्रियों को खा जाते हैं) का इस्तेमाल कियाजाता है। वर्मीकम्पोस्ट तैयार करने में केंचुओं की गैर-छिद्रिल किस्म (पीले रंग के, जो मिट्टी के भीतर रहते हैंऔर 90 प्रतिशत मिट्टी को खा जाते हैं) का इस्तेमाल नहीं किया जाता है।

जैविक सामग्रिया

मवेशियों को खिलाने के बाद जैविक अवशिष्टों में ज्वार की भूसी एवं चावल की भूसी, सूखे पत्ते, गेहूं की भूसी,सब्जियों की बची-खुची सामग्री, सोयाबीन का अवशिष्ट, खरपतवार, गन्ने का कूड़ा-कर्कट, पशु खाद, डेयरीएवं पॉल्ट्री का अवशिष्ट, बॉयोगैस की गाद, चीनी मिलों की खोई (बैगासे)आदि का इस्तेमाल किया जा सकता है।

प्रक्रिया

- एक पोलीथीन की चादर से सीमेंट के घेरे के निचले भाग (90 सेंटीमीटर व्यास 30 सेंटीमीटर ऊंचाई) को ढकें और इस चादर पर जैविक अवशिष्ट (50 किलो) की एक परत (15-20 सेंटीमीटर) का छिड़काव करें। इस परत पर रॉक फोस्फेट (2 किलो) का छिड़काव करें।
- गाय के गोबर को गाढ़ा (15 किलो) करें और उसका एक परत पर छिड़काव करें।
- जैविक सामग्रियों को परतों में पूरी तरह से भरें।
- गाय के गोबर या मिट्टी की लेई बाड़े के सबसे ऊपरी भाग पर लगाएं और इस सामग्री को 20 दिनों तक अपघटित होने दें।
- 20 दिनों के बाद केंचुओं (500-750) को दरारों के जरिए इसमें छोड़े।

- पक्षियों द्वारा केंचुओं को चुगने से रोकने के लिए तारों की जाली या टाट के बोरों से बाड़े को ढंकें ।
- केंचुओं का शारीरिक तापमान और नमी बनाए रखने के लिए पानी (3 दिन के अंतराल पर 5 लीटर)का छिड़काव करें।
- यह वर्मीकम्पोस्ट 2-2.5 महीनों में तैयार हो जाता है। यह काला, वजन में हल्का होता है और उसमेंकोई गंध नहीं होती।
- कम्पोस्ट तैयार होने पर उसे बाड़े से हटाएं और एक शंकु (कॉन) के रूप में ढेर लगाएं। ढेर को 2-3घंटे तक न छेड़ें और केंचुओं को धीमे-धीमे ढेर के निचले भाग में जाने दें।
- ऊपरी हिस्से को अलग करें और केंचुओं को अलग करने के लिए निचले भाग को छानें, जिसका पुनः इस्तेमाल किया जा सकता है।
- इसे बोरियों में पैक करें और एक ठंडे स्थान पर उसका भंडारण करें।

वर्मीकम्पोस्ट उत्पादनके समय ध्यान रखने योग्य विशेष सावधानिया

कम समय में अच्छी गुणवत्ता वाली वर्मीकम्पोस्ट बनाने के लिए निम्न बातों पर विशेष ध्यान देना अति आवश्यक है ।

1. वर्मीकम्पोस्ट बनाने के लिए हमेंषा ऊँचे स्थान का चयन करें।
2. आंशिक रूप से सड़े कार्बनिक व्यर्थ पदार्थों का ही उपयोग करें इससे कम्पोस्टिंग प्रकिया तेजी से होती है।
3. वर्मीबेडों में भरे गये कचरे से कम्पोस्ट तैयार होने तक 30 से 40 प्रतिशत नमी बनाये रखें। कचरे में नमीं कम या अधिक होने पर केंचुए ठीक तरह से कार्य नही करतें।
4. वर्मीबेडों में कचरे का तापमान 20 से 27 डिग्री सेल्सियस रहना अत्यन्त आवष्यक है। वर्मीबेडों पर तेज धूप न पड़ने दें। तेज धूप पड़ने से कचरे का तापमान अधिक हो जाता है परिणामस्वरूप केंचुए तली में चले जाते हैं अथवा अक्रियाशील रह कर अन्ततः मर जाते हैं ।
5. वर्मीबेड में ताजे गोबर का उपयोग कदापि न करें। ताजे गोबर में गर्मी (Heat) अधिक होने के कारण केंचुए मर जाते हैं ।
6. केंचुआ खाद तैयार करने हेतु कार्बनिक कचरे में गोबर की मात्रा कम से कम 20 प्रतिशत अवश्य होनी चाहिए ।
7. कांग्रेस घास को फूल आने से पूर्व गाय के गोबर में मिला कर कार्बनिक पदार्थ के रूप में आंशिक रूप से सड़ा कर प्रयोग

करने से अच्छी केंचुआ खाद प्राप्त होती है।

8. अच्छी वायु संचार के लिए वर्मी बेड में प्रत्येक सप्ताह कम से कम एक बार पंजा चलाना चाहिए जिससे केंचुओं को वर्मी कम्पोस्ट बनाने हेतु उपयुक्त वातावरण मिल सके।
9. कचरे का पी. एच. उदासीन (7.0 के आसपास) रहने पर केंचुए तेजी से कार्य करते हैं अतः वर्मीकम्पोस्टिंग के दौरान कचरे का पी. एच. उदासीन बनाये रखे। इसके लिए कचरा भरते समय उसमें राख (ash) अवश्य मिलायें।

केंचुआ खाद का महत्व

मिट्टी की दृष्टि से महत्व

- केचुँआ खाद सेभूमि उपजाऊ एवं भुरभुरी बनती हैंतथाभूमि की गुणवत्ता में सुधार आता है।
- केचुँआ खाद में ह्यूमस भरपूर मात्रा में होने से नाइट्रोजन, फास्फोरस पोटाश एवं अन्य सूक्ष्म द्रव्य पौधों को भरपूर मात्रा में व जल्दी उपलब्ध होते हैं।
- यह भूमि की जल सोखने की क्षमता में भी वृद्धि करता हैं, साथ ही भूमि की उर्वरकता, वातायनता को बढ़ाता हैं।
- वर्मी कम्पोस्ट का उपयोग करने वाले खेतों में अलग अलग फसलों के उत्पादन में 25-30% तक की वृद्धि हो सकती हैं।
- केचुओं के मल में पेरीट्रापिक झिल्ली होती हैं, जो जमीन से धूल कणों को चिपकाकर जमीन का वाष्पीकरण होने से रोकती हैं।
- वर्मी कम्पोस्ट मिट्टी में कार्बनिक पदार्थों की वृद्धि करता हैं तथा भूमि में जैविक क्रियाओं को निरंतरता प्रदान करता हैं।
- मिट्टी में केचुओं की सक्रियता के कारण पौधों की जड़ों के लिए उचित वातावरण बना रहता हैं, जिससे उनका सही विकास होता हैं।
- केचुँआ खाद एक जैविक खाद है के उपयोग से मृदा में सुधार होता है एवं मृदा की उर्वरा शक्ति बढ़ती है जिससे फसल उत्पादन में स्थिरता के साथ गुणात्मक सुधार होता है।
- भूमि में उपयोगी जीवाणुओं की संख्या में वृद्धि होती है जिससेमृदा की जैविक क्रियाओं में बढ़ोतरी होती है। जो भूमि में रहने वाले सूक्ष्मक जीवों के लिये लाभदायक एवं उत्प्रsिरक का कार्य करते हैं।
- केचुँआ खाद में ह्यूमस भरपूर मात्रा में होने से वर्मीकम्पोस्टक में उपस्थित सभी आवश्यक पोषक तत्व पौधों को आसानी से उपलब्ध हो जाते हैं। जिससे पौधों में रोगरोधी क्षमता भी बढ़ जाती है। अतः वर्मीकम्पोस्ट के उपयोग से पौधों का विकास अच्छा होता है।

- कृषि उत्पादकता एवं निरन्तरता बढ़ाने, मृदा की क्वालिटी सुधारने के लिए बहुत उपयोगी है।
- वर्मीकम्पोस्ट के प्रयोग से मृदा में जीवांश पदार्थ (हयूमस) की वृद्धि होती है, जिससे मृदा संरचना, वायु संचार तथा की जल धारण क्षमता बढ़ने के साथ-साथ भूमि का उपयुक्त तापक्रम बनाये रखने में सहायक।
- वर्मीकम्पोस्ट एक संतुलित खाद है इसमें नत्रजन, फास्फोरस तथा पोटाश की मात्रा गोबर की खाद से अधिक होती है, इसके अलावा सूक्ष्म पोशक तत्व जैसे जिंक, ताँबा, कैल्षियम, गंधक व कॉबाल्ट भी मिलते है
- वर्मीकम्पोस्ट में ऑक्जिन्स, जिब्रैलिन्स, साइटोकाइनिन्स, विटामिन्स, अमीनोअम्ल आदि अनेक तरह के जैव-सक्रिय पदार्थ (Bioactive compounds) पर्याप्त मात्रा में पाये जाते हैं जिनसे पौधों में सन्तुलित बढ़वार तथा अधिक उपज देने की क्षमता का विकास होता है।
- वर्मीकम्पोस्ट जलग्राही (Hygroscopic) होती है जो वातावरण से नमी व सिंचाई के रूप में पौधों को दिए गये पानी को सोख कर भूमि से वाष्पीकरण (Evaporation) तथा निक्षालन (Leaching) द्वारा पानी के नष्ट होने को रोकती है अतः वर्मीकम्पोस्ट का खेत में उपयोग करने पर पौधों में बार-बार या अधिक मात्रा में पानी देने की आवष्यकता नहीं होती।
- वर्मीकम्पोस्ट में अनेक तरह के सूक्ष्म-जीव नाइट्रोजन स्थिरीकरण जीवाणु, फॉस्फोरस घोलक जीवाणु, पौधों की बढ़वार में वृद्धि करने वाले जीवाणु, एक्टीनोमाइसिटीज, फफूँद और सैलूलोज व लिगनिन को विघटित करने वाले पॉलीमर्स भारी संख्या में मौजूद रहते हैं। ये सूक्ष्म-जीव भूमि में मौजूद पेड़-पौधों के अवशेष तथा अन्य जैविक कचरे को सड़ाने व पौधों की बढ़वार में सहायक होते हैं।
- वर्मीकम्पोस्ट में उपस्थित एक्टीनोमाइसिटीज एन्टीबायोटिक पदार्थों का सृजन करते हैं जिनसे पौधों में कीट व्याधियों के आक्रमण से बचाव की क्षमता बढ़ जाती है।
- वर्मीकम्पोस्ट में 7 गुना एक्टीनोमाइसिटीज होता है और वे सभी पानी में घुलनषील है और पौधों को तुरन्त प्राप्त हो जाते है।
- केंचुए के शरीर से कई प्रकार के एन्जाइम जैसे पैप्टेज-प्रोटीन पाचन के लिए, एमाइलेज -स्टार्च व ग्लाईकोजन पाचन के लिए, लाइपेज -वसा पाचन के लिए, सेलुलेज -सेलूलोज पाचन के लिए,

इनवर्टेज -शर्करा पाचन के लिए तथा कैटाइनेज -काइटिन पाचन के लिए कार्य करता है अतः स्राव के रूप में उत्पादित एंजाइमों से केंचुआ खाद की गुणवत्ता के साथ-साथ फसलों की पैदावार पर गुणकारी प्रभाव होता है।

- वर्मीकम्पोस्ट के उपयोग से भूमि के भौतिक गुणों जैसे रन्ध्रावकाश (Porocity), जलधारण क्षमता (Water Holding Capacity), मृदा संरचना (Soil structure), सूक्ष्म-जलवायु (Micro-climate), तत्वों को रोकने व पोषण क्षमता (Nutrients Retention)एवं SupplyingCapacity), रासायनिक गुणों जैसे - कार्बन : नाइट्रोजन के अनुपात में कमी (Reduction in C:N ratio), कार्बनिक पदार्थों के अपघटन में सुधार (improvement in decomposition of organic matter) और जैविक गुणों जैसे-नाइट्रोजन स्थिरीकरण एवं फास्फोरस घोलक जीवाणु, पॉलीमर्स, एक्टीनोमाइसिटीज आदि की संख्या में पर्याप्त सुधार होता है परिणामस्वरूप भूमि की उर्वरतालम्बे समय तक कायमरहती है।
- वर्मीकम्पोस्ट के उपयोग से भूमि के तापमान, नमी, स्वास्थ्य तथा पी. एच. नियंत्रित रहते हैं जिससे मृदा में ताप संचरण व माइक्रोक्लाइमेट की एकरूपता (Homogeneity) के लिए अनुकूलता पैदा होती है।

कृषकों की दृष्टि से महत्व

- भूमि में वाष्पीकरण कम होता है अतः सिंचाई जल की बचत होती है। सिंचाई के अंतराल में वृद्धि होती है।इसके प्रयोग से सिंचाई की लागत में कमी आती हैं।
- यह बहुत कम समय में तैयार हो जाता हैं।रासायनिक खाद पर निर्भरता कम होने के साथ काश्त-लागत में कमी आती है।
- ग्रामीण क्षेत्रों में इसके उपयोग से रोजगार की संभावनाएं उपलब्ध हो जाती हैं।
- केंचुआ खाद, जैविक खाद होने के कारण इसके प्रयोग से फल, सब्जी, अनाज की गुणवत्ता में सुधार आता हैं, जिससे किसान को उपज का बेहतर मूल्य मिलता हैं।
- वर्मी कम्पोस्ट प्राकृतिक एवं सस्ती होती है। तथा किसान इसको आसानी से तैयार कर सकते है
- फलो, सब्जियों एवं अनाजों की उत्पादन बढ़ जाता है और स्वाद, रंग व आकार अच्छा हो जाता है। एवं किसान को भरपूर उत्पादन मिल जाता हैउपभोक्ताओं को पौष्टिक भोजन की प्राप्ति होती हैं।

- वर्मीकम्पोस्ट में खरपतवारों के बीज नहीं होते अतः खेत में इसका उपयोग करने पर किसी भी तरह के खरपतवार की समस्या नहीं होती। इसके विपरीत गोबर के खाद (FYM) एवं न्य कम्पोस्टों के उपयोग से खेत में खरपतवार अधिक उगते हैं।
- वर्मीकम्पोस्ट के उपयोग से कृषि उत्पादों की गुणवत्तामें सुधार आता है, नतीजन उच्चगुणवत्ता वाले उत्पादों की भण्डारण क्षमता एवं ऊँचे मूल्य पर बिक्री होने से आय में भारी वृद्धि होती है।

पर्यावरण की दृष्टि से महत्व

- कचरे का उपयोग खाद बनाने में होने से बीमारियों में कमी होती है।
- यह कचरा, गोबर तथा फसल अवशेषों से तैयार किया जाता हैं, जिससे पर्यावरण प्रदूषित नहीं होता हैं।
- खाद में बदबू नहीं होती। मक्खी, मच्छर आदि भी नहीं बढ़ते। अतः वातावरण दूषित नहीं होता।
- वर्मीकम्पीस्टि के माध्यम से अपशिष्ट पदार्थो या जैव उपघटित कूड़े-कचरे का पुनः चक्रण आसानी से हो जाता है। इसके प्रयोग से खेतों में खरपतवार भी कम होती है।
- भूमि के जलस्तर में वृद्धि होती है।
- मिट्टी खाद्य पदार्थ और जमीन में पानी के माध्यम से होने वाले प्रदूषण में कमी आती है।
- भूमि के जलस्तर में वृद्धि होती है। ग्रीन हाउस गैस के उत्पादन को रोकता है।
- केचुए गंदगी फैलाने वाले हानिकारक जीवाणुओं को खाकर उसे लाभदायक हूमस मे परिवर्तित कर देते है।
- वर्मीकम्पोस्ट में मनुष्य तथा पौधों को नुकसान पहुँचाने वाले किसी भी तरह के जीवाणु(Pathogens) उपस्थित नहीं होते।
- वर्मीकम्पोस्ट बनाने या केंचुआ पालन से पर्यावरण को स्वच्छ रखने में सहायता मिलती है ।

जैविक खादों में केंचुआ खाद (Vermi-compost) एक महत्वपूर्ण आदान है जिसकी सार्थकता को राष्ट्रीय व अन्तराष्ट्रीय स्तर पर सभी ने स्वीकारा है। अनेक विकसित व विकासषील देषों में वर्मीकम्पोस्ट का उपयोग बड़े पैमाने पर किया जाने लगा है।यह हर प्रकार के पेड पौधों, फल वृक्षों, सब्जियों, फसलों के लिए पूर्ण रूप से प्राकृतिक, सम्पूर्ण व संतुलित आहार (पोषण खाद) है। इसमें बेरोजगार युवकों एवं गृहणियों को रोजगार के अवसर प्रदान किये जा सकते है तथा पर्यावरण प्रदूषण की समस्या भी सुलझ सकती है।

कोविड संक्रमण के दौरान गृह वाटिका का महत्त्व

ननिता बेरी, निकिता राय, आई. टी. के. दिलराज एवं सौरभ दुबे

वन संवर्धन, वन प्रबंधन एवं कृषि वानिकी प्रभाग

उष्ण कटिबंधीय वन अनुसन्धान संस्थान

जबलपुर, मध्यप्रदेश

गृहवाटिका, जैसा की नाम से ही समझ में आता है कि, घर में स्थित ऐसी वाटिका या एक ऐसा स्थान है, जहां दैनिक जीवन में रसोई में उपयोग होने वाली शाक, सब्जियों, औषधियों एवं फलों को उगाया जाता है | मुख्यतः इसका आकर एवं क्षेत्रफल, परिवार में उपस्थित परिवार जनों की संख्या एवं जमीन की उपलब्धता के अनुसार होता है, साथ ही साथ इस वाटिका में उगाई जाने वाली शाक, सब्जी एवं फलों का चयन परिवार के सदस्यों की पसंद के अनुसार होता है, जिससे परिवार के सदस्यों को वर्ष भर ताजी शाक, सब्जी एवं फल प्राप्त होते है |

पहले गृहवाटिका के लिए जगह का चयन रसोई के निकट होता था, जिससे की रसोई में उपयोग किये गए पानी को गृहवाटिका में पुनः उपयोग किया जा सके, साथ ही साथ हरी सब्जियों के डंठल एवं छिल्को का उपयोग कर घर में ही खाद का निर्माण कर रासायनिक उर्वरको के बिना भी गृहवाटिका में शाक, सब्जियों एवं फलों का सफल उत्पादन किया जाता था |

परन्तु बढते शहरीकरण एवं औधोयोगिक विकास के कारण मुख्यतः शहरी क्षेत्रों में जमीन की उपलब्धता कम होने लगी है, कृषि क्षत्रों को भी अब रहवासी क्षेत्रों में परिवर्तित किया जा रहा है एवं दिन प्रतिदिन स्वतन्त्र मकान की जगह अब बहुमंजिला इमारते लेते जा रही है, जहां पहले घरो में छोटा आँगन, छोटा उद्यान एवं गृह वाटिका का चलन था, वह शहरी इलाकों से लुप्त सा होता प्रतीत हो रहा है |

सर्व विदित वैश्विक महामारी कोविड-१९ के कारण वर्ष २०१९ से अब तक जिस प्रकार नागरिकों की जीवनशैली, कार्यो एवं खानपान में अचानक परिवर्तन हुआ है, यह किसी से छुपा हुआ नहीं है, इस समय में सब्जियों के दामों में काफ़ी इजाफ़ा हुआ था, जिससे हर वर्ग के व्यक्तियों को सब्जियों एवं फलों की खरीदी ज्यादा दामों में करनी पड़ी थी, वर्ष २०२० में लॉक डाउन के दौरान यह भी देखा गया की, बाहर से आने वाली सभी सामान, सब्जियों, शाक एवं फलो को भी १-२ दिन अलग रख कर अंदर लाया जाता था, एवं संचार के विभिन्न माध्यमों से सब्जियों को भिन्न तरीकों से साफ़ करने के विधि भी बताई जा रही थी, जिसके फलस्वरूप न वो ताजी ही रह पाती थी, एवं संक्रमण होने का खतरा भी बना रहता था| इस समय औषधीय पौधों जैसे-गिलोय, हल्दी, अदरक, तुलसी जैसे पोधो की भी मांग बढ़ रही थी | यदि, इस समय शहरी क्षेत्रों में कम स्थान होने पर गृहवाटिका (छत पर वाटिका) का ज्यादा प्रचलन होता तो,उपरोक्त दैनिक सब्जियों एवं औषधीय का घर में ही उत्पादन संभव हो सकता था |

कोविड संक्रमण के दौरान गृह वाटिका में औषधीय पौधों का महत्त्व

इस वाटिका के माध्यम से साल भर ताजी शाक, सब्जी, औषधी एवं फल उपलब्ध हो जाते है |

हानिकारक रसायन, कीटनाशक एवं संक्रमण मुक्त सब्जियों, औषधीयों को घरों में ही उत्पादित किया जा सकताहै |

मन पसंद शाक, सब्जी एवं फलों को मनचाहे तरीके से कम लगत में उगाया जा सकता है |

कोविड-१९ महामारी के समय, घर में ही सब्जी एवं फलों की उपलब्धता होने के कारण बार - बार बाजार जाने से बचा जा सकता है, जिससे संक्रमण का खतरा इंसान एवं सब्जियों दोनों में नहीं होता है |

गृह वाटिका में औषधीय पौधों का उत्पादन, काढ़े को बनाने में सहायक होते है, जो की कोविड संक्रमण को कम करने में भी सहायक होता है (जैसे - गिलोय, अदरक, हल्दी) |

गृह वाटिका में औषधीय पौधों को लगाकर इनका संरक्षण भी किया जा सकता है, जैसा की देखा जा रहा है कि, महत्वपूर्ण औषधीय पौधे अब वन्य क्षेत्रों से विलुप्त होने की कगार में है |

न केवल महामारी अपितु रोज की भाग दौड़ भरे जीवन में मुख्यतः शहरी क्षेत्रों में गृह वाटिका में समय देकर प्रकृति के निकट होने से तनाव मुक्त एवं सकारात्मक का अनुभव भी प्राप्त होता है |

वर्त्तमान मैं वैज्ञानिकों एवं सलाहकारों द्वारा सब्जियों और फलों में उपस्थित आवश्यक पोषक तत्वों का महत्व, उनसे होने वाले फायदों, इत्यादि को विभिन्न संचार सुविधाओं के माध्यम से आम जनता को जागरूक किया जा रहा है, जिससे अब कीटनाशक एवं रासायनिक उर्वरक मुक्त सब्जियों और फलों की मांग में बढ़ोत्तरी हो रही है |

कोविड संक्रमण के दौरान यह कहावत सही सबित होती देखी गयी की "आवश्यकता ही अविष्कार की जननी होती है" इस समय बहुमंजिला इमरतओ में रहने वाले लोगों ने घर में उपलब्ध पुरानी वस्तुओं जैसे- खराब पानी की टंकी, पुराने पेंट एवं तेल के डिब्बे, पुराने कूलर की क्षतिग्रस्त टंकियाँ, टूटी हुई टोकरीयों पुराने मटके, सुराहियों का उपयोग गमलो की तरह किया जा सकता है, एवं इन में मिट्टी, घर में ही निर्मित कम्पोस्ट एवं रेत को बराबर मात्रा में भरकर कर ऋतु अनुसार सब्जियों के पौधे लगाकर उत्पादन लिया जा सकता है और साथ ही नीम की पत्तियों का घोल समय-समय में डाल कर रासायनिक कीटनाशकों से मुक्त सब्जियों का उत्पादन किया जा सकता है | मिट्टी, कम्पोस्ट एवं रेत मिश्रण को इन खराब पात्रों में भरने से पूर्व, उपरोक्त पुरानी वस्तुओं के नीचे जल निकासी हेतु छेद एवं पुरानी कूलर की टंकियो में पुनः पेंट कर प्लास्टिक कवर में कुछ छेद करके बिछाया जा सकता है, जिससे जल का एकत्रीकरण पात्रों में न हो | मिट्टी, कम्पोस्ट एवं रेट को इस में भरकर विभिन्न प्रकार की सब्जियों के बीज व पोधों को इन में लगा दिया जाता है | इस प्रकार न केवल पुरानी खराब प्लास्टिक एवं लोहे की वस्तुओं का पुनः उपयोग हो पाता है, परन्तु कुछ समय उपरांत परिवार जनों को रासायनिक उर्वरक मुक्त, कीटनाशक मुक्त, कोविड वायरस मुक्त एवं ताज़ा सब्जियों, औषधीय एवं फलों को भी सफलतापूर्वक उगाया जा सकता है | इस तरह गृह वाटिका से वैश्विक महामारी के समय आम जनता को न केवल ताजी शाक, सब्जी, औषधीय एवं फल उपलब्ध होते है, अपितु, परिवार जन

गृहवाटिका में समय देकर, प्रकृति के करीब रहकर तनाव मुक्ती का भी अनुभव कर पता है | यदि हम सोशल मीडिया एवं न्यूज़ को देखे, तो पाते है की, आम जनता द्वारा घर में रहकर ही सब्जियों एवं फलो का उत्पादन किया गया | जिससे ये भी साबित होता है, मानव कितना भी आधुनिक क्यों न हो जाये आवश्यक सामग्रियों के लिए उसको जमींन से ही जुड़ना पड़ेगा|

सब्जियों के सफल एवं सतत उत्पादन के लिए यह भी आवश्यक है की, सही ऋतू में सही सब्जियों का चुनाव किया जाये, जैसे की गर्मी के समय करेला, परवल, टिंडा, टमाटर, चुलाई, खीरा, भिण्डी, इसी प्रकार बरसात के समय में शिमला मिर्च, बैंगन, बीन, तरोई, भिण्डी, चुलाई, करेला, लौकी, गोभी, खीरा, टिंडा एवं शरद ऋतू में चुकंदर, ब्रोकली, गाजर, पत्तागोभी, मटर, फ्रेंच बीन, शलजम, प्याज, मूली, टमाटर, पालक आदि सब्जियों का चयन कर सफल एवं सतत उत्पादन किया जा सकता है | वही कुछ सब्जियाँ ऐसी भी है, जो वर्षपर्यंत सब्जियों को उत्पादित कर सकती है जैसे-टमाटर, बैंगन, चुलाई, पालक, भिण्डी आदि |

सब्जियों व फलो का उपरोक्त पात्रो में प्रबंधन- यदि उत्पादन के समय पौधों की पत्तियों का रंग पीला एवं बढ़त कम दिख रही है तो, समय-समय पर गुड़ाई कर जैविक खाद जैसे-केचुआ खाद, घर में निर्मित खाद एवं गोबर की खाद का उपयोग किया जा सकता है | साथ ही साथ यदि कीट प्रकोप दिखाई देता है तो नीम की पत्तियों का घोल एवं नीम तेल का समय - समय में छिडकाव किया जा सकता है, जिससे जैविक रूप से सब्जियों का उत्पादन किया जा सकता है | पानी की मात्रा, सूर्य प्रकाश, छायाप्रिय पौधों के लिए छाया की व्यवस्था, लताओं वाली सब्जियों के लिए उचित सहारा देने का प्रबंध एवं फलों के सफल उत्पादन के लिए इन पर भी विशेष रूप से ध्यान देना आवश्यक है |

शहरीय क्षेत्रों के कुछ व्यक्तियों द्वारा उपरोक्त पात्रो में जैसे पूरानी कूलर व पानी की टंकियो में पालक, लालभाजी, गिलकी, लौकी, करेला एवं बैंगन का सफल उत्पादन किया जा रहा है,साथ ही साथ पुराने प्लास्टिक के डिब्बों मे पुदीना, मिर्ची, धनिया जैसी सब्जियों एवं औषधियों जैसे गिलोय, अदरक, तुलसी आदि का ही सफलतापूर्वक घरों में उगाया जा रहा है | जिससे “Recycle and Reuse” के concept को अपना कर छत पर वाटिका (गृहवाटिका) से विभिन्न सब्जियों एवं औषधियों का सफल उत्पादन किया जा रहा है, जैसा की नीचे दिए गए चित्र पटल में दर्शाया गया है |

गृह वाटिका में सब्जियों एवं औषधियों का सफल उत्पादन


पुदीना

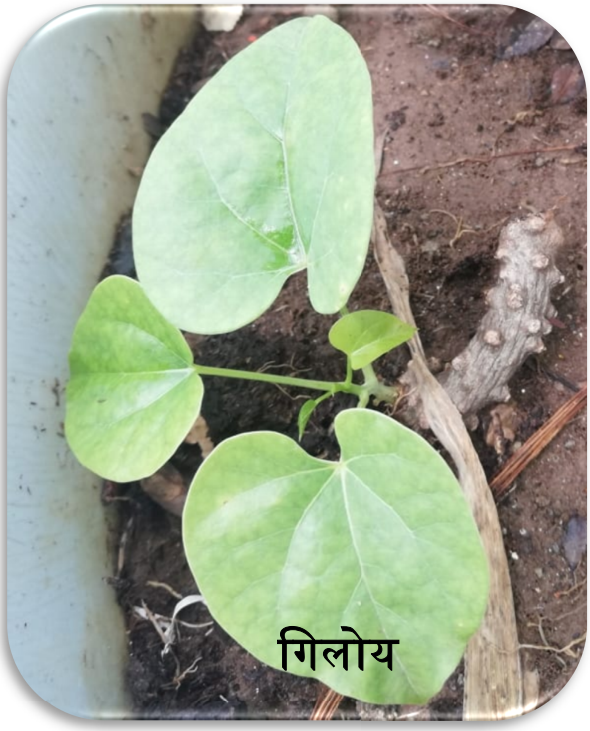

टमाटर


बैंगन


मिर्ची

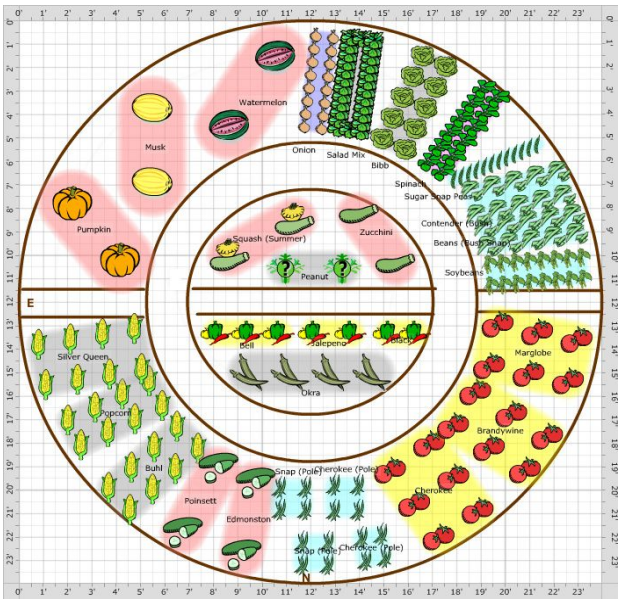

तुलसी

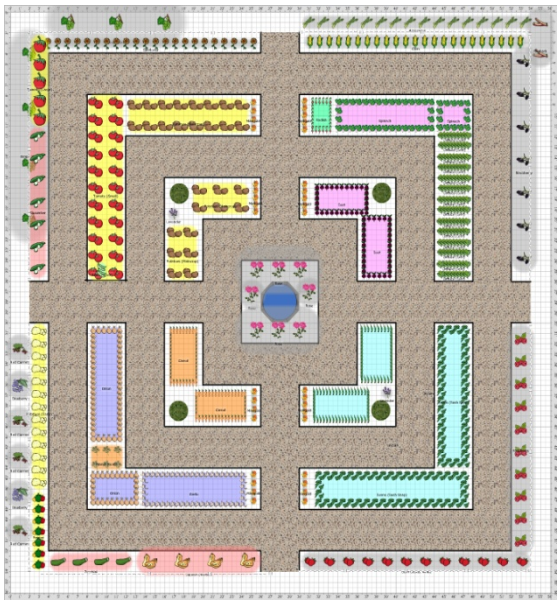

बेल


गिलोय


अदरक

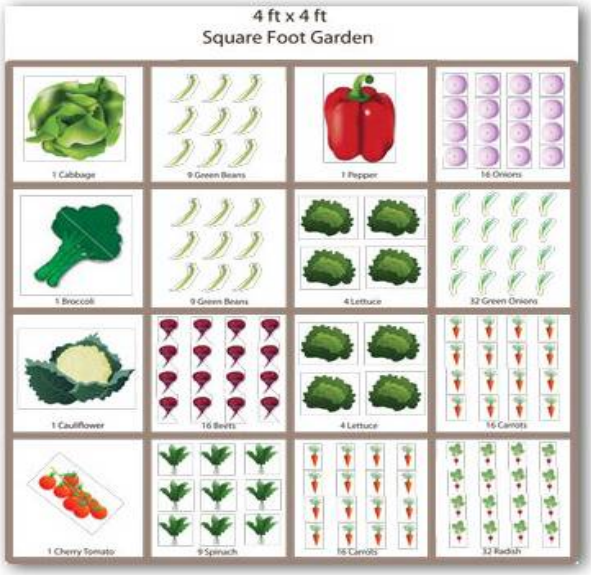
गृहवाटिका का नक़्शा





वर्त्ताकार गृहवाटिका का नक़्शा

(Source- https://www.almanac.com/create-kitchen-garden-potager)



आयताकार गृहवाटिका का नक़्शा

(Source-https://www.almanac.com/create-kitchen-garden-potager)

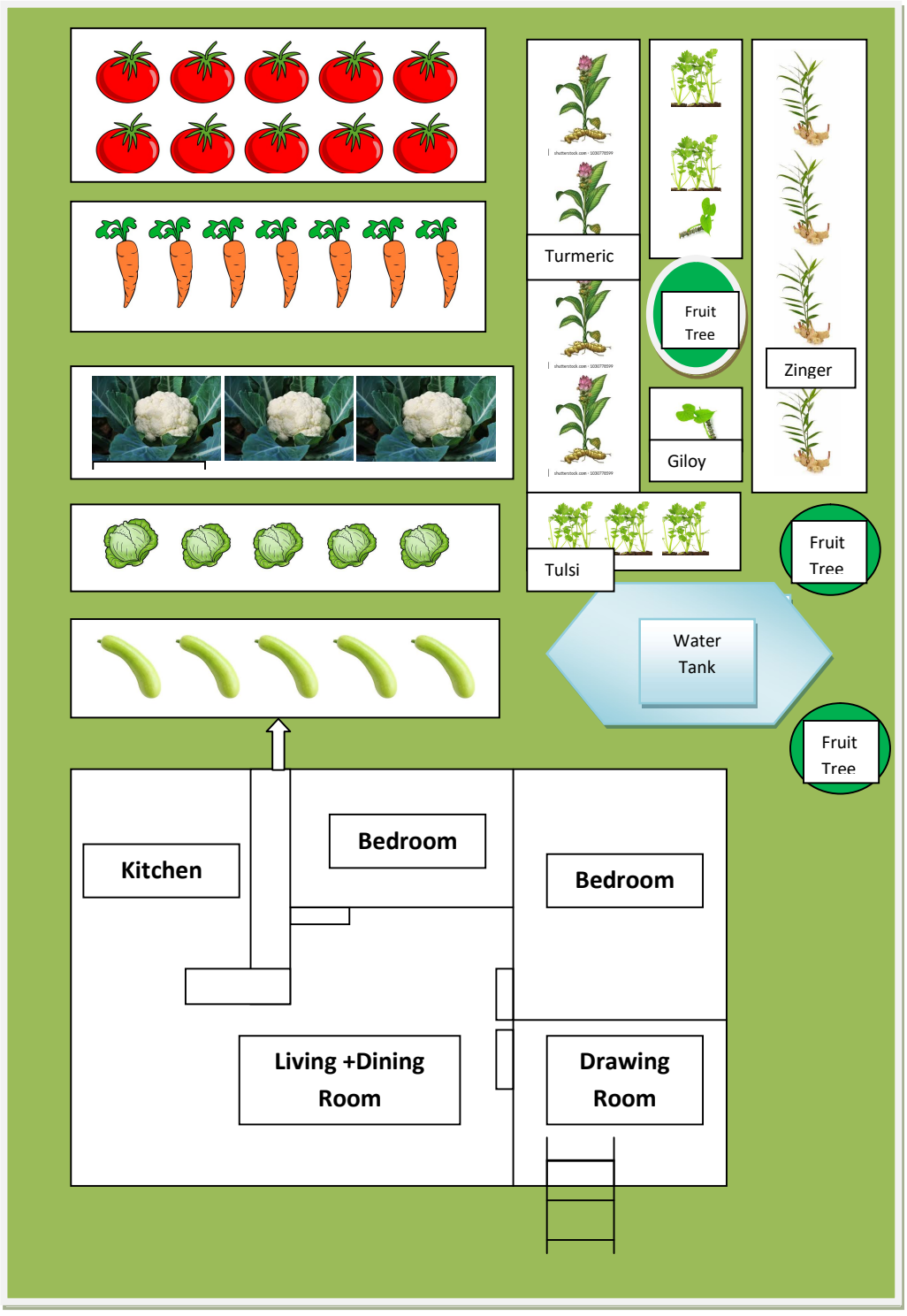
वर्गाकार गृहवाटिका का नक़्शा

(Source-http://www.vegetable-gardening-online.com/basic-vegetable-garden-design.html)

छत पर वाटिका का चित्र

(Source-https://homecrop.in/wp-content/uploads/2018/02/homecrop-kitchen-garden-01.jpg)

गृहवाटिका का **नक़्शा**


Turmeric
Fruit Tree
Zinger
Giloy
Tulsi
Fruit Tree
Water Tank
Fruit Tree
Kitchen
Bedroom
Bedroom
Living +Dining Room
Drawing Room

Indian gypsy moth, *Lymantria obfuscata* and its control measures

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Abstract

This article deals with the pest profile of *Lymantria obfuscata* Walker (Lepidoptera: Lymantriidae), a key insect defoliator of white willow, *Salix alba* L. (family Salicaceae) in India. The management aspects of this insect pest are mentioned.

Key words: Willow, *Salix alba*, defoliator, *Lymantria obfuscata*, control measures

Introduction

The willows belong to the genus *Salix* (Salicaceae) is one of the most important taxonomic entities in the world because of the great number of species and varieties. There are about 330-500 species worldwide (Zhenfu et al., 1999), occurring mostly in the arctic region and north temperate zone, but few species in the southern hemisphere covering tropical and subtropical zones. In India, about 33 species of *Salix* are reported from temperate regions, except *S. tetrasperma* and *S. acmophylla*, which are found in tropical and sub-tropical riparian areas of the entire country. Few introduced species have been sporadically cultivated in the foot hills and inner valleys of Himachal Pradesh, Jammu and Kashmir, Uttarakhand and the north eastern regions of India for many years. Among them, the most popular is *Salix alba*, commonly known as white Willow. The other *Salix* species are *S. fragilis*, *S. caprea*, *S. babylonica*, *S. matsudana*, *S. amygdaloides*, *S. purpurea*, *S. viminalis*, *S. triandra* and *S. phylisifolia*.

Overview of insect pests

Browne (1968) has mentioned about 19 species of insects belonging to five orders, such as Coleoptera (2 species), Diptera (3 species), Hemiptera (4 species), Hymenoptera (5 species) and Lepidoptera (5 species) associated with *Salix alba* in India. Among all, *Lymantria obfuscata* is a key insect defoliator of white willow. The pest profile and control measures of this insect are described.

Pest profile

***Lymantria obfuscata* Walker**
(Lepidoptera: Lymantriidae)

L. obfuscata is commonly known as Indian gypsy moth, occur in the montane and submontane zones of north western India and West Pakistan. The eggs hatch in early April and caterpillars feed for about six weeks. Feeding takes place during the cooler hours of the day and at night during the middle of the day the caterpillars congregate in colonies of hundreds of individuals on the bark of the trunk, underside of the branches, in forks, under the shelter of epicornic shoots and the foliage of ground plants, under stones, etc. (Beeson, 1941). The full grown larva is about 45 mm. Pupation occurs in similar positions and under the protection of sticky silk webs. The pupal period lasts for 10-14 days and emergence of moths occurs during June-July. The female has vestigial wings and does not move far

from site of her pupation, close to which she lays a mass of eggs covered with yellow hairs from her body. The eggs remain unhatched until next spring. Hence, the generation is annual.

The species is known principally as a pest of orchards and plantations of *Alnus nitida*, *Malus domestica*, *Populus* spp., *Quercus dilatata*, *Juglans regia*, *Salix alba*, *S. babylonica* and S. *fragilis*, in Kashmir and the north west Himalayas (Beeson, 1941; Gupta, 1982; Masoodi et al., 1987).

L. obfuscata is a damaging defoliator of willows and defoliation causes loss of increment. Trees may be killed if they are severely defoliated for more than one year (FAO, 2003).

Control measures

Gupta (1982) evaluated several insecticides against the eggs and larvae of *L. obfuscata* in apple on hills of Uttar Pradesh and found mineral oil based ESSO tree spray oil, IOC tree spray oil and Power oil WSE 7267, all at 3, 6 or 9 per cent and Sandolin A, a dinitro or the cresol preparation, at 1, 2 or 3 per cent very effective in reducing the viability of the eggs. Further, application of 5% dust formulation of insecticides like BHC, Aldrin, DDT, Heptachlor, Chlordane or Carbaryl in 30 cm wide and 0.5 cm thick bands on the ground around the trunk of the trees or spraying the trees with 0.05 per cent emulsion of insecticides like Diazinon, Endosulfan, Methyl parathion, Dichlorvos, Quinalphos or Fenitrothion resulted in satisfactory control of the larvae. Masoodi et al. (1987) carried out field trials to evaluate the effectiveness of Endosulfan, Fenthion, Fenvalerate and burlap bands against larvae of *L. obfuscata* on walnut in Kashmir. Burlap bands 30 cm wide were stapled around the trunks of experimental trees at waist to breast height and subsequently Endosulfan and Fenthion were applied at 0.05% and Fenvalerate at 0.03%. All treatments significantly reduced the pest population, Fenvalerate and Endosulfan being the most effective.

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Impact of solar radiation on plant growth

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Plants have adapted to an extraordinarily wide range of light environments, from the deep shade of rainforest understory and underwater habitats to the high-radiation environments of deserts and mountain tops. Exploitation of a wide diversity of habitats is possible because plants have evolved various mechanisms to optimize their use of sunlight. Many plants also exhibit great plasticity in their response to changes in light availability within a particular habitat. This potential for acclimation enables plants to exploit more variable environments than plants with a narrower range of responses to light.

In low light, plants need to absorb maximum light for photosynthesis if they are to survive. In high light the problem is reversed. Plants need to maximize their capacity for utilizing their abundant light energy. At the same time, the plants have to deal with excess sunlight when their photosynthetic capacity is exceeded. As a consequence of such unrelenting selection pressures, plants have evolved a variety of features that optimize light interception, absorption and processing, according to the light environment in which they had evolved and adapted. Adaptation implies a genetically determined capability to adjust attributes, i.e., acclimate to either sun or shade. Such acclimation calls for adjustment in one or more attributes concerned with interception and utilization of sunlight. Common features of either sun or shade plants are outlined below, and the advantage to plants growing in different light environments is discussed. Field applications are illustrated with examples of sun/shade acclimation and sun fleck utilization in rainforest plants.

Shade plants can increase their interception of light by producing large leaves. Some of the largest leaves produced by plants are found in rainforest understory. Leaf size can even change within an individual plant, smaller leaves are produced near the top, where irradiance is highest, and larger leaves towards the interior and base, where light levels are lower. Another way to change light interception is by changing leaf angle and/or orientation.

Vertical arrangements enhance interception of light at low sun angles during early morning or late afternoon, and reduce interception at solar noon when radiation levels are highest. Horizontal leaves will intercept light all day long, but especially around midday. Accordingly, leaves in a rainforest tend to be vertical in emergent crowns and horizontal in the understory. Similarly, pendulant leaves of many Australian trees such as eucalypts

that typically occur in high light environments represent an adaptation that helps avoid excess midday radiation.

A seed germinating in a rainforest understory starts life in a low light environment. This will not present major problems to an obligate shade species which cannot tolerate strong sunlight; such species have adapted to life in an understory. However, many rainforest species are better described as either shade tolerant (i.e. able to germinate and persist in low light, but requiring higher light to reach maturity) or shade intolerant (unable to germinate or grow in low light). In succession terms, shade tolerance is a feature associated with climax species and shade intolerance with pioneer species.

Shade-intolerant species tend to produce numerous small seeds throughout the year which are widely dispersed. Their seeds are also able to remain viable for long periods (years) by going through a period of dormancy. This is often broken by high temperature or strong direct sunlight with a high ratio of red to far-red irradiance (R:FR ratio decreases with sunlight attenuation through canopies). Such environmental cues for germination are all experienced in wide gaps. Following germination, seedlings show rapid growth to maturity, allowing them to become well established in a gap before other slower growing species. These characteristics increase the probability of success for shade-intolerant species in the heterogeneous light environment of a rainforest.

Shade-tolerant species, on the other hand, have evolved a different suite of characteristics. They tend to produce a few large seeds which are generally not well dispersed, with little or no dormancy. However, the seeds have the ability to germinate in low light and persist in the understory as seedlings for years. A rarity of gaps and a lack of dormancy found in most shade-tolerant species increases the probability of establishing in a low-light understory environment. In situations like this, the larger seed provides seedlings with a reserve which they can draw upon during early establishment. In rainforests, tree seedlings survival in understory habitats is positively correlated with seed size, especially in the first few months following germination.

Emergent trees of tropical rainforests have to endure strong sunlight, and leaves comprising the crowns of such trees will have acclimated to full sun. In young-growth forests, canopy emergent are early-succession fast-growing species that are adapted for fast growth in full sun on large disturbances. Such species represent an initial phase in forest dynamics that might last 10–20 years. By contrast, in old-growth forests, early-succession species have long since completed their life cycles, and will have been replaced by later-succession species whose seedlings initially tolerated deep shade on the forest floor, but now endure full sun as canopy emergent. Such remarkable plasticity is an adaptive feature of late succession species and involves sun/shade acclimation by individual leaves.

Formation of gaps provides an important opportunity for many rainforest plants to escape from the dim understory environment and reach maturity as canopy trees. Rainforest habitats actually present a continuum of light availability ranging from almost total shade through intermediate levels of direct and diffuse sunlight to a wide gap where direct sunlight is received for most of a day. Input of direct sunlight beneath a closed

canopy can be surprisingly high because of sun patches and more transient sun flecks. Sun patches occur when small and variable openings in the overlying canopy permit direct sunlight to penetrate to the forest floor, resulting in the familiar patchwork of sunlight and shade which can be seen in any understory on a clear day.

Plants often harvest more light than they can use in photosynthesis. When they are exposed to excess light there is an ever-present possibility of photo inhibition. This may happen when tree fall produces a rainforest gap and suddenly exposes seedlings adapted to life on a forest floor to sustained 10- or 20-fold increases in photon irradiance, or when water stress or low temperature restricts access to carbon dioxide in sun plants.

Clearly, photo inhibition is an integral and indispensable component of photosynthesis. The Inefficiencies it produces in light utilization are essential to the stability of the photosynthetic apparatus in organisms that depend on light for life, and especially in environments where they can do little to regulate the incoming flux of this basic resource.

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Biodiversity and traditional medicinal wealth

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Abstract

The human civilization directly or indirectly relies on the natural resources and biodiversity. Human used it in diversify form from consumption to various utilization to cater the daily needs. Biodiversity includes all the living components of the biosphere. The utilization of the biodiversity exists since from the human civilization. The biodiversity is utilized by the people in the form of food, medicines and other purposes leading to the human wealth and prosperity. Traditionally, the people of the India live with the harmony with the nature and utilize the natural resources in a sustainable way for generating the livelihood, food supply, herbal drug, medicinal value and primary health care systems besides obtaining the economic gain. The sustainable harvesting of the natural resources is essential to fulfill the current and future needs of the coming generation. Therefore, judicious utilization of the natural resources especially the biodiversity needs to be taken care with due consideration of their prioritization, conservation, management through well planning, extension and policies instruments.

Keywords: Biodiversity, Herbal resources, Conservation, Management, Sustainable harvesting, Traditional medicine

Introduction

Biodiversity refers to the living variety in the Earth representing variation of flora and fauna in a given ecosystem and biome. Biodiversity is key indicator of healthy biological systems. Globally in present time, there is growing concern about the traditional knowledge and medicine. This is very important from livelihood, industrial modernization, agriculture and medicinal and herbal drugs perspectives. India is known as most diverse and biological rich country in the world. India is bestowed with diversified habitats from tropical to temperate forest, wide coastal range and wetlands including various river systems, geology, topography and climatic regimes which support wealthy biodiversity. As per the estimate of the MoEF&CC (Ministry of Environment, Forests and Climate Change), India have 47,000 flora and 81000 fauna which accounts 7% and 6.5% earth's flora and fauna, respectively. India reflects centre of origin of 5000 flowering plants, 160 crop plants and 320 species of wild relative of cultivated crops. Further, India has 372 different mammals (8^{th} in world), 1228 bird species (8^{th} in world), 428 different reptiles (5^{th} in world), more than 50,000 insect species along with 13000 butterflies and moths.

Traditional knowledge is practicing the indigenous and local techniques by the communities across the globe. This knowledge is developed from the historical experience and passes from generation to generation among the communities regarding the various resources, environment, culture and tradition

(Chandel et al. 2017; Rathia et al. 2019). Traditional knowledge is precious in the form of plant based health care system and medicines derived from bio-resources. This knowledge contributes significantly for human society and leading to sustainable development. The indigenous and local communities reside closely with the nature and live with the harmony with plant genetic resources. They cultivate, use and preserve these biodiversity from past, thus their techniques and skills gives precious ideas and informations to worlds communities.

Traditional medicinal values and utilization of biodiversity: A snapshot

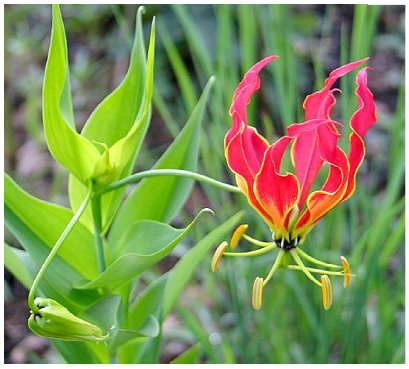
In Indian perspective biodiversity is well-linked with the traditional medicine and healthcare systems (Figure 1). India is one among the 12 mega diversity country of the globe and nearly 8000 species used by Indian communities as herbal wealth. This accounts 50% Indian flowering plant species and among them only 10% are in active trade. It is reported that in Ayurveda 1200 species are used, 700 in Unani, 900 in Siddha, 450 by Tibetan, 600 in Amchi and nearly 1800 species in classical medicinal system of India. The Chhattisgarh bestowed with the rich biodiversity and regarded as herbal and tribal state due to rich forest cover, tribal diversity and population. In rural area and forest dwelling people used to rely on local medical tradition for primary health care for various diseases. These people live with the harmony with the biodiversity and they utilize, protect, manage and conserve it judiciously for sustainble use. They linked with nature traditionally, culturally and spiritually. Their belief, knowledge and skills make these resources more precious in terms of medical tradition.

In Indian herbal industry, nearly 95% supplied of medicinal plants or raw material is supplied from forests. Thus, traditional medicine contributes significantly in primary health care systems and approximately 60% of global populations rely on this. The medicinal plants are directly collected from the natural forests and from domesticated farming system. However, synthetic medicines offered several needs and utility, the natural product and drugs requirements also persists worldwide for medical care system, pharmaceuticals science, ethno-botany, biomedical research and human health point of view which depends upon flora and fauna.

Prospects of biodiversity in human wellbeing

The utilization of biodiversity for human wellbeing is well known and acknowledge by the scientific community and people of the world. This is also reflected in the quote of Mahatampa Gandhi "*True happiness is impossible without true health"*. Biodiversity is important for humans and ecological life support through ecosystem function, process and services (Jhariya and Raj 2014). The loss of biological resources affects the raw materials supplies, exploration of essential drugs and allied technology which leads to loss of potential medicines, natural chemical, genes, medical models and threaten to human health and civilization (Raj et al. 2019). Therefore, the biodiversity conservation is essential to explore molecular diversity for drug discoveries in future. But, the current trend of biodiversity loss affects the natural balance and alters the ecosystem function and services associated with human health and prosperity in a great extent.

Biodiversity and local medical tradition depends upon the traditional knowledge to utilize the various biological resources for health status of the community. Biodiversity offers various goods and services to humankind to maintain the life on the earth (Jhariya and Raj 2014). Further, the development of various medicines and pharmaceuticals are directly rely on the understanding of biological resources which supports the good health, economy and overall wellbeing and prosperity of human civilization. The proper conservation of these valuable resources through scientific management is essential to benefit the society in sustainable manner (Painkra et al. 2015).



Gloriosa superva

Hemidesmus indicus

Terminalia arjuna

Azadirachta indica

Mucuna pruriens

Aegle marmelos

Catharanthus roseus

Aloe vera

Adhatoda vasica

Fig. 1: Views of few plants used in traditional medicinal health care system

Threats to biodiversity

Globally, the biodiversity is decreasing with the passing of time. Due to various factors and drivers, the earth is losing various flora and fauna which altering the natural process, function, services as well as balance which affecting the biosphere in a great extent (Raj et al. 2019). The factors which causing the biodiversity loss includes the changing climate, faulty land use change, forest fragmentation, mining, deforestation, wildfire, grazing, poaching, unscientific management, overexploitation, shifting cultivation, illegal activities, habitat loss, invasive alien species, socio-economic activities, technological intervention and biotic pressure in the form of urbanization, industrialization, extensive/intensive agricultural production, etc. (Millennium Ecosystem Assessment, 2005; Raj et al. 2018).

Management aspects

The management aspects include the technological, applied and practical applications which help to conserve the biodiversity. The conservation of biodiversity can be meeting out through *ex-situ* and *in-situ* methods/techniques (Raj et al. 2018). The integration of different tool and techniques must be designed and applied towards checking the further biodiversity loss as well as conserving it for future generation. Further, the knowledge and awareness regarding the biodiversity among the people must be disseminated through scientific exploration, extension and institutional collaboration with people participation to achieve the desired goal of management (Jhariya et al. 2019). Further, legal framework along with effective policy must be framed in order to check and regulates the various biodiversity

degrading agents, factors and drivers. Moreover, the promotion and adoption of eco-environment friendly technology can be the best cost-effective management aspect to move forward for eco-environmental sustainability (Khan et al. 2020 a,b; 2021a,b,c).

Conclusions

Biodiversity is the integral part of the human and it contributes towards resiliency, security, social interactions, economical, traditional, eco-environmental, health system, etc. for human wellbeing. Due to increased human interference the changes in the scenario of biodiversity have observed globally. This leads to alteration in ecosystem services and natural balance of the Earth. However, people derived the direct benefits from the biodiversity but the societal cost is much higher by losing the precious biodiversity. The timely conservation affords needs to be designed to strengthen the response option towards sustainble utilization of biodiversity as well as for the human wellbeing. Proper research and development is needed to improve the measure to conserve the biodiversity as well as decision making progress. This leads to best information and database availability through which we can design and plan of action towards conserving the precious biological resources. Thus, "*Biodiversity starts in the distant past and it points toward the future*", therefore, for overall prosperity of human being one should needs to follow the moral duty "*Give back to the mother nature more than what you have taken*" for sustainable development and sustainability.

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