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Van Sangyan

Editoriral Board

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.

From the Editor's desk

Soils are made up of organic remains, clay and rock particles, found on the Earth's surface. We need soils to produce food, give clothes and build homes. Soils also store and filter water, recycle nutrients, and create a barrier against floods. The area of fertile soils covering the world's surface is limited. Deforestation, bad agricultural practices and pollution can cause soil degradation and erosion. Soils are also trapped underground when cities keep growing in size and more buildings are made. Soil pollution is defined as the phenomenon of addition of various harmful chemicals, salts, microorganisms and other toxic substances into the top layer of the soil. Such addition often decreases the fertility of the soil by reducing its mineral content and thus adversely affects the ecological balance by affecting growth of plant and animal species. Soil pollution is one of the major problems faced worldwide presently; however various preventive steps are being taken to control and prevent it. Soil pollution, or soil contamination, is the accumulation of man-made toxic substances in soil that has a negative effect of plant and animal life. Common pollutants include herbicides and pesticides; litter and waste. Soil pollution is usually caused by mistreatment of the soil through poor cultivation or farming practices, industrial waste dumping and mineral utilization. Soil pollution can be prevented or at least reduced by educating ourselves on the cause and effects of soil pollution; and the ways to stop it. Often we do not realize, but we are also contributing to soil pollution. Hence, it is important to know how to prevent soil pollution, so that small measures taken by each individual will go a long way in protecting the soil and in turn protecting the earth.

This issue of Van Sangyan contains an article on Soil pollution: Causes, effects and control and Management of soil erosion in forest plantations. There are also useful articles on Diversity of some aquatic and terrestrial fauna, Clonal forestry - benefits and limitation, Industrial agro forestry, Space agriculture - a new horizon of agriculture, badly deteriorated medicinal seeds by mycoflora and their effect on human blood, आंवला: रोपण हेतु पौध तैयार करना and biodiversity of Taxus baccata and Myophonus caeruleus

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

Looking forward to meet you all through forthcoming issues.

We wish all the readers and contributers a very happy and prosperous NEW YEAR, 2016.

Dr. N. Roychoudhary
Scientist G & Chief Editor

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Soil pollution: Causes, effects and control

(On world soil day, December 5, 2015)

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World Soil Day was established in 2002

by the International Union of Soil Sciences (IUSS) to celebrate the importance of soil and its vital contributions to human health and safety. On December 20, 2013, the 68th UN General Assembly recognized December 5th, 2014 as World Soil Day and 2015 as the International Year of Soils. This official recognition of these events will emphasize the importance of soils beyond the soil science community.

It took two years for the leadership of Thailand and the FAO Global Soil Partnership (GSP) to get these dates approved by the UN, but their hard work prevailed and soil has garnered the attention it has so long deserved. World Soil Day is annually held on December 5 to highlight soil's importance on Earth. We need soil for basic survival - food and energy. It is linked with the United Nations' (UN) Year of Soil.

World Soil Day serves as a reminder to all of us that we owe our existence to the soil. As we face mounting global production, climate and sustainability challenges.

Soil is fundamental to human life on Earth. Most plants require a soil substrate to provide water and nutrients, and whether we farm the plants directly or consume animals that feed on the plants, this means that we don't eat without soil. Having said that, it is not hard to see that a) it is possible to have a sea-based diet and b) it is possible to grow our food hydroponically. In those cases, it is possible to reduce the importance of soil. However, we still have the other reasons that soil is fundamental: it is required for trees. I don't think I need to go into the importance of trees for shade, animal habitat, building materials.

Soil is a vital part of the natural environment. It is just as important as plants, animals, rocks, landforms, lochs and rivers. It influences the distribution of plant species and provides a habitat for a wide range of organisms. It controls the flow of water and chemical substances between the atmosphere and the earth, and acts as both a source and store for gases (like oxygen and carbon dioxide) in the atmosphere. Soils not only reflect natural processes but also record human activities both at present and in the past. They are therefore part of our cultural heritage. The modification of soils for agriculture and the burial of archaeological remains are good examples of this.

Soil, together with the plant and animal life it supports, the rock on which it develops its position in the landscape and the climate it experiences, form an amazingly intricate natural system – more powerful and complex than any machine that man has created. Soil may look still

and lifeless, but this impression couldn't be further from the truth. It is constantly changing and developing through time. Soil is always responding to changes in environmental factors, along with the influences of man and land use. Some changes in the soil will be of short duration and reversible, others will be a permanent feature of soil

Soil pollution is the reduction in the productivity of soil due to the presence of soil pollutants. Soil pollutants have an adverse effect on the physical chemical and biological properties of the soil and reduce its productivity. Pesticides, fertilizers, organic manure, chemicals, radioactive wastes, discarded food, clothes, leather goods, plastics, paper, bottles, tins-cans and carcasses- all contribute towards causing soil pollution. Chemicals like iron lead mercury, copper, zinc, cadmium, aluminium, cyanides, acids and alkalies etc. are present in industrial wastes and reach the soil either directly with water or indirectly through air. (e.g. through acid rain).

The improper and continuous use of herbicides, pesticides and fungicides to protect the crops from pests, fungi etc. alter the basic composition of the soils and make the soil toxic for plant growth. Organic insecticides like DDT, aldrin, benzene hex chloride etc. are used against soil borne pests.

They accumulate in the soil as they degrade very slowly by soil and water bacteria. Consequently, they have a very deleterious effect on the plant growth stunting their growth and reducing the yield and size of fruit. Their degradation products may be absorbed by the plants from where they reach the animals and man through the food chains.

Radioactive wastes from mining and nuclear processes may reach the soil via water or as 'fall-out'. From the soil they reach the plants and then into the grazing animals (livestock) from where ultimately reach man through milk and meat etc. resulting in retarded and abnormal growth of man. Human and animal excreta used as organic manure to promote crop yield, pollute the soil by contaminating the soil and vegetable crops with the pathogens that may be present in the excreta.

Nitrification, which is the process of forming soluble nitrates from the elemental atmospheric nitrogen or from originally harmless organic materials actually contribute towards water pollution when the nitrates leach out of the soil and accumulate to toxic levels in the water supply.

Therefore, intensification of agricultural production by practices of irrigation (causes salination), excessive fertilisers, pesticides, insecticides etc. have created the problems of soil pollution. Soil pollution can be checked by restricting the use of above mentioned soil pollutants, resorting to organic farming, adopting better agriculture practices etc.

Soil pollution comprises the pollution of soils with materials, mostly chemicals that are out of place or are present at concentrations higher than normal which may have adverse effects on humans or other organisms. It is difficult to define soil pollution exactly because different opinions exist on how to characterize a pollutant; while some consider the use of pesticides acceptable if their effect does not exceed the intended result, others do not consider any use of pesticides or even chemical fertilizers acceptable. However, soil pollution is also caused by means other than the direct addition of xenobiotic

(man-made) chemicals such as agricultural runoff waters, industrial waste materials, acidic precipitates, and radioactive fallout.

Both organic (those that contain carbon) and inorganic (those that don't) contaminants are important in soil. The most prominent chemical groups of organic contaminants are fuel hydrocarbons, polynuclear aromatic hydrocarbons, polychlorinated biphenyls, chlorinated aromatic compounds, detergents, and pesticides. Inorganic species include nitrates, phosphates, and heavy metals such as cadmium, chromium and lead; inorganic acids; and radionuclides (radioactive substances). Among the sources of these contaminants are agricultural runoffs, acidic precipitates, industrial waste materials, and radioactive fallout.

Soil pollution can lead to water pollution if toxic chemicals leach into groundwater, or if contaminated runoff reaches streams, lakes, or oceans. Soil also naturally contributes to air pollution by releasing volatile compounds into the atmosphere. Nitrogen escapes through ammonia volatilization and denitrification. The decomposition of organic materials in soil can release sulfur dioxide and other sulfur compounds, causing acid rain. Heavy metals and other potentially toxic elements are the most serious soil pollutants in sewage. Sewage sludge contains heavy metals and, if applied repeatedly or in large amounts, the treated soil may accumulate heavy metals and consequently become unable to even support plant life.

In addition, chemicals that are not water soluble contaminate plants that grow on polluted soils, and they also tend to accumulate increasingly toward the top of the food chain. The banning of the pesticide DDT in the United States resulted from its tendency to become more and more concentrated as it moved from soil to worms or fish, and then to birds and their eggs. This occurred as creatures higher on the food chain ingested animals that were already contaminated with the pesticide from eating plants and other lower animals. Lake Michigan, as an example, has 2 parts per trillion (ppt) of DDT in the water, 14 parts per billion (ppb) in the bottom mud, 410 ppb in amphipods (tiny water fleas and similar creatures), 3 to 6 parts per million (ppm) in fish such as coho salmon and lake trout, and as much as 99 ppm in herring gulls at the top of the food chain.

The ever-increasing pollution of the environment has been one of the greatest concerns for science and the general public in the last fifty years. The rapid industrialization of agriculture, expansion of the chemical industry, and the need to generate cheap forms of energy has caused the continuous release of man-made organic chemicals into natural ecosystems. Consequently, the atmosphere, bodies of water, and many soil environments have become polluted by a large variety of toxic compounds. Many of these compounds at high concentrations or following prolonged exposure have the potential to produce adverse effects in humans and other organisms: These include the danger of acute toxicity, mutagenesis (genetic changes), carcinogenesis, and teratogenesis (birth defects) for humans and other organisms. Some of these man-made toxic compounds are also resistant to physical, chemical, or biological degradation and thus represent an environmental burden of considerable magnitude.

Numerous attempts are being made to decontaminate polluted soils, including an array of both *in situ* (on-site, in the soil) and off-site (removal of contaminated soil for treatment) techniques. None of these is ideal for remediating contaminated soils, and often, more than one of the techniques may be necessary to optimize the cleanup effort.

The most common decontamination method for polluted soils is to remove the soil and deposit it in landfills or to incinerate it. These methods, however, often exchange one problem for another: landfilling merely confines the polluted soil while doing little to decontaminate it, and incineration removes toxic organic chemicals from the soil, but subsequently releases them into the air, in the process causing air pollution.

For the removal and recovery of heavy metals various soil washing techniques have been developed including physical methods, such as attrition scrubbing and wet-screening, and chemical methods consisting of treatments with organic and inorganic acids, bases, salts and chelating agents. For example, chemicals used to extract radionuclides and toxic metals include hydrochloric, nitric, phosphoric and citric acids, sodium carbonate and sodium hydroxide and the chelating agents EDTA and DTPA. The problem with these methods, however, is again that they generate secondary waste products that may require additional hazardous waste treatments.

In contrast to the previously described methods, *in situ* methods are used directly at the contamination site. In this case, soil does not need to be excavated, and therefore the chance of causing further environmental harm is minimized. *In situ* biodegradation involves the enhancement of naturally occurring microorganisms by artificially stimulating their numbers and activity. The microorganisms then assist in degrading the soil contaminants. A number of environmental, chemical, and management factors affect the biodegradation of soil pollutants, including moisture content, pH, temperature, the microbial community that is present, and the availability of nutrients. Biodegradation is facilitated by aerobic soil conditions and soil pH in the neutral range (between pH 5.5 to 8.0), with an optimum reading occurring at approximately pH 7, and a temperature in the range of 20 to 30°C. These physical parameters can be influenced, thereby promoting the microorganisms' ability to degrade chemical contaminants. Of all the decontamination methods bioremediation appears to be the least damaging and most environmentally acceptable technique.

The upper layer of the unsaturated zone of earth is the soil. Soil is the natural body made of mineral and organic constituents. It is produced by solid material recycling and complex processes of solid crust modifications. Soil offers shelter, habitat for numerous organisms and is the living medium for plants. Soil is the basis for agriculture. All vegetation for human food and animal feed depend upon soil.

Enormous quantities of waste from man-made products are being released into the soil causing soil pollution. Polluted water also causes soil pollution. Soil pollution is caused due to unhygienic habits, agricultural practices and inappropriate methods of disposal of solid and liquid wastes. Soil pollution is a also caused as a result of atmospheric pollution.

In industrialized countries, soil pollution is a result of use of chemicals in agriculture,

dumping of waste materials, mining, smelting of metals and also dumping of domestic refuse and solids, untreated sewage and industrial wastes.

Types of Soil Pollution

Soil pollution may be any chemicals or contaminants that harm living organisms. Pollutants decrease soil quality and also disturb the soil's natural composition and also lead to erosion of soil. Types of soil pollution can be distinguished by the source of the contaminant and its effects of the ecosystem. Types of soil pollution may be agricultural pollution, Industrial wastes and urban activities.

Agricultural Pollution

- Agricultural processes contribute to soil pollution.
- Fertilizers increase crop yield and also cause pollution that impacts soil quality.
- Pesticides also harm plants and animals by contaminating the soil.
- These chemicals get deep inside the soil and poison the ground water system.
- Runoff of these chemicals by rain and irrigation also contaminate the local water system and is deposited at other locations.

Industrial Waste

- About 90% of oil pollution is caused by industrial waste products.
- Improper disposal of waste contaminates the soil with harmful chemicals.
- These pollutants affect plant and animal species and local water supplies and drinking water.
- Toxic fumes from the regulated landfills contain chemicals that can fall back to the earth in the form of acid rain and can damage the soil profile.

Urban Activities

- Human activities can lead to soil pollution directly and indirectly.
- Improper drainage and increase run-off contaminates the nearby land areas or streams.
- Improper disposal of trash breaks down into the soil and it deposits in a number of chemical and pollutants into the soil. These may again seep into groundwater or wash away in local water system.
- Excess waste deposition increases the presence of bacteria in the soil.
- Decomposition by bacteria generates methane gas contributing to global warming and poor air quality. It also creates foul odors and can impact quality of life.

Causes of Soil Pollution

Soil Pollution is a result of many activities by mankind which contaminate the soil.

Soil pollution is often associated with indiscriminate use of farming chemicals, such as pesticides, fertilizers, etc. Pesticides applied to plants can also leak into the ground, leaving long-lasting effects. Read about the dangers of pesticides. In turn, some of the harmful chemicals found in the fertilizers (e.g. cadmium) may accumulate above their toxic levels, ironically leading to the poisoning of crops. Heavy metals can enter the soil through the use of polluted water in watering crops, or through the use of mineral fertilizers. Faulty landfills, bursting of underground bins and seepage from faulty sewage systems could cause the leakage of toxins into the surrounding soil. Acid rains caused by industrial fumes mixing in rain falls on the land, and could dissolve away some of the important nutrients found in soil, as such change the

structure of the soil. Industrial wastes are one of the biggest soil-pollution factors. Iron, steel, power and chemical manufacturing plants which irresponsibly use the Earth as a dumping ground often leave behind lasting effects for years to come. Fuel leakages from automobiles, which get washed by rain, can seep into the nearby soil, polluting it. Deforestation is a major cause for soil erosion, where soil particles are dislodged and carried away by water or wind. As a result, the soil loses it structure as well as important nutrients found in the soil. Some the causes of soil pollution can be as follows:

- Industrial effluents like harmful gases and chemicals.
- Use of chemicals in agriculture like pesticides, fertilizers and insecticides.
- Improper or ineffective soil management system.
- Unfavorable irrigation practices.
- Improper management and maintenance of septic system.
- Sanitary waste leakage.
- Toxic fumes from industries get mixed with rains causing acid rains.
- Leakages of fuel from automobiles are washed off due to rains and are deposited in the nearby soil.
- Unhealthy waste management techniques release sewage into dumping grounds and nearby water bodies.
- Use of pesticides in agriculture retains chemicals in the environment for a long time. These chemicals also effect beneficial organisms like earthworm in the soil and lead to poor soil quality.
- Absence of proper garbage disposal system leads to scattered garbage in the soil. These contaminants can block passage of water into the soil and affects its water holding capacity.
- Unscientific disposal of nuclear waste contaminate soil and can cause mutations.
- Night soil contamination due to improper sanitary system in villages can cause harmful diseases.

Effects of soil pollution

The main reason for soil contamination is due to the presence of anthropogenic activities. These waste products are made of chemicals that are not originally found in nature and hence lead to soil pollution. Soil pollution is typically caused by industrial activity, chemicals used in agriculture and improper disposal of waste. Soil contamination leads to health risks due to direct and indirect contact with contaminated soil. Soil pollution causes huge disturbances in the ecological balance and the health of the organisms is under risk. The effects of pollution on soil are quite disturbing and can result in huge disturbances in the ecological balance and health of living beings on earth. Normally crops cannot grow and flourish in a polluted soil. However if some crops manage to grow, then these crops might have absorbed the toxic chemicals in the soil and might cause serious health problems in people consuming them. Sometimes the soil pollution is in the form of increased salinity of the soil. In such a case, the soil becomes unhealthy for vegetation, and often becomes useless and barren. When soil pollution modifies the soil structure, deaths of many beneficial soil organisms (e.g. earthworms) in the soil could take place. Other than further reducing the ability of the soil to support life, this occurrence could also have an effect on the larger predators (e.g. birds)

and force them to move to other places, in the search of food. People living near polluted land tend to have higher incidences of migraines, nausea, fatigue, skin disorders and even miscarriages. Depending on the pollutants present in the soil, some of the longer-term effects of soil pollution include cancer, leukemia, reproductive disorders, kidney and liver damage, and central nervous system failure. These health problems could be a result of direct poisoning by the polluted land (e.g. children playing on land filled with toxic waste) or indirect poisoning (e.g. eating crops grown on polluted land, drinking water polluted by the leaching of chemicals from the polluted land to the water supply, etc).

Long term effects of soil pollution

The long term effects of soil pollution are many and can be difficult to deal with, depending on the nature of the contamination.

How Soil Gets Polluted

Soil is a sort of ecosystem unto itself, and it is relatively sensitive to foreign matter being applied to it. That's good for us in the case of wanting to add soil amendments, fertilizer and compost to make the soil healthier, but not so good when it comes to soil pollution.

There are many different ways that soil can become polluted, such as:

- Seepage from a landfill
- Discharge of industrial waste into the soil
- Percolation of contaminated water into the soil
- Rupture of underground storage tanks
- Excess application of pesticides, herbicides or fertilizer
- Solid waste seepage
- The most common chemicals involved in causing soil pollution are:
- Petroleum hydrocarbons
- Heavy metals
- Pesticides
- Solvents

Soil pollution happens when these chemicals adhere to the soil, either from being directly spilled onto the soil or through contact with soil that has already been contaminated.

As the world becomes more industrialized, the long term effects of soil pollution are becoming more of a problem all over the world. It is thought that a full 150 million miles of China's farmland is contaminated.

Even when soil is not being used for food, the matter of its contamination can be a health concern. This is especially so when that soil is found in parks, neighborhoods or other places where people spend time.

Health effects will be different depending on what kind of pollutant is in the soil. It can range from developmental problems, such as in children exposed to lead, to cancer from chromium and some chemicals found in fertilizer, whether those chemicals are still used or have been banned but are still found in the soil.

Some soil contaminants increase the risk of leukemia, while others can lead to kidney damage, liver problems and changes in the central nervous system.

Those are just the long term effects of soil pollution. In the short term, exposure to chemicals in the soil can lead to headaches, nausea, fatigue and skin rashes at the site of exposure.

When it comes to the environment itself, the toll of contaminated soil is even direr. Soil that has been contaminated should no longer be used to grow food, because the

chemicals can leech into the food and harm people who eat it.

If contaminated soil is used to grow food, the land will usually produce lower yields than it would if it were not contaminated. This, in turn, can cause even more harm because a lack of plants on the soil will cause more erosion, spreading the contaminants onto land that might not have been tainted before.

In addition, the pollutants will change the makeup of the soil and the types of microorganisms that will live in it. If certain organisms die off in the area, the larger predator animals will also have to move away or die because they've lost their food supply. Thus it's possible for soil pollution to change whole ecosystems.

There are some ways to get soil back to its pristine condition or to remove the spoiled soil so the land can be used for agriculture again. Tainted soil can be transported to a site where humans won't be exposed to the chemicals, or the soil can be aerated to remove some of the chemicals (which can add the problem of air pollution if the chemicals can be released into the air).

Other options include what's known as bioremediation, where microorganisms are used to consume the pollution-causing compounds as well as electromechanical systems for extracting chemicals, and containment of chemicals by paving over the tainted area.

None of these are an ideal solution. Preventing contamination in the first place is the best way to go. It won't eliminate all potential pollution problems, but choosing to farm organically is a good way to protect the soil (and yourself) from chemicals found in pesticides and other common garden chemicals.

Effects on soil micro-organism

The effects of pesticides on soil micro-organisms can cause a ripple effect that can last for years. Micro-organisms are essential to healthy soil. Without them, your plants will not reach their true potential.

Micro-organisms are organisms that are too small to be seen with the human eye. They live on the top-most layer of soil. There are many micro-organisms which live in the soil including:

- Bacteria
- Fungi
- Algae
- Protozoa

Micro-organisms are responsible for the decomposition and recycling of organic materials in the soil. They aid in the plant's absorption of essential nutrients. An example of this is the nitrogen fixing bacteria, *Bradyrhizobium*, which lives in a nodule on the soybean plant. It provides nitrogen to the plant and boosts growth.

Biopesticides are micro-organisms that can help a plant defend it against pests. These micro-organisms include antimicrobial metabolites, antibiotics and extracellular enzymes. The potential of these biopesticides has not been fully examined by scientists. It is hopeful that science will be able to re-produce the effects of the biopesticides, which will help to

eventually eliminate the need for harmful chemical pesticides.

Pesticides are designed to kill bugs that are harmful to plants. Pesticides kill specific pests on plants such as slugs, beetles and flying insects. The chemicals used in most pesticides can kill more than just garden pests; they can kill the helpful organisms that live in the soil. Some of these chemicals can remain in the soil for years, effectively keeping necessary micro-organisms from working the soil.

Common chemical pesticides that are used in gardens and by large-scale crop producers include the following:

- Basic Copper Sulfate
- Silica Gel
- Sodium Fluoride
- Carbon Disulfide
- Hydrogen Cyanide
- Methylchloroform
- Fenthion
- Boric Acid

There are literally hundreds of pesticides that have been manufactured and applied to soil in the past. We are beginning to understand the ramifications of using these toxic chemicals on the soil. In places where the chemicals are used extensively, plants will no longer grow at all, or will fail to thrive.

Unfortunately, many pesticides can kill more than just their intended targets, namely the necessary micro-organisms in the soil. When chemicals are used for a period of time on plants in an area, they will eventually leach into the soil. Once in the soil they can kill the micro-organisms living in the soil that break down organic material and aid in plant growth. It can take years before micro-organisms can once again live in soil that has had toxic chemicals applied to it.

Alternatives to Harmful Chemical Pesticides

For the average gardener, the use of organic pesticides can keep a healthy balance in the soil. Many organic pesticides are made of minerals or other plant materials that will keep pests at bay and break down quickly in the soil. Examples of some common organic pesticides include the following:

- Cayenne pepper spray--Can be sprayed on the leaves of plants to deter harmful insects.
- Soap spray--Also sprayed on plants to get rid of aphids.
- Tobacco powder--A spray can be made from the finely ground tobacco leaves and water. It is used to kill sucking insects on plants such as aphids, thrips and spider mites.
- Pyrethrin--Made from the chrysanthemum plant. This organic pesticide is used to knock out flying insects and ground pests such as grubs.
- Neem--Derived from the neem tree. Used to control Gypsy moths, leaf miners, mealy bugs, whiteflies and caterpillars.
- Sabadilla--Derived from the sabadilla lily. Used to control caterpillars, leaf hoppers, stink bugs and squash bugs.

Soil pollution causes huge disturbances in the ecological balance and health of living organisms at an alarming rate. Some the effects of soil pollution are:

- Disturbance in the balance of flora and fauna inhabiting in the soil.
- Contaminated soil decreases soil fertility and hence there is decrease in the soil yield.
- Reduced soil fertility hence decrease in soil yield.
- Loss of natural nutrients in soil.

- Reduced nitrogen fixation.
- Loss of soil and nutrients.
- Increased soil erosion.
- Imbalance in the flora and fauna of the soil.
- Increase in soil salinity, makes it unfit for cultivation.
- Creation of toxic dust.
- Foul odor due to industrial chemicals and gases.
- Alteration in soil structure can lead to death of organisms in it.
- Reduction in soil fertility.
- Loss of the natural nutrients of the soil.
- Imbalance is the flora and fauna of the soil.
- Salinity increases in the soil making it unfit for cultivation.
- Crops grown on polluted soil cause health problems on consumption,
- Soil pollution creates toxic dust.
- Foul odor due to chemicals and gases can lead to problems like headaches, nausea, etc.
- Pollutants in soil cause alteration in soil structure, causing death of many soil organisms. This can affect the food chain.

Effects on humans

- Soil pollution has major consequences on human health. Consumption of crops and plants grown on polluted soil cause health hazards. This could explain small and terminal illness.
- Long term exposure to polluted soil affects the genetic make-up of the body and may congenital illnesses and chronic health diseases.
- Chronic exposure to heavy metals, petroleum, solvents and agricultural chemicals can be carcinogenic.
- Exposure to benzene for a long term is associated with higher incidence of leukemia. Mercury causes higher incidences of kidney damage. Cyclodienes are linked to liver toxicity.
- Organophosphates can lead to chain of responses leading to neuromuscular blockage.
- Chlorinated solvents induce damages to liver, kidney, depression of the central nervous system.

On plant growth

- The balance of ecological system is affected due to contamination of the soil.
- Plants are mostly unable to adapt to the change in the chemistry of the soil in short time period.
- The microorganisms found in the soil decline and create additional problems of soil erosion.
- Fertility of the soil decreases due to soil pollution, making it unsuitable for agriculture and local vegetation to survive.
- Soil pollution is hazardous to health.
- Polluted lands cannot support most forms of life.

On soil fertility

- The chemicals present in the soil due to pollution are toxic and can decrease the fertility of the soil, thereby decreasing the soil yield.
- Agriculture on contaminated soil produces fruits and vegetable that lack quality nutrients.
- Consumption of these may be poisonous and cause serious health problems to people consuming them.

Toxic dust

- Emissions of toxic gases and foul odor from the landfills pollute the

environment and causes serious health effects on some people.

- The foul odor causes inconvenience to people.

On soil structure

- Soil pollution can lead to death of many soil organisms like the earthworms which can lead to alteration in the soil structure.
- This can force other predators to move to other places in search of food.

Control of soil ollution

A number of ways have been suggested to curb the pollution rate. Attempts to clean up the environment require plenty of time and resources. Some the steps to reduce soil pollution are:

- Ban on use of plastic bags below 20 microns thickness.
- Recycling of plastic wastes.
- Ban on deforestation.
- Encouraging plantation programmes.
- Encouraging social and agro forestry programmes.
- Undertaking awareness programmes.
- Reducing the use of chemical fertilizer and pesticides.
- Recycling paper, plastics and other materials.
- Ban on use of plastic bags, which are a major cause of pollution.
- Reusing materials.
- Avoiding deforestation and promoting forestation.
- Suitable and safe disposal of wastes including nuclear wastes.
- Chemical fertilizers and pesticides should be replaced by organic fertilizers and pesticides.
- Encouraging social and agro forestry programs.
- Undertaking many pollution awareness programs.

Prevention of soil pollution

Toxic chemical compounds, salts, radioactive agents, toxins and other waste contribute to soil pollution. These have adverse effect on plant and animal health. Soil contains both organic as well as inorganic material. The organic material is

A tilled field with rich soil.

(Photo Credit Digital Vision./ Photodisc/ Getty Images)

formed due to decaying of plant and animal matter. This often makes up the upper most layer of soil. The organic soil such as rocks, has taken over thousands of years to be formed. The top layer is made up of organic soil, while the layers below are inorganic soil. Pollution has gradually reached the inorganic layers as well. There are different types of soil pollution, namely agricultural soil pollution, industrial waste causing soil pollution, urbanization causing soil pollution. These different types of pollution cause the fertility of the soil to reduce and mineral content in the soil to be destroyed. Therefore, measures have to be taken for preventing soil pollution.

To increase agricultural yield, most farmers took to using chemical fertilizers. No doubt that the yield did indeed increase, but at the cost of the soil losing its fertility. To restore the fertility of the soil to what it was, will take a very long time, however, one has to start at some point of time. Drastic measures are required for the same. Farmers should be

encouraged to start using bio fertilizers. The microorganisms in these fertilizers will help in increasing the fertility of the soil.

To avoid soil pollution, it is important, that along with fertilizers, farmers should shift to bio pesticides and fungicides, also known as herbicides. These products will take a little longer to react, but they do not have adverse effect on the soil. It is best to use manure both as a fertilizer as well as pesticide, as it has far less side effects as opposed to its chemical counterpart.

If one has to look at the soil pollution facts, it will be seen that toxic waste has a big role to play in soil pollution. Hence, industrial toxic waste should be treated to reduce its toxicity before it is disposed off. At the same time, responsible methods should be used for disposing off the waste. The best, however, is to avoid the use of harmful chemicals unless they are of extreme importance.

Although a lot of propaganda has been carried out about recycling waste, not many measures have been taken about the same. If each family has to take it upon themselves to recycle waste, the land pollution caused due to landfills will be reduced considerably. The land so saved can be used constructively for a number of better tasks.

After plastic was invented, people thought it was convenient to opt for plastic containers, bags, etc., which could be disposed off after use. However, plastic is one of the main causes of soil pollution, as it takes a very long time to disintegrate. Therefore, people should consider shifting to reusable containers like glass, cotton bags, etc. Although paper does disintegrate faster, a lot of trees are cut for producing paper bags. Therefore, it is best to opt for cloth bags. Similarly, instead of using tissue papers in the kitchen, etc., one should opt using cloth napkins, handkerchief, etc. This will go a long way in reducing landfills.

There is no doubt that the organic products are costly as opposed to the chemically grown products. But choosing the organic products will encourage more organic production. This will help in preventing soil pollution.

To prevent soil pollution, deforestation measures have to be undertaken at rapid pace. Soil erosion is caused, when there are no trees to prevent the top layer of the soil from being transported by different agents of nature like water and air. At the same time, measures should be taken to avoid over cropping and over grazing, as it leads to flood and soil erosion and further deterioration of the soil layer.

Various chemicals such as pesticides, insecticides and fungicides play important roles in plant growth; however the overuse of these chemicals is considered to be one of the prime factors leading to soil pollution. Reducing or even avoiding the use of such chemicals is one of the most elementary and important preventive measures. Manures and bio-fertilization can be used as alternatives to chemicals. Manures are often recommended by environmentalists and agriculturists because, as compared to pesticides, manures have minimal adverse effect on the environment. Bio-fertilization is a process in which certain microorganisms such as rhizobium are used to increase the soil fertility in place of chemicals.

Another common measure used to minimize soil pollution is controlling the growth of weeds. Weeds are unwanted plants that grow alongside the main plant and often result in the accumulation of various minerals into the soil layer. One of

the common methods to control weed growth is covering the soil with layers of newspapers or plastic sheets just before cultivation.

Other common methods of preventing soil pollution include reforestation and recycling of waste materials. De-forestation or the cutting down of trees often leads to erosion of the soil, which leads to soil pollution due to the loss of fertility of the soil. Thus, reforestation is an effective method of preventing soil pollution.

In addition, reducing the volume of refuse or waste in landfills by recycling materials such as plastics, papers and various other materials is another effective and common method of preventing the phenomenon of soil pollution.

- Strong regulatory programs to minimize soil contamination need to be introduced.
- Reuse and recycle unwanted items. Or even better, reduce consumption and reduce your trash. The less rubbish we create the less chance the waste will end up in our soil.
- There is a need to educate the public about the harms done when they litter.
- For gardens, make use of organic fertilizers and organic pesticides, because they are usually made of natural substances, are bio-degradable and do little harm to the natural balance in the soil.
- Insist on buying natural and organic food, because chemical pesticides and fertilizers are not used in their growing process. Not only are organic foods healthier for the environment, they are also healthier for you and your family. Read about the benefits of organic food.
- Cut down usage of paper. Or use recycled paper. In this way, fewer trees need to be cut down and there would be reduced deforestation. Read about the benefits of recycling to the environment.

For decades people have believed that harmful chemical pesticides were the only true way to rid gardens and crop fields from pests. Soil pollution has occurred from the use of pesticides and it takes years and sometimes decades for some of these chemicals to break down. Luckily there are many organic chemicals that are just as effective. The effects of pesticides on soil micro-organisms are less invasive when organic pesticides are used. People need to break the habit of using harmful pesticides and switch to using organic ones that break down quickly in the sunlight and in the soil. The faster a chemical breaks down, the sooner the soil can return to a healthy state. Most organic pesticides are also safe to use around people and pets. They can easily be washed from fruits and vegetables making them healthier for you and your family to eat.

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Management of soil erosion in forest plantations by means of cost effective cultural practices

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Soil erosion is natural phenomenon of soil detachment and transportation as influenced by gravity, wind or water and this process has existed throughout geological time. But in current scenario of higher human interference, rate of soil erosion has reached at alarming stage. Though forest plantations offers immense ecological and economic benefits to mankind, it also posses some disadvantages. Problem of soil erosion in early stages of plantation is of major concern. Various activities such as site preparation, road construction, logging operations etc. promote different stages of erosion such as splash, rill & gully erosion. It should be also observed that soil erosion is one of the key problems in forest plantations establishment. Measures to control soil erosion to increase soil productivity has a long history, thus with time various mechanical and cultural methods are evolved. Forest plantations are lucrative in economic terms but truly speaking only after a long span of time. Hence spending vast amount of economic resources at initially is neither possible nor desirable for small and medium scale plantation owners both private and public.

Thus cultural soil conservation practices, which are low-cost in nature, are appropriate compared to expensive mechanical measures. Information pertaining to cost effective cultural management methods in plantation forestry is scanty. The cultural practices are capable of minimizing detachment and transportation through providing soil cover, modifying soil structure and increasing soil moisture retention capacity. Various cultural soil conservation measures can be adopted from agriculture and horticulture into plantation forests with minor improvisation depending upon site and crop. Some of the important cultural practices for managing soil erosion are grass-legume mixtures, cover and under crops, mulches, minimum & zero tillage, contour strip cropping, gully control by vegetation and afforestation etc.

Grass based soil conservation includes grasses some time along with legumes to improve the soil fertility. This combination reduces soil erosion, enhances soil structure, soil moisture levels and fertility. Matted roots of grasses promote stable soil aggregation and also enrich soil with micro fauna. Some of the important grasses to be combined along with forest plantation in order to reduce soil erosion as recommended by various authors are eucalyptus-bhabar grass, leucaena-napier grass, teak-leucaena-bhabar and poplar-Liriodendron tulipifera (Bhattacharyya *et al*., 2015).

Planting cover crops, such as cowpea horsegram, crotalaria, rye grass or clover, when forest plantations are young would be an important practice for reducing soil erosion by runoff, not only reducing soil erosion it also have the potential to add nourishment to soil especially when nitrogen fixing species are planted (Ponder, F. 1994). Cover crops help in

reducing weed growth, reduces need for fertilizers when nitrogen-fixing species are used and thus reduces need for mechanical weeding or herbicides. Perhaps, cover crops are associated with drawbacks like damaging of permanent crops by twining, increase risk of fire, pest and disease etc. Some of the under crops are, *Centrosema pubescens, Calopogonium mucunoides, Pueraria phaseoloides* and *Indigofera spp.*

Mulch can be loose coverings of material placed on the cultivated soil surface. Mulching in forest plantations offers immense benefits such as it helps in suppression of weeds, water retention, improvement of soil physico-chemical characteristic, protects roots from adverse soil temperature promote beneficial soil micro fauna and flora while addressing different kinds of soil erosion. Depending on the material used to mulch, mulches can be categorized into two classes i.e. 1. biodegradable and 2. non-biodegradable. Some of the easily available and effective organic mulches are leaf litter, nursery or plantation compost, spent mushroom compost, material left behind logging and sawmill waste, well rotted manure, Newspaper and sea weed etc. (http://teca.fao.org/read/7414).

Minimum tillage is nothing but less time and work than is required in conventional tillage practices. Measures such as shallow tillage, strip cultivation, and other similar methods constitute minimum tillage. While, there is a comparative advantage of increased soil and moisture conservation in zero tillage. Though runoff rate is grater in zero tilled soils, still they are more resistant to soil loss and erosion in spite of the extra surface runoff. Contour cropping is the practice of planting in rows and operating tillage implements across slope or along contour. Each row acts as a barrier to the flow of water, thus reducing soil and water losses. Contouring should be complemented by good farming practices for achieving better results. Some of species which can be used as barrier plants are *Vetiveria zizanioides, Cymbopogon citrate* and *Paspalum conjugatum.*

The role of trees in reducing soil erosion is well known. In general soil erosion issues are less severe in forested lands when compared to arable lands. Tree canopy and their extensive root system deep in soil are the forces stabilizing soil in forest plantations. Hence poor sites with various limitations to serve agricultural or horticultural purpose are put under plantation forestry land use. Down flow in gullies thus soil abrasion can be reduced by establishment of vegetation along the gullies. Fast growing species like *Eucalyptus grandis, E. camaldulensis, Acacia spp, mecaranga peltata, Dendrocalamus stictus, Dalbergia sissoo* and *albizzia spp* etc. (Dwivedi A P. 1993).

In conclusion it can be said that prevention is better than cure. So preventing soil erosion is appropriate measure for low input forest plantations. The some of the above mentioned less expensive cultural practices could be employed successfully when appropriate technical help is offered to plantation owners by scientific institutions. It is well known that soil under forest plantations is more vulnerable before crown covering, hence, practices such as cover crops, undergrowth, mulching and contour planting along with ridge and furrow system can minimize erosion in forest plantations.

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Diversity of some aquatic and terrestrial fauna in national chambal sanctuary in Madhya Pradesh

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Introduction

In India National Chambal Sanctuary is in three states of Madhya Pradesh, Uttar Pradesh and Rajasthan. The interstate boundary of Madhya Pradesh and Rajasthan along the Parvati river up to the point where Chambal right main canal crosses the Parvati river and the interstate boundary of Madhya Pradesh, Rajasthan and Uttar Pradesh running parallel at a distance of one km either side of Chambal river has been declared National Chambal Sanctuary for Crocodile, Gharial and other wild animals. During 1978 the Chambal river was declared as a Crocodile Sanctuary under Crocodile Project with an aim to provide fully protected habitat for conservation and propagation of gharial, crocodilian and other wild animals. The river Chambal is one of the country's most beautiful and least polluted river systems. The National Chambal Sanctuary extends over the Chambal River from Jawahar Sagar Dam to Kota barrage and after a gap of 18 km free zone, from Keshoraipatan (Rajasthan) through Pali to Pachanada Uttar Pradesh where it forms a common confluence with the Yamuna along with the Kunwari, Pahuj and Sindh rivers. The total length of river inside the sanctuary is about 600 kms. The width of the river that is included inside the Sanctuary is 1000 m from midstream on either side of the bank in Rajasthan and Madhya Pradesh. Uttar Pradesh has a greater width to an area 635 sq. km geographically. The sanctuary lies between the latitude 25^{o} 35' N and 26^{o} 52' N and longitude 76^{o} 28' E and 79^{o} 01' E.

In Madhya Pradesh the Sanctuary runs for a length 435 km. The National Chambal Sanctuary was formed to protect this pristine river ecosystem, complete with its varied flora, acquatic life and avifauna. The river harbours a variety of aquatic life like the elusive Ganges River Dolphin (*Platanista gangetica*), Gharial (*Gavialis gangeticus*), Crocodile (*Crocodylus palustris*), seven species of fresh water turtles (*Asperidetes gangeticus, Lissemys punctata, Chitra indica, Batagur kachuga, Kachuga dhongoka, Pangshura tentoria* and *Hardella thurjii*), the Otter (*Lutra perspicillata*) and a variety of fishes. The rare Ganges river Dolphin *P. gangetica*, the sole member of the cetaceans group is one of the main attractions of the sanctuary. So called the queen of Chambal, the Dolphin inspire of being blind can be seen perusing their playful antics in the water while coming out to breathe for air. The Chambal sanctuary is one of their safest breeding areas. As per the management plan of National Chambal Sanctuary, around 170 species of birds have been identified in the Sanctuary. Among the different species of birds found in the sanctuary are: bar headed goose, brahmini duck, teals, cormorants, egrets, black and white ibises, brown headed gulls, pointed stork, common crane, sarus crane, herons, spoon bills, pelicans, etc. One can have an easy sighting of the

Indian Skimmer- the highest population of which in the world is found in the NCS. The other important terrestrial animals present in the ravines of the sanctuary are land monitor lizard, variety of other lizards and snakes, sambhar, porcupine, hares, desert cat, blue bull, wild boars etc. (Anon. 2003). Some of the important contributions in this field have been made by some authors (Singh 1978, 1985; Rao 1990; Ali and Vijayan, 1986). Keeping this view, the aim of this study is diversity and impact of fauna in NCS. In the present study diversity of some aquatic, terrestrial fauna and their probable impact in National Chambal Sanctuary are discussed.

Material and methods

The information of general habitat of animals was collected. Habitat analysis was carried out on the basis of river bank types located in different zones both aquatic and terrestrial and the water depth during different seasons. Habitats used by the various animals were observed (Railsback et al., 2003). Data sheets were prepared to record field observations, interview results, past records etc. A detailed survey was carried out by motorboat and also walking along the river bank. During 5th May, 2010 a stretch of 1.0 km in National Chambal Gharial Sanctuary at Deori near 10 km away from Morena district, Madhya Pradesh, India was surveyed for recording the aquatic and terrestrial fauna and exhibits a wide diversity in faunal composition. The aquatic birds were observed with the help of field binoculars. The fauna were identified with the help of Dr. R. K. Sharma, Range Officer, National Chambal Sanctuary, Deori, Morena, M.P. (India) and using management plan of National Chambal Sanctuary (2003).

As a measure of α- diversity (diversity within habitat), the most popular and widely used the following Shannon's diversity index (H') was calculated since it is well accepted that all species at a site, within and across systematic groups contribute equally to its biodiversity (Ganeshaiah *et al.*, 1997).

$$\text{Shannon's index } H' = \sum_{i=1} (pilnpi)$$

Where, p= is the proportional abundance of the ith species

s = total number of species

ln = log with base'e' (Natural log)

Results and discussion

The numbers of fauna sighted, density percentage and Shannon diversity index of some aquatic and terrestrial fauna in National Chambal Sanctuary (NCS) at Deori (Morena) during the present study are shown in Table 1 and 2. The census of aquatic and terrestrial fauna in NCS during 2010 showed that out of eighteen species of birds; Grey Shrike, *Lanius excubitor* (Family : Laniidae) was recorded one hundred twenty numbers followed by Whistling Teals, *Dendrocygna javanica* (Family : Anatidae) twenty eight numbers and Common Swallow, *Hirundo rustica* (Family : Hirundinidae) twenty six numbers respectively. The Indian Skimmer, *Rynchops albicollis* (Family: Laridae) is globally threatened and recorded only two numbers.

In entomofauna particularly in order Lepidoptera, three butterflies viz. Plain Tiger, *Danus chrysipus* (Family: Danaidae) three numbers; Grass Yellow, *Terias (Eurema) blanda* (Family: Pieridae) two numbers; Common Emigrant *Catopsilia crocale* (Family: Pieridae) two numbers were recorded. In order Odonata, Dragonfly, *Orthetrum pruinosum*

neglectum (Family: Libellulidae) five numbers; *O. taeniolatum* three numbers were recorded.

In crocodiles, Gharial, *Gavialis gangeticus* (Family: Crocodilidae) five numbers, their nests of *G. gangeticus* five number were also recorded. This species was dominant in NCS whereas Mugger, *Crocodylus palustris* was found in less (one) number. Hard Shell Turtle, *Kachuga kachuga* (Family: Emydidae) and their Nests two numbers were also recorded. In fish, Rohu, *Labeo rohita* five numbers; Catla *Catla catla* (Family: Cypinidae) two numbers and Cat fish, *Heteropneustes fossilis* (Family: Saccobranchidae) twelve numbers were recorded and generally observed throughout the year.

During the survey the wetland avifauna was observed in higher numbers as compare to other fauna. The surveyed stretch of the site is mainly sandy banks. The sandy banks of river are used by the gharial, mugger and turtle for basking and nesting. Fishes constitute secondary level of food chain. Availability of avifauna in their numbers and available species is another important significant biodiversity criteria that requires immediate attention in this site. World famous Keoladeo Ghana Bird Sanctuary at Bharatpur is only 95 kms away from this site and it is very natural to expect richness species, numbers and offering an extensive habitat for resident as well as migratory birds. Chambal River lies on the migratory route of aquatic fauna providing an approximate stretch of 300 km of perennial wetland habitat for wintering aquatic bird fauna. Most of the entire avifauna recorded in this site are residents and migrants. On the basis of data of avifauna clearly indicates that major congregator birds are fish feeders exemplifying the richness of fishes in the river system. This also signifies high levels of primary production in the site. It also observed that bird population fluctuate in Chambal river which has some direct relation with the habitat condition with Bharatpur which is one of the major habitat for water bird situated 95 km away from this site. It is presumed that during the drought period in Bharatpur more birds take refuse in Chambal River which perhaps includes endangered Siberian Crane which is also reported from Madhya Pradesh. Wetlands are highly productive systems. They are rated third among the highly productive systems of the world. In NCS, cattails, *Typha* spp. is the main aquatic plant. *Typha* accounts for high level annual net primary production levels (tons / h), which is 10-94 tons / ha. Like primary production the secondary production is also fairly high in wetlands. The secondary production depends upon the pathway and efficiency of utilization of energy in primary production. In wetlands a relatively small portion of primary production of algae and higher plants is directly utilized by herbivores. Large part of plant production is used only after it is dead and partly decomposed. Various benthic organisms, some fishes and dolphins feed on detritus in different stages of decay. Other carnivores including amphibians, fish, certain turtles, gharial, mugger, dolphin and waterfowl consume the Benthos and fish. Gharial, mugger and dolphin are important tertiary players in the food chain but almost all of them are basically sympatric with each other in their feeding habits. Thus, they generally avoid each other for food and habitat or to say there is least competition among the various carnivores for food and space. Gharials hunt surface fishes, dolphins mostly depend on deep water

fishes, otters may have habitat overlapping with dolphins, but muggers are totally different with respect to size and quantity of the prey. They generally feed on bigger prey. Birds to some extent certainly compete with muggers and gharials of lower age group for the small catch fish.

Pre- predatory and intra –predatory relationships are the least studied aspect in the NCS almost all the key stone species viz. gharial, gangetic dolphin and mugger are pisivorous species. Illegal fishing on commercial scales has reduce in the availability of chief prey in the NCS which may have a direct bearing on the reduced numbers of the above species especially that of gharials. Birds prey, some of the migratory birds, jackles, monitor lizards, carnivores and omnivore turtles prey upon eggs and hatchlings of gharial and mugger. This intra-predatory relationship controls the natural recruitment of gharial and muggers. Thus, it becomes very important to study pre-predator and intra-predatory relationships to maintain dynamic and viable populations of keystone species in the site.

Population directly dependent upon wetland resources and cultural-indigenous practices of wetland resource utilization

As detailed elsewhere more than four lakhs population is directly dependent on the river ecosystem. They invariably cultivate the land up to the brim, pump out the water for irrigation purposes. Agricultural practices up to the brim of the river to some extent certainly adversely affect the nesting behavior of gharials, muggers and turtles. Fishing is almost through the length of the sanctuary. Fishing on commercial scales is most prevalent in NCS. There are many fake owners who auction the fishing permits every year to small traders. The fishing activity in recent times is gravely affected actual numbers of gharial and mugger population. Once caught in to the fishing nets these creatures get entangled and then beaten to death to relieve the fishing nets. Simultaneously fishing activity also reduces the food availability for tertiary components of the biological pyramid (keystone species). Sand mining is major detrimental activity that is destructing the habitat in a highly dangerous way. Recent survey of NCS and the court commissioner's report has brought out some disturbing picture of habitat destruction and highly mortality of wild animals.

Existing conservation measures

National Chambal Sanctuary is one of the rare protected areas where good amount of conservation measures were successfully taken up and implemented. Gharial rehabilitation project was started in the year 1979 when all time low gharials were recorded (50 gharials as per report of science today report in 1979). Deori has been designated as Gharial Rehabilitation Centre (DGRC) where artificial hatching and rearing of gharials was carried out. In all 1287 gharials were released in to the sanctuary. Initially there was no much pressure with respect to resource and utilization on to the Chambal Ecosystem. Then people were law abiding and had fear for administration. There was a spirit of team work that resulted in better conservation measures as reflected in above table. But, as a result of gradual political and muscle power getting into lucrative sand mining business over a period of last 10-15 years, people have become more daring and destructive. Unabated illegal sand extraction in many stretches of the NCS resulted in savior

habitat destruction and reduction in number of gharials. Even the migratory avifauna is being hunted mercilessly in the NCS. Around 37 animals were found dead during the survey of the year 2003. The casualties included 8 gharials, 2 muggers, 1 dolphin, 7 turtles and several birds. The high number of mortality of wild animals caused due to illegal fishing and mining is a matter of serious concern. Additional boon for NCS is simultaneous conservation of one of the rarest and highly endangered aquatic mammal i.e. fresh water river dolphin (Gangetic Dolphin) during implementation of gharial project. Results of the recent survey indicated that number of gharials dwindled almost less than 50% in comparison to 1997 estimated population. Regular monitoring could have saved the NCS and the department from the sudden embarrassment of touching a nadir with respect to gharial numbers after receiving national and international acclaim. NCS on the river Chambal is a refuse for the rare and endangered gharial (*Gavialis gangeticus)* and ganges river dolphin (*Platanista gangetica*). The Chambal river is holding the best population of dolphins among the southern tributaries of Ganges. The 400 km stretch of crystal clear water also supports marsh crocodiles, smooth coated otters, 7 species of turtles (*Asperidetes gangeticus, Lissemys punctata, Chitra indica, Kachuga kachuga, K. dhongoka, Pangshura tentoria* and *Hardella thurgii*) and 250 species of birds. The Chambal river also supports more than 40 species of fish species, which include Deccan mahseer *Tor khudree* and the giant fresh water ray *Himantura chaophraya*, which occur only in the Chambal river (Taigor and Rao, 2010). A good population of Indian Skimmers is the strongest birding attraction here. Black Bellied Terns, Red Crested and Ferruginous Poachards, Bar-Headed Goose, Sarus Crane, Great Thick-Knee, Indian Courser, Pallas's Fish Eagle, Pallid Harrier, Greater and Lesser Flamingos, Darters, and the resident Brown Hawk Owl, all add up to an impressive list of birds of Chambal. The habitat of aquatic animals in the Chambal river is characterized by expanses of open sand which is sparsely covered with the variety of herbs, the most common in the open sand being *Tamarix dioca.* Some Turtle species frequently dig nest adjacent to the *T. dioca* on some occasions soft shell turtles also dig nests near this vegetation. The *T. dioca* on the open sand help prevent the wind from eroding the sand and exposing nests. Aquatic and semi-aquatic vegetation are similar along the entire Chambal river. Herbivorous Turtles feed and take shelter on *T. dioca*, *Potamogeton demersum*, and *Zennichelia* spp. vegetation. During summer the aquatic vegetation dries up due to low water level, however, during wet season the vegetation is completely submerged in the flood waters and it is difficult to collect the plant material during this period. Major tree species are *Prosopis* spp., *Acacia* spp., *Zizyphus marutiana etc*. Turtle, *Asperderetes gangeticus* travel more than 500 m and lay eggs under the shade of *Acacia* spp. (Taigor and Rao, 2010).

The habitat of the fauna in NCS is mostly aquatic with terrestrial habitat within 1 km from the mid river bank. The micro habitats are: deep water pools, shallow riffle areas, sand peninsulas, muddy banks, sand banks (steep and sand banks), rocky banks, xerophytes vegetation on the banks etc. The habitat as the key to organizing knowledge about fauna and maintenance

of appropriate habitat is the foundation of all wildlife management (Thomas 1979). Species richness can be affected by habitat loss, fragmentation and modification. Habitat studies provide crucial information about the ecological requirements of a species or community. Increasing habitat loss causes a significant increase in extinction risk among many species. The management criteria in the NCS are cessation of commercial fishing, anti-poaching measures, extending protection to habitat and rehabilitation of Gharial under 'grow and release programme' and monitoring of the population of fauna and research (Singh, 1985).

Conclusion

Diversity of aquatic and terrestrial fauna in NCS during 2010 clearly indicated that there is rich diversity of fauna in NCS at Deori (Morena). Observations of NCS were considerably altered and there are disturbances by the sand miners, poachers, fishermen and farmers. Considerably the poor survival it is recommended to provide greater protection by management practices. Effective co-operations between the forest department of Madhya Pradesh and adjoining states are needed as sand mining and poaching becomes an interstate problem. Thus, strategic location of this site in the migratory route of water birds enhances its importance as a significant water bird habitat. NCS Management Plan 2003 gives very good account of avifauna of the NCS. It over emphasizes significant and important birds species available in the NCS which are of National and International importance. Crocodiles use sand banks for nesting and basking. Fauna in the NCS is very much influenced by various factors like habitat suitability and protection of their habitats. Their distribution is depending on availability of deep water pools. Another important factor on which distribution of animals depends is long stretches of long sand banks. Sloppy and steep sand bank with loose soil are essential for good habitats for nesting of crocodiles, turtles and birds. NCS will have negative impact mainly on the Gharial, Turtle breeding programmes and other avifauna.

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Table 1: Census of some aquatic and terrestrial fauna in NCS during 2010

S. N.	Common Name	Scientific Name	Family	No. of fauna sighted	Remark
	Birds				
1	Black Drongo	*Dicrurus adsimilis*	Dicrurudae	02	
2	Redwattled Lapwing	*Vanellus indicus*	Charadiidae	15	
3	Little Cormorant	*Phalacrocorax niger*	Phalacrocoracidae	02	
4	Spurwinged Plover	*Vanellus spinosus*	Charadiidae	05	
5	Indian Skimmer *	*Rynchops albicollis*	Laridae	02	
6	Common Swallow	*Hirundo rustica*	Hirundinidae	26	
7	Green Bea Eater	*Merops orientalis*	Meropidae	02	
8	Whistling Teals	*Dendrocygna javanica*	Anatidae	28	
9	Little Egret	*Egretta garzetta*	Ardeidae	01	
10	Blue Rock Pigeon	*Columba livia*	Columbidae	01	
11	Bank Myna	*Acridotheres gingianus*	Sturnidae	04	
12	Red Tuttle Dove	*Streptopelia tranquebatica*	Columbidae	03	
13	Stone Curlew	*Burhinus oedicnemus*	Burhinidae	01	
14	Grey Shrike	*Lanius excubitor*	Laniidae	120	
15	River Tern	*Sterna aurantia*	Laridae	02	
16	Ring Dove	*Strptopelia decaocto*	Columbidae	02	
17	Common Peafowl	*Pavo cristatus*	Phasianidae	02	
18	Scavenger Vulture	*Neophron percnopterus*	Accipitridae	01	
	Entomofauna **I. Lepidoptera**				
19	Plain Tiger	*Danus chrysipus*	Danaidae	03	
20	Grass Yellow	*Terias (Eurema) blanda*	Pieridae	02	
21	Common Emigrant	*Catopsilia crocale*	Pieridae	02	
	II. Odonata				
22	Dragonfly	*Orthetrum pruinosum neglectum*	Libellulidae	05	
23	Dragonfly	*O. taeniolatum*	Libellulidae	03	
	Crocodiles				
24	Gharial	*Gavialis gangeticus*	Crocodilidae	05	Gharials Nests=5 nos.
25	Mugger	*Crocodylus palustris*	Crocodilidae	01	
	Turtles				
26	Hard Shell Tuttle	*Kachuga kachuga*	Emydidae	02	Turtle Nests=2nos.

	Fish				Seasonal availability
27	Rohu	*Labeo rohita*	Cypinidae	05	R/Y
28	Catla	*Catla catla*	Cypinidae	02	R/Y
29	Cat Fish	*Heteropneustes fossilis*	Saccobranchidae	12	R/Y

*Globally Threatened, R/Y Round the year

Table 2: Density percentage and Shannon diversity index of some aquatic and terrestrial fauna in NCS during 2010

S.N.	**Common Name**	**Scientific Name**	**% Density**
1	Black Drongo	*Dicrurus adsimilis*	0.766284
2	Redwattled Lapwing	*Vanellus indicus*	5.747126
3	Little Cormorant	*Phalacrocorax niger*	0.766284
4	Spurwinged Plover	*Vanellus spinosus*	1.915709
5	Indian Skimmer *	*Rynchops albicollis*	0.766284
6	Common Swallow	*Hirundo rustica*	9.961686
7	Green Bea Eater	*Merops orientalis*	0.766284
8	Whistling Teals	*Dendrocygna javanica*	10.72797
9	Little Egret	*Egretta garzetta*	0.383142
10	Blue Rock Pigeon	*Columba livia*	0.383142
11	Bank Myna	*Acridotheres gingianus*	1.532567
12	Red Tuttle Dove	*Streptopelia tranquebatica*	1.149425
13	Stone Curlew	*Burhinus oedicnemus*	0.383142
14	Grey Shrike	*Lanius excubitor*	45.97701
15	River Tern	*Sterna aurantia*	0.766284
16	Ring Dove	*Strptopelia decaocto*	0.766284
17	Common Peafowl	*Pavo cristatus*	0.766284
18	Scavenger Vulture	*Neophron percnopterus*	0.383142
19	Plain Tiger	*Danus chrysipus*	1.149425
20	Grass Yellow	*Terias (Eurema) blanda*	0.766284
21	Common Emigrant	*Catopsilia crocale*	0.766284
22	Dragonfly	*Orthetrum pruinosum neglectum*	1.915709
23	Dragonfly	*O. taeniolatum*	1.149425
24	Gharial	*Gavialis gangeticus*	1.915709
25	Mugger	*Crocodylus palustris*	0.383142
26	Hard Shell Tuttle	*Kachuga kachuga*	0.766284
27	Rohu	*Labeo rohita*	1.915709
28	Catla	*Catla catla*	0.766284
29	Cat Fish	*Heteropneustes fossilis*	4.597701
			100
Shannon Diversity Index			**2.17057**

Clonal forestry: Benefits and limitation

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Abstract

The potential impact of climate change might suggest conservation strategies that differ from tree breeding objectives for timber production, although fast-growing trees may help reduce CO_2 from the atmosphere, since biomass accumulation is related to the diameter and height of trees. Clonal forestry research efforts may also be valuable in identifying tree varieties that are more adaptable to climate change, should naturally-regenerated stands become affected on a large scale. However, if production issues can be overcome, tree cloning techniques may possibly accelerate forest tree selection processes and reduce cloned seedling costs. Maintaining genetic diversity and managing risks associated with mass infestation of trees from diseases and insects are other issues for forest management and planning.

Introduction

The use of vegetative propagation to produce planting stock from elite genotypes for reforestation can improve forest plantation productivity and quality (Zobel, 1992). Two strategies for using vegetative propagation are common (Frampton *et al.*, 2000): (1) multiplying (bulking-up) limited quantities of full-sib seed derived from crossing parents of known genetic value, and (2) choosing clones from within families for multiplication and deployment. Trees, unlike agricultural crops, have been difficult to improve genetically, because of their long rotation periods, irregularity of flowering and fruiting, the prevalence of out-breeding and low heritability of desirable traits and the frequent absence of substantial germplasm collections. Although some genetic gains have been achieved by tree-breeding including hybridization, mutation effect, biotechnological tools *viz.*, transgenic technology, Ribonucleic acid (RNA) interference, functional genomics, marker assisted selection, quantitative trait loci (QTL) and tissue culture *etc.* (Vikas Kumar *et al.*, 2015a,b,c,d). Recently, a new technique came as clonal forestry in India. Actually, Clonal approaches to forestry are not new, and have been practised for hundreds or thousands of years in Europe with willows (*Salix* spp.), poplars (*Populus* spp.), *Cryptomeria japonica* in Japan and China (Ohba, 1993), *Pinus*, *Eucalyptus*, *Melia*, *Casuarina* and conifers species like other commercially important species in tropics (Ahuja and Libby, 1993a, b; Elridge *et al.*, 1993; Evans and Turnbull, 2004, Warrier, K.C.S., 2010; Huse *et al.*, 2012; Rajpoot *et al.*, 2014; Singh *et al.*, 2015).

Clonal forestry

Clonal Forestry has been emerging as a new revolutionary technology to mitigate the demand of quality planting material in shortest time. So it has immense attention in modern forestry tree plantation. Initially the vegetative propagation of trees are used for the species which reproduced vegetatively under natural condition such as *Poplars*, *Cryptomeria* etc. On later years many tree breeders multiplied the

superior trees, by grafting and cuttings to germplasm preservation and seed orchard establishment. Recently, forest tree seedling are produced at large scale in low in similar to those of seedlings. There has been ever growing interest in clonal techniques. Traditional asexual tree propagation methods like cutting, layering, budding, grafting etc., are required many ex-plant/ tree often establish very slowly or even fail. Clonal propagation are offer much advantages and greater manipulation from single plant (Vikas Kumar and Kunhamu, 2016).

Indian clonal forestry revolution

Rapid deforestation and genetic resources made new strategies of large amount of planting stock in shorter period with high biomass yielding, pest and disease resistant. After implementation of national forest Policy in 1988, under para 4.9 had a crystal clear indication that the forest based industries need to develop of their own raw materials for their consumption. It has created the new scenario in Indian forestry that forest based industries actively involved in production of quality high yielding planting material, technical advice, assured buyback schemes, insurance and loan, harvesting and transportation for farmers. The policy also encourages the small and marginal farmers grow the woody species in their lands to meet the demand of the forest born industries. So this created immense scope for establishing large scale plantation by using rapid clonal propagated seedlings.

Clonal forestry refers to the use of a relatively small number of tested clones deployed in operational plantations through mass-propagation techniques (Bonga and Park, 2003). There are several opportunities and strategies of clonal forestry are given below:

- Achieving greater genetic gains than under traditional tree breeding.
- The ability to rapidly capture a greater proportion of the additive and non-additive genetic variation than can be achieved by breeding.
- The ability to select and utilize greater genetic diversity than is normally found in a single progeny.
- The greater simplicity and flexibility of managing sets of stock plants than in seed orchards.
- The shorter period, compared to seed orchards, between selection and production.
- The increasing superiority of clones passing through multiple-trait selection programmes.
- Using genotype x environment interaction by selecting clones most suited to specific site conditions.
- Detecting and utilizing correlation breakers for traits with undesirable genetic correlations.
- Preventing inbreeding in populations.
- Increasing plantation and product uniformity by quality planting materials.
- To sustainability production with short rotation between breeding and testing cycles.
- To obtained pest and disease free plants.
- It helps to conserve the rare and endangered plant for further utilization and breeding programme. Example- *Shorea macrophylla*

Limitations of clonal forestry

- Clonal propagation is very much costly than conventional seedling.
- Inadequate special training and skills labours require.

- Because of vegetative propagation have short life time.
- Lack of tap roots it may uprooted during heavy wind and storms.
- Erode genetic diversity of natural species.
- Heavy intensive management operation may harm the environment.
- It is misgivings that clonal forestry will give rise to large, biologically-uniform stands that will be at risk from pests, diseases or other hazards.

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Industrial agro forestry - An outcome of contract farming

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Contract farming is an effective and efficient system of success for production and consumption systems of agricultural and allied sectors. It is an essentially agreement between unequal parties, which include the growers, processors and consumers (Eaton, 1998: Gahukar, 2007). Contract farming is viewed as essentially benefiting the promoters or user agencies by enabling them to obtain the necessary raw material on sustainable basis (Gupta, 2002). In the era of market liberalization, globalization and expanding agribusiness, there is a danger that small scale farmers will find difficulty in participating in the market economy (Jackson and Cheater, 1994). In many cases, small farmers could become marginalized as larger farms become increasingly necessary for profitable operations. This system of contractual farming existed from time immemorial but the success in many sectors of agricultural production is of recent origin.

In contrast to agriculture, the production in forestry is of long rotation in nature. Besides, the forests of the country are under acute socio- economic pressure and till recently, the deforestation rate in the country was estimated to be 1.5 million ha year $^{-1}$. Currently the forest area in the country is around 23.57 % and Tamil Nadu state is around 17.41% (FSI, 2005), which is low against the mandated requirement of 33%. The less forest area coupled with low productivity of Indian forest has ushered in a large gap between demand and supply of both domestic and industrial wood requirements (Parthiban and Govinda Rao, 2007).

The biggest challenge faced by wood based industries is the raw material shortage. A conservative forest policy coupled with promotion of farmers/ industries linked plantation activities on under-utilized cultivable and marginal agricultural lands will help to mitigate the crisis. This necessitates a business farm forestry model, in order to expand the area under farm and agro forestry plantations through multi-stake holder's participation. A multi functional agroforestry systems in India has already been elaborately indicated (Pandey, 2007)

The success of industrial wood plantation schemes and the related plantation establishment is widely questioned. The reasons for the failure are numerous; but the key reasons are non-involvement of local people, lack of quality planting stock, lack of assured buy back / minimal support price etc. The middlemen and local contractors in the existing marketing system play a significant role and in most of the cases, they decide the harvesting time and also price fixation. Absence of efficient production to consumption system coupled with price incentives and assured buy back agreement is a major constraint faced by the tree growing farmers. This constraint on industrial agroforestry can be overcome through augmenting the existing supply chain system by linking the farmers directly with industries through contract farming system. The success of WIMCO seedling

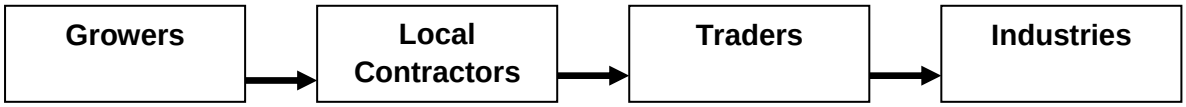
Ltd. for popular in North-Western states and ITC for clonal eucalyptus are the resultant initiatives of multistakeholder's partnership on quality planting stock, marketing, finances, etc. (Pande and Pandey, 2004; Dhiman, 2008; Karmarkar and Haque, 2008). Hence the quad – partite model contract farming system through public private partnership has been introduced in the state of Tamil Nadu involving various levels of stake holders and its success is discussed in this manuscript.

Pulp wood industries

There are 39 paper industries in the state of which, two industries are wood based and the remaining industries are based on agricultural waste or other sources of fiber. The two industries viz., Tamil Nadu News Prints and Papers Limited (TNPL), Karur and Seshasayee Paper Board (SPB), Erode use predominantly hardwoods like Eucalyptus and Casuarina as raw material. These two paper industries required nearly 4.0 lakh tonnes of wood pulp and most of the raw material requirement is met from the Tamil Nadu Forest Plantation Corporation and partly from farm lands. Currently, both the industries have expanded their paper production capacity, which ultimately resulted in the wood pulp demand of nearly 8.0 lakh tonnes per annum against the actual availability of around 3.5 to 4.0 lakh tonnes of wood pulp. Industries have developed contract farming system through technological support from Forest College and Research Institute of TNAU at Mettupalayam, Coimbatore.

Existing supply chain

Currently there exist two supply chain systems. Viz., Forest department supply and farmer's supply. The major raw material supply comes from the Tamil Nadu Forest Plantation Corporation (TAFCORN), which accounts for nearly 1.5 lakh tonnes of wood pulp supply (TNPL, 2008). The remaining raw material comes from the farm lands through the traders. The supply chain of farm forestry is depicted below



In the existing supply chain, growers sell the whole plantation on the acreage basis not taking into consideration the actual volume of the growing stock, which resulted in minimal returns to the growers. The local contractor's buy the plantations, fell them and classify them into poles, pulpwood and firewood. Only the wood size of 1 to 2 inches alone is supplied to the industries and other sizes are sold for pole purpose by the traders, which resulted in uncertain and erratic pulp recovery and quality (SPB, 2008). This necessitated development of strong supply chain with a successful contract farming model.

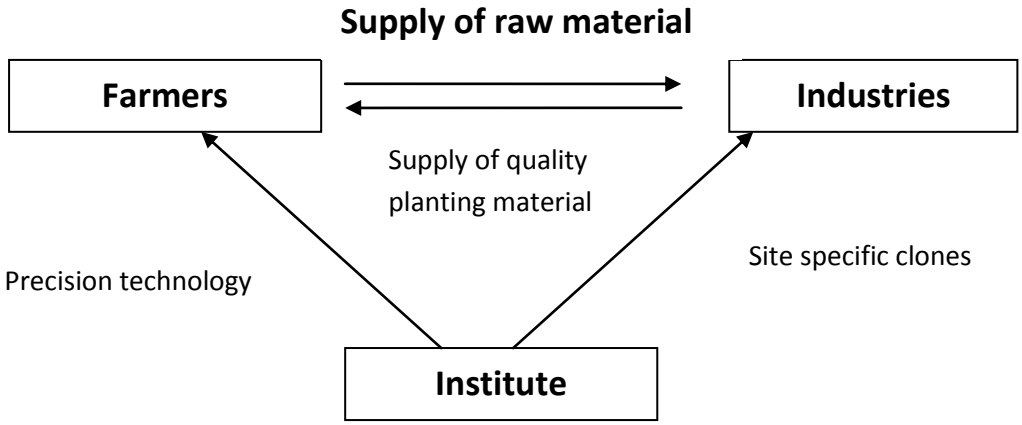
Contract farming model

To meet the above needs and increase the area under pulp wood plantation through farm forestry, the two paper industries in association with Tamil Nadu Agricultural University has developed a tripartite and quad-partite model for promotion of pulp wood based contract farming system. Through the system, it is intended to produce quality and sustained raw material through a strong supply chain.

Tri-partite model

This model incorporates industry, growers and financial institutions. Under this system, the industry supplies quality planting material at subsidized rate and assures minimum support price of Rs. 2000 per tonnes or the prevailing market price which ever is higher. The financial institutions viz., Indian Bank, State Bank of India and Syndicate Bankprovide credit facilities to the growers at the rate of Rs. 15000 to 20000 per acre in three installments. For credit facilities, a simple interest rate at 8. 5 per cent is followed and the repayment starts after felling. The contract farming system extends no collateral security for loan amount up to Rs.1, 00,000/- per farmer. (Fig. 1)

Fig 1. Tri-partite Model contract tree farming

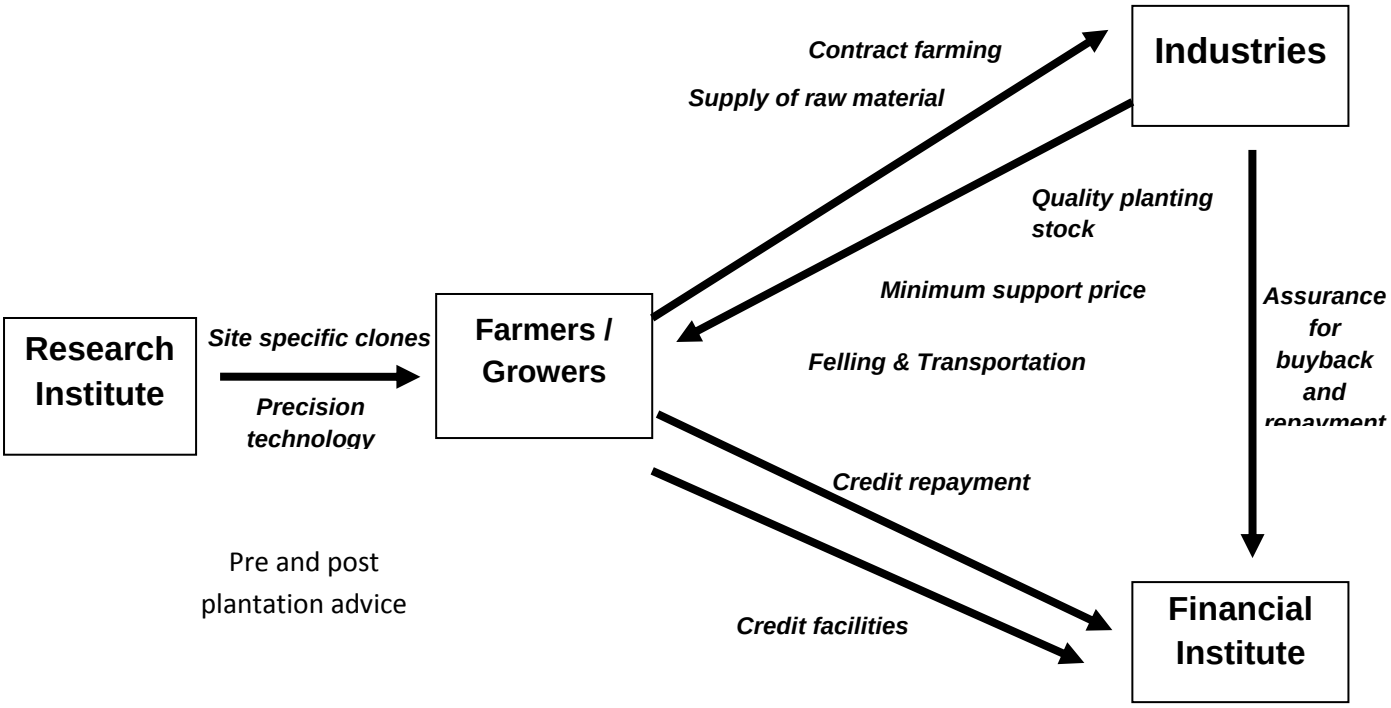


Quad-partite model

This system is similar to tri-partite model barring the involvement of research institute (Fig. 2). In this system, research institute particularly Forest College and Research Institute (TNAU) play a significant role for technological advancements through varietal development and also to advice site specific precision silvicultural technology to the growers. A pre and post-plantation scientific advice helps to develop human resources through on and off institute mode to farmers and plantation staff of the industries.

Similarly, the industries mass multiply the potential genetic materials identified by the research institute in a decentralized manner and supply them at subsidized costs. The industry also facilitates felling and transport at their own costs, which resulted in strong linkage between industry and the farmers. The industry also help to repay the loan amount after felling of farm grown raw materials there by help the financial institutions for timely repayment, which resulted in strong institutional mechanism for sustainability of the contract tree farming system in the state. Hooda and Hooda (2005) emphasized to provide suitable packages to provide credit facility and marketing to recap benefits of agroforestry/ farm forestry to reduce poverty in rural areas.

Fig 2. Quad-Partite Model contract tree farming



The promotion of industrial wood plantation on the farm lands in Tamil Nadu was followed through following three approaches to develop industrial wood plantations under contract farming system.

a.	Farm forestry	:	The farmers raise pulpwood plantations in their farm lands as block plantations
b.	Agroforestry	:	The farmers raise pulpwood plantations as the major crop coupled with suitable intercrops
c.	Captive plantations	:	The industries develop pulpwood plantations in the farm lands through lease or through benefit sharing mechanism.

Planting material

Currently pulpable species viz., *Casuarina, Eucalyptus, Leucaena*, *Meliadubia* and various *Bamboo* species are promoted in the state.

. The clonal planting materials are supplied to all stake holders at subsidized rates through contract farming system.

Industrial wood plantations covered under contract farming

In order to have better monitoring and improve working efficiency with minimum logistic expenses, contract tree farming activities were confined to a compact area i.e., around 200 km from the mill.

As on date, two industries have concentrated in 16 Districts of the state

and covered nearly 40,000 acres under the contract tree farming system. Among two industries, TNPL, a state government owned industry has established more area under contract farming than SPB.

Conclusion

Contract farming through public private partnership has long-term benefits for both the grower and the purchaser, provided that their long-term association is mutually complementary. Contract farming, as it existed then was different from the design and functioning of contract farming method today. Tree farming is gaining momentum in the state through the institute-industry linked public participation. The pulp wood industries in the state of Tamil Nadu promoted pulpwood based contract farming system and contributed significantly for the successful establishment of *Eucalyptus* and *Casuarina*based pulp wood plantations. The industries have adopted tri and quad-partite contract farming models and these systems proved successful in promotion of farm forestry across the state. The tree based contract farming system, industry provided quality planting material in terms of seedlings and clones coupled with strong buy back system. Besides, the contract farming system also facilitated availability of credit facilities, which promoted more number of small farmers entering into pulp wood plantations. This contract farming system has proved lucrative in the state, which resulted in successful industrial agro and farm forestry model.

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Space agriculture: A new horizon of agriculture

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Introduction

Scope for manned space activities is widely discussed among space faring nations as one of the important features in post-International Space Station era. There seems to be a consensus that human presence is necessary to expedite Moon and explore to Mars for the purpose of clarifying the birth and evolution of Solar system and origin of life. Space agriculture concept which is developing expected to become one of the essential systems to support the human activities on Moon and especially Mars. Space agriculture refers to the cultivation of crops for food and other materials in space or on off-Earth celestial objects – equivalent to agriculture on Earth.

Space agriculture supporting life

Space agriculture is a concept of supporting life through biological and ecological processes. We have adapted to terrestrial biosphere and its environment through the evolutional history of living organisms on Earth. If a slice of this environment and terrestrial ecology is cut out and reconfigured in extraterrestrial space to live in, then we might be able to exploit supreme functions of natural ecology. Those elements and functions have been selected and sustained through the long history of terrestrial biosphere. It is already known to us in part, not all, what type of mechanism or event let the living organisms extinguished or survived through their evolutionary history. At configuring natural elements and ecology, we may count an advantage of their durability taking in the space system. One of biological functions widely seen in organisms or living systems is homeostasis. Homeostasis, implemented in organisms and the other levels of hierarchy of living system, keeps their internal state and function adjusted within optimum range against outside environmental changes. Space agriculture is meant to utilize such homeostatic ability through its system components, thus can make the system stable and reliable.

We also know that many complex and ingenious compounds are biosynthesized, which have been selected and refined during evolutional history of living beings. Those substances, which help controlling and regulating physiology of organisms and even ecological balance, cannot be fully replaced by man made artificial systems yet. In another word, our science has not reached to the horizon of fully understanding the biological systems and simulating them for the defined purpose. Even though such excellent features are equipped with natural living organisms and ecological system, they are delicate and vulnerable. Once environmental change or resource shortage exceeds its tolerable range, biological or ecological systems suffer transition to irreversible or unrecoverable state. Such delicate and vulnerable nature suggests that some of the functions might be easily lost when a small part of terrestrial ecological system is cut out to build small living ecosystem in

space. In terrestrial biosphere human activities are related to about 10% of materials and energy flow. This materials loop is still supported by huge sink and stock of Earth. Air, water, and solar light are given to human as natural resources. Space agriculture needs to be developed from furnishing those resources, creating ecosystem, and maintaining it. In such space agricultural system, human should dominate and control almost 100% of energy and material flow. No existence of huge sink or storage is postulated.

Fundamental concept of space agriculture

The goal of space agriculture is to create and maintain optimum living environment on extraterrestrial planet for enabling human and other living organisms, including animal, plant and microorganism to live comfortably. The fundamental configuration of space agriculture is the followings in the case of living on Mars: Pressurized greenhouse dome will be built for cultivating plants. Human living compartment is included inside the dome but separated and isolated from the planting part. The total inside pressure of the greenhouse dome can be maintained at 20 kPa. Partial pressure of oxygen, water vapor and carbon dioxide is regulated to 10 kPa, about 2 kPa and less than 500Pa, respectively. Nitrogen is separated from Martian atmosphere and balanced to adjust the total pressure 20 kPa by filling the rest. Total pressure in the human living compartment is maintained higher than 50 kPa, with oxygen at 20 kPa. The reason for the reduced inside pressure of the greenhouse dome is the structural limitation due to membrane strength of pressurized structure of the dome. It should be noted that atmospheric pressure greatly influence on growth of plants and physiology of human and because of it the living and farming parts should be carefully designed and built. Safety is important, for example, human should avoid to be exposed to lower pressure of farming part by accident. Ergonomics of human wearing pressurized work suit in greenhouse dome is another issue. Gas exchange requires subtle control between the living compartment and greenhouse especially with proper distribution of carbon dioxide and oxygen for each side. Space agriculture on Mars takes advantage of similarity of a day length on Mars to that on Earth. Solar light is major and almost only natural energy source for space agriculture on Mars. However, additional artificial light system is also required for the purpose of regulating longday/shortday for plant flowering, and substituting sun light during Martian sandstorm period. A thermal analysis was conducted for the design of greenhouse dome and its ambient environment by applying a simple model. Reduced atmospheric pressure (1/5) and less gravity (1/3) are considered in the evaluation of convective flow and diffusive transport for mixing gas inside the dome. The model can be easily scaled up by non dimensional parameters.

Recycling of material in space agriculture

In order to design space agriculture on Mars, an estimated amount of material flow for human and plant required 100 kg of water including household use, more than 0.5 kg of carbon dioxide and oxygen each, 2 kg of food in fresh weight, 20 g of plant nutrients and cooking salt per person per day. Photosynthetic reaction of plant is chosen as core process to drive the materials recycle loop of space agriculture. The photosynthesis of plants not only

produces food but also convert carbon dioxide exhaled by human to oxygen at stoichiometrically equivalent amount. Based on the intensity of solar light on Martian surface and efficiency of plant photosynthesis, required farming area for agriculture on Mars is estimated to 200 m^2 for a person. Once production rate of food and oxygen is thus defined, it is estimated that sufficient amount of water could be provided by recovery of transpired water vapor from plant leaf, based on the ratio between transpiration and biomass production in plant.

Nutrient management in space agriculture

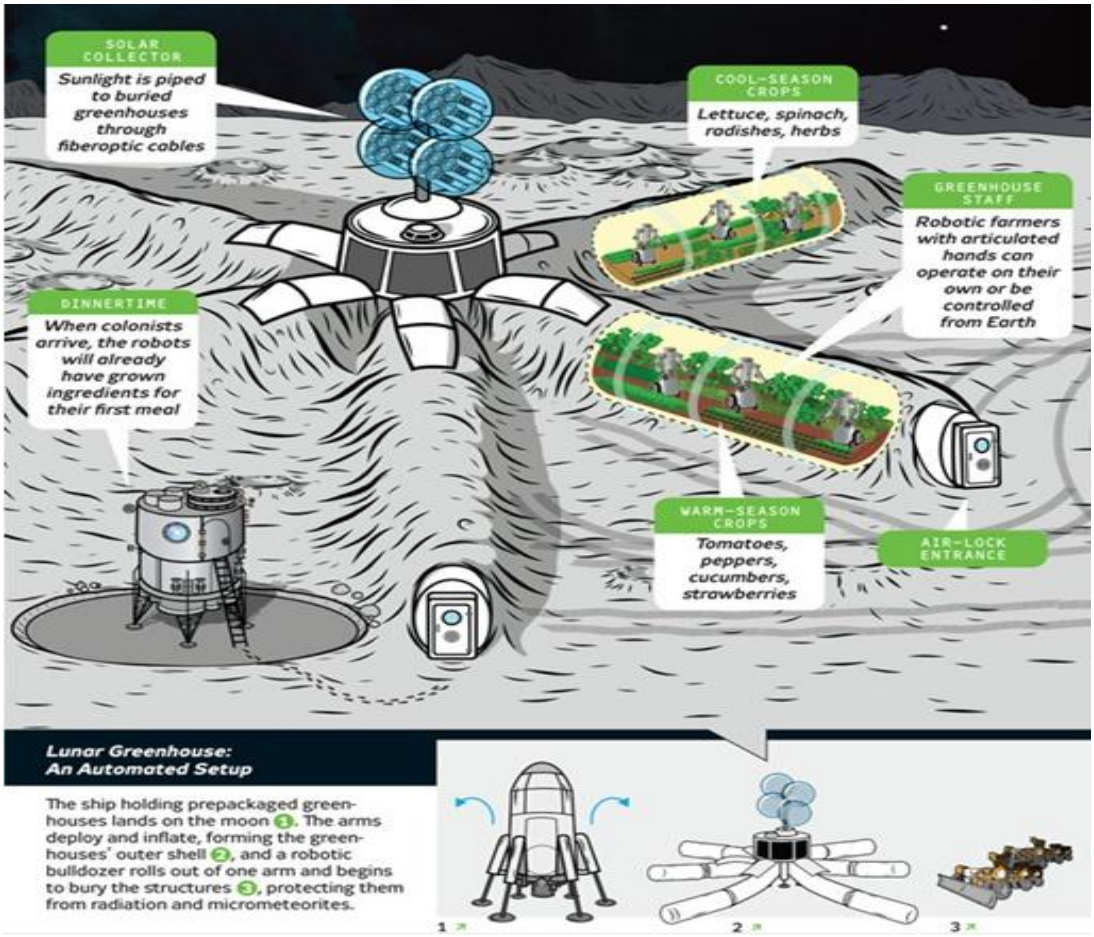
Space agriculture should utilize hyperthermophilic aerobic composting bacterial ecology to process human and animal waste and inedible biomass. Fertilizer and humus can be acquired through the process to result in creation of soil. While ordinary composting has typical reaction temperature around 50-60 ºC, optimum reacting temperature for hyperthermophilic aerobic composting bacteria is as high as 80-100 ºC. After metabolic substrate is given, reaction temperature is auto-regulated to the optimum range after being heated by heat release due to metabolic reaction, in case volume of reaction bed is relatively large compared to its surface area. Since most of bacteria are proliferated under aerobic condition, pathogenic bacteria are rarely member of this microbial ecology. Even raw materials for composting contain pathogenic bacteria, eggs of parasite, or wild plant seeds, they are killed by natural autoclaving at temperature of 80-100 ºC. Reaction (composting) rate is high because of high temperature and activation energy of overall composting reaction. The high temperature composting also work on chelating heavy metal ions and makes them insoluble. The microbial soil ecology could acquire and maintain good quality in biological and chemical state and as a result growth of crop plants would be enhanced by presence of hyperthermophilic aerobic composting bacteria or their excreting chemical products. In fact, hyperthermophilic aerobic composting bacterial technology has been implemented in a kitchen garbage composting machine sold widely as a household appliance in Japan. It is a matured technology and its safety is well verified. In the area where sewage system is under-developed and food garbage cannot dispose from kitchen sink to sewage system, load of garbage collection is reduced by on-site composting. In contrast to Europe or North America where human waste has been considered to spread plague in high populated cities, human waste has been positively accepted in Asia with Japan at no exception. We shared history of materials recycle loop between city and farming village at its vicinity almost 300 years ago. Farmers paid for human waste to fertilize their farming yard for higher productivity. In these days, due to the hygienic concern and limited space of land, Japanese local governments are mostly incinerating their municipal waste. However, hyperthermophilic aerobic composting technology might be widely used for such purpose because propagation of parasite eggs and other negative aspects can be avoided.

Indoor farms- A Cost effective input for Space

Indoor farms in space would reduce the need for costly resupply missions while removing carbon dioxide from the air, thus replenishing the astronauts' breathing

supply, and could produce about 500 pounds of oxygen a year. Space farming is diverse for diversed situations as follows

Space Area	Structure	Current status
Moon	A farm at the moon's poles could tap water ice trapped in craters. Burying the farm buildings will protect them from cosmic rays, micrometeorites and extreme temperatures.	Researchers at the University of Arizona are operating a moon-farm prototype that yields 1100 pounds of edible plants per year.
Earth Orbit	Plants in microgravity draw up water and fertilizer faster than roots can process them. Slowly trickling in fertilizer solves the problem and improves plant health.	Russians on the International Space Station developed the technique by growing radishes, peas and barley.
Mars	The planet's protective atmosphere allows structures to be built aboveground.	Italy's space agency is designing greenhouses that can endure Mars's low-pressure, high-carbon-dioxide environment.



Crazy purple cube- One giant step for Space agriculture

Today, if all goes according to plan, a Space 'X' Dragon capsule will launch from Cape Canaveral, bound for the International Space Station. The

capsule will be delivering supplies—2.5 tons of them—to the Station, among them a series of experimental tools designed to test things like Earth-to-space laser communication and microgravity's effects on the human aging process. Also among them, however, is a device that may be of more immediate interest to astronauts aboard the Station: the *Vegetable Production System*. "Veggie," it's nicknamed, is basically a farm in the form of a transportable cube. It provides space crops with lighting and nutrient delivery, taking advantage of the Station's cabin environment for temperature control—and for carbon dioxide. The farm-in-a-box is collapsible, the better to facilitate both transportation and storage, but it expands to nearly 12 inches in width and nearly 15 inches in depth—making it the largest plant-growth chamber yet to be sent into space. "Veggie" will host science experiments that will feature, as NASA puts it, "edible results."

Challenges for space agriculture

A variety of technical challenges will face colonists who attempt off-Earth agriculture. These include:

- The effect of reduced gravity on various greenhouse crops
- Reduced lighting in some locations; for example, Mars receives about half of the solar radiation as Earth does, and any pressurized greenhouse enclosure will further reduce the light reaching plants. Moon locations or orbital colonies would likely receive more sunlight due to the absence of a humid atmosphere as on Earth and therefore would have more solar energy available to reach the plant.
- Plant growth under conditions of lower pressure atmosphere, because the higher the pressure inside a greenhouse the more massive must be the structural elements and enclosure of the greenhouse. At one tenth of standard atmospheric pressure plants can still function.
- Effects of dealing with the higher radiation without the protective effect of Earth's atmosphere and the Van Allen radiation belts will require shielding or mitigation

Conclusion

Space agriculture enables human to live and survive comfortably with biological and ecological functions. Water and gas are revitalized by photosynthetic processes of plants. Hyper-thermophilic aerobic composting bacteria drive recycling loop of metabolic waste of human and inedible biomass to cultivate plants. Trees and insects play important role in space agriculture as suppliers of additional oxygen, wooden materials, and animal protein as food sources. Space agriculture not only provides fresh food to the astronaut but also will bring a new horizon in agriculture. Undoubtly a day is not far when some species can exist in the space environment and that day earth will find her new friend.

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Study of badly deteriorated medicinal seeds by mycoflora and their effect on human blood

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Abstract
Seed deterioration is an irresistible physiological phenomenon. The aim to study seed deterioration is to see if seed deterioration can be retarded artificially and the higher seed vigour of the fine varieties be maintained. The change of seed deterioration occur in almost every system, and affects many kinds of enzyme and almost all organelle, as a result the seed loses its vigour. Invasion of mycoflora increase the speed of seed deterioration and seeds become unfit for the consumption of human health.

Key words: Deterioration, phenomenon, Consumption, organelle, vigour, mycoflora, Enzyme.

Introduction

Seeds are very important part of plant life. During storage seeds are deteriorate due to the invasion of mycoflora, good quality seeds require for production of seeds of higher quality as well as for conservation. Among the factors affecting quality during storage, the initial quality of the seed lot, the environment for conservation (with its variations on temperature, moisture, oxygen availability and the packaging) as well as characteristics inherent to the species should be taken in to account. The type of packaging during storage, assumes relevant importance on seed quality, one the packaging indeed helps on lessening the speed of deterioration by maintain the initial moisture content of seeds stored and by diminishing or not, their respiration rate. Seeds are known to carry a wide range of micro organisms on their surface which become active at the advent of favourable conditions and thus causing appreciable damage. The fungi being ubiquitous in nature may invade seeds, fruits and other parts while in field or during collection and storage. The climatic conditions in tropical and moist tropical region like ours and the storage practices often provide ideal conditions for mould invasion, proliferation and elaboration of mycotoxins. Fungi associated with stored materials not only reduces the quality but also make them unsuitable for consumption and propagation .The secretion of certain toxic metabolites by the fungi in the plant products create alarming situation with regard to their consumption by the human beings due to its hepatotoxic, nephrotoxic and cytotoxic effect singh (2003).

Mycotoxins are the products of secondary metabolism of fungi. They are not essential to maintain the life of the cell in a primary way i.e. these toxins are not involved in the central metabolic processes of the organism such as obtaining energy or synthesizing structural components, information molecules or enzymes and are known as secondary metabolites. Mycotoxins are cytotoxic compounds, which disrupts various cellular structure such as membranes and interferes with vital cellular processes such as protein, R.N.A., D.N.A. synthesis (Moss, 1987). They are also toxic to the cells of higher plants and animals including humans. It is therefore defined that al the toxic fungal metabolism, help in

pathogenesis/virulence or induce physiopathological abnormalities in affected plants and animals are designated as mycotoxins.

Materials and methods

Collection of samples

Samples of various medicinal plants seeds viz. *Terminalia chebula, Terminalia bellerica, Sphiranthus indicus, Withania somnifera* were collected from local market of Jabalpur, seoni, TFRI, SFRI. These were collected in sterilised polythene bags and labelled properly and were further analysed in the laboratory.

Isolation of fungal flora

The fungi associated with the samples were isolated by standard blotter technique as recommended by international seed Testing Association (ISTA.1993) as well as by dilution method.

Blotter technique

10 **s**eeds of each sample were randomly sorted out and rinsed in sterile distilled water. These were placed on 3 layers of moistened blotter pads in pre sterilised petridishes. All the plates were incubated at 28± 1°c. Observations were recorded after 4 days of incubation period. Fungal colonies developed were isolated by aseptically transferring small quantities of inoculums (fungal spore/mycelium) to PDA slants.

Potato dextrose agar medium (Agarwal & Hasija1986)

1	Potato	200gm
2	Dextrose	15gm
3	Agar	20gm
4	Distilled water	1000ml

Dilution method

2gms of each sample was aseptically transferred to 250ml Erlenmeyer flask containing 100 ml of sterile distilled water. The flask were shaken for some time and serial dilutions up to 10^{-3} dilution for each sample were prepared. 1ml of each dilution was transferred aseptically in pre sterilised petriplates and PDA media was poured. The plates were rotated gently and were left till the medium solidified. All the plates were incubated at 28 ± 1°c. Fungal colonies developed were transferred to PDA slants.

Purification, identification and maintenance of the cultures

The culture of different fungi was purified by single spore / hyphal tip method. The cultures were identified with the help of relevant literature. chupp(1953),Ellis (1976),Ellis and Ellis (1985) etc, and maintained by sub culturing on PDA slants and incubation at 28 ± 1°c for 10 to 15 days. Later these cultures were stored in the refrigerator at 8-10°c.

Production of aflatoxin

The fungi isolated from samples of medicinal plants were *A. flavus, A. fumigatus, A. ochraceus A. niger, Rhizopus, Mucor,* etc.

Total 10 isolates of *Aspergillus* were grown on 25ml liquid medium (Potato Dextrose) in 150ml conical flask. The flask were inoculated with these isolates aseptically and incubated at 28±1°c for 2 weeks and were shaken daily for 30 min, on a mechanical shaker (Chandra and Sarbhoy1997).

Extraction of aflatoxin, from fungal mycelium

After 2 weeks incubation on 15 day 10ml absolute alcohol was added in each flask and kept for 30 min. After 30min, the wet mycelium was crushed in 10 ml chloroform for 2min.Homogaenate was then poured in to 250ml flask, 30ml chloroform was added, than flask was

shaken for 30 min on a shaker and contents was filtered through Whatman no 1 filter paper followed by 2 washing using separating funnel, chloroform were pooled and chloroform layer was separated using separating funnel. Chloroform extract was again passed through filter paper containing 5gms anhydrous sodium sulphate. The filter was evaporated to dryness and dissolved in 2 ml methanol (Singh and Chand, 1998)

Elaboration of aflatoxin

2 gms of each sample of medicinal seeds were transferred in 150ml Erlenmeyer flask containing 10 ml distilled water. All the flasks were sterilised in an autoclave at 15lbs psi for 15-20 min. These flasks were than inoculated with 1 ml spore suspension of known toxigenic strains of *Aspergillus*. All inoculation carried out in laminar flow under sterile conditions. Flasks were incubated at 28 ± 1°c for 10 days. On 11^{th} day the infested materials were dried at60°c for 48 hrs. Once completely dried, these were ground in to fine powder.

Extraction of aflatoxin from infected seeds

In all the flasks, containing powder of infected samples, 25ml of 80% water chloroform v/v was added and kept overnight. On the following day, 30ml chloroform was added in each flask and filtered through Whatsman filter paper 1 followed by 2 washing with chloroform. The chloroform layer was separated using separator funnel and was re passed through filter paper containing sodium sulphate. The resulting filtrate was evaporated to dryness and dissolved in 2ml methanol (Acharya et al.1984) and Singh and Chand, 1998).

Thin layer chromatography (TLC) of aflatoxin

Aflatoxins were separated on TLC plates coated with silica gel G. Glass plates were cleaned with acetone. The plates were than clamped in a plate leveller, 30 gms of silica gel G was taken in to a 250ml conical flask and 50ml distilled water was added to it. The flask was shaken for some time. The resulting slurry was poured on the plates. The plates were than tapped gently so that a uniform layer of silica is formed and were left to dry for about 10 min. Then the plates were transferred to an oven at 60°C for 60 min, and were cooled before using.1 ml of each sample was spotted on TLC plates separately and these plates were developed in a closed solvent saturated glass chamber. Solvent system used was toluene, iso-amyl alcohol and methanol (90:32:2 v/v/v) (Reddy et, al. 1970).Plates were dried. Bands/spots and colour on TLC plates of different aflatoxins were observed under UV light

Quantitative estimation

The quantity of aflatoxin was determined by spectrometer (Nabney and Nesbitt.1965). The individual spots were extracted in methanol after scrspping from TLC plates. The UV absorption spectrum of methanolic solution was recoded in spectrophotometer taking methanol as blank.The amount of aflatoxin can be calculated by the following formula.

$$\frac{\text{DXMX } 1066 \text{ mg/ml}}{\text{EXIX } 1000}$$

D—Optical Density

M—Molecular Weight of Aflatoxin

E---Molar Extraction coefficient

I---Path length (1cm)

Aflatoxin	Wave Length(nm)	Molecular Weight (M)	Molar extraction Coefficients (E)
B1	360	312	22000
B2	362	314	23000
G1	360	318	18700
G2	362	330	21000

Effect of aflatoxin on human blood

5 ml of human blood was collected with the help of sterilized syringe and was immediately transferred to an autoclaved 250 ml conical flask containing a coil for defibrination. The flask was then shaken vigorously for about 10-15 mins. Then the autoclaved media was poured in to the flask in which defibrinated blood was transferred. The resulting blood agar media was poured in to the presterilised petriplates and the plates were left to get solidified. All this was done under strict sterile conditions.

Wells on plates were made by dumicutter. These wells were than filled separately with the selected toxigenic strains of Aspergillus spp were inoculated at 28±°c for 48 hrs.

Composition of blood agar media

S. No.	Particulars	Gm/lit
1	Proteose peptone	15.00
2	Lever extract	2.50
3	Yeast extract	5.00
4	Nacl	5.00
5	Agar	15.00
6	Defibrinated Blood	5%

Determination of moisture content

A known quantity of seeds of different medicinal plants was weighed. These seeds were kept in sterilised petriplates and these plates were then kept in oven at 110°c for 5 hrs. After 5 hrs seeds were taken out and placed in a dessicator filled with dry CaCl2 and left for 2 hrs. The dried seeds were weighted again (Belcher, 1983). The moisture content was calculated by the following formula---

$$Moisture = weight - Dry\ weight\ x \frac{100}{wet\text{weight}}$$

Result and discussion

Isolation of fungi from medicinal seeds

A total of 13 fungi were isolated from the seeds p of terminalia chebula, T. Bellarica, Withania somnifera and spharanthus indicus. These fungi were mainly Aspergillus species viz *A.flavus, A.fumigatus, A.ocharaceus, A.terreus, A.niger and isolates of Furarium, Rhizopus* and Mucor sp., were found to be associated with these seeds. *A. niger* was invariably found associated with all seeds and a.flavus also proved to be the dominating fungi.

The fungi were isolated by both blotter technique and dilution method. The frequency of fungi isolates were more in case of blotter method than that of dilution method. This may be because in case of

dilution method only surface infecting fungi are isolated whereas in case of blotter method sub sueface fungi could also be isolated.

Occurance of mycotoxin producing fungi on 3 constituents of triphala was earlier studied by Singh (2003). Different fungal species associated with grains were isolated by Chandra and Sarbhoy (1997).

Investigation on the microflora of oil seeds and oil cakes revealed a wide variety of fungi. Commonly occurring fungi were that of Aspergillus, Penicillium, Mucor and Rizopus species (Verma et al, 1997).

The entry and infection of these fungi in seed samples may occur as the result of biological and mechanical injury during development of plant parts, transportation and storage of samples. Poor storage condition is one of the major cause of infection. Apart from this, climatic condition in India, also make agricultural commodities more vulnerable to fungal attack.

Production of aflatoxin

Isolates of aspergillus spp., belong to 5 species namely A. flavus, A. fumigates, A. ochraceus, A. niger and A. terreus were selected for further studies. Aflatoxin producing ability of the selected strain was determined. These were grown on liquid media (Potato Dextrose) and were analysed for aflatoxin production. The quantitative assessment of aflatoxin shoes wide variation (Table 1).Out of the total strains, 3 viz Afl, Afm1 and Afm2 produced aflatoxin G1 and G2. Af3 produced all the four major aflatoxin viz B1, B2, G1, G2, Af2 produced aflatoxin B1, A.ocharaceus and A. terreus produced aflatoxin G1. A. niger was found to be atoxigenic strain. Af3 produced the highest amount of B1 i.e. 0.65µg/ml and 1.8µg/mlG2. Afm2 produced the maximum amount of aflatoxin G1 i.e. 72µg/ml.

From the data present in table 1, we can conclude that the Af3 strain is the most potent aflatoxin producing strain.

Different isolates produced varying concentration of toxin. The growth and aflatoxin producing ability by fungus in liquid media depends on genetic make up of the strain and the environment i.e. temparature, incubation period, aeration, nature of the substrates etc. The environment provided being the same for all the strains, variation in genetic make up remains the only possible factor for the difference in afl atoxin production by the isolates. Bilgrami and sinha (1992) also supported the fact that toxin producing potentials of fungi varied with due to variation in their genetic make up.

Elaboration of aflatoxin

When seeds of medicinal plants were inoculated with the selected strains of aspergillus, they showed increased production of toxins in comparison to toxins produced inartificial media (Table 2).

Genetic make up of strain, incubation period and the temperature conditions etc. Being the same for the broth and solid substrate experiments, the nutritional components is the only factor which becomes responsible for difference in toxin production in broth and solid substrate. In case of seeds, Aflatoxin B1 was produced by each strain. Most of the strain viz. Af1 (12.9µg/gm), Af2 (4.18µg/gm), Af3 (8.87µg/gm) and Afm3 (0.98µg/gm) produced the highest amountof toxins in seeds Withania somnifera, A. ochraceus, Afm1, Afm2, Afm4, A.terreus produced the maximum amount of toxin in seeds of Sphiranthus indicus, Terminalia chebula and T.

Bellerica respectively. High concentration of aflatoxin i.e. 0.08-0.30µg/gm in Emblica officinalis, 0.08-0.14µg/gm in T. Bellerica and 0.13-0.75µg/gm in t. Chebula was recorded (Singh, 2003).

Amount of toxin produced by same strain in different seeds also varied significantly. The fungus being the same and toxigenic nature varied with the kinds of substrates to the differences in the chemical compositions of the seed substrates as well as the surface area of the individual seed.

Earlier mycotoxin in edible and medicinal fruit/seeds of forestry origin has been reported by Zohari and Kharia (1987),Reichert (1988) and Singh et.al.(2002)Chourasia (1995) reported different levels of mycotoxin in herbal drugs.Natural contamination of aflatoxin in various medicinally important spices is reported from different regions of the country (Singh and khan 2001 and Singh et al 2002). Several samples of crude herbaldrugs collected from different regions were found to be contaminated with substantial level of mycotoxin (Roy, 2003).

Effect of aflatoxin on human blood

Strains of Aspergillus were screened for haemolytic activity. Although aflatoxin was produced by all the strains of *Aspergillus*, haemolysis was sing to few isolates.

Four isolates viz Af1, Af3 Afm1and Afm2 produced clear zone of haemolysis around the inoculated well (table 3and 4) while rest of the isolates did not showed any significance effect. All these 4 isolates produced aflatoixnB1 and B2 which may be responsible for causing lysis erythrocytes.

Panda et. al. (1975) have observed the effect of aflatoxin B1 on blood of rats and guines pigs and recoded reduction in total counts of RBC, WBC and HG content of the blood similar results were observed by Roy (2003).

In case of bacteria, toxins called haemolysis are produced which are responsible for causing haemolysis. Haemolysis are cyotoxic extracellular proteins which act by forming holes in cell membranes by inserting in to lipid bilayer, thus destroying the membrane permeability barrier (Howard and Buckely, 1985).Haemolysis are of 2 types α haemolysin andβ haemolysis. They may be detected by the increase of zones of haemolysis around colonies of bacteria grown on blood agar media (Burke et.al, 1981).

Determination of moisture content

The moisture content of the seeds was determined and it was found thatthe seeds of Withania somnifera had the highest moisture content i.e. 36%. The moisture content of the seeds of spheranthus indicus, Terminalia bellerecia and T.chebulla was found to be 24%, 24.5% and 19% respectively.

The two factors which determine the viability of the seed in storage are the seed moisture content and the storage temperature. Determination of seed moisture content is therefore, very essential in order to decide the extent to which the seed needs to be dried for storage (Khullar and Sharma1991).

Moisture level is one of the most important factor for the growth and development of fungi. Thus seeds stored at low moisture level are less prone to fungal invasion. In the present study most of the strains growing on the seeds of Withania somnifera produced highest amount of aflatoxin in comparison to other seeds. This confirms that although moisture is not the only factor but it has significant impact

on the growth of microflora which ultimately affects aflatoxin production.

Table 1. Showing different type and quantity of aflatoxins produced by different Aspergillus isolates.

S.No	Name of strain-	Aflatoxin production(µg/ml)			
		B1	B2	G1	G2
1.	*A.flavus (Af1)*	0.18	0.14	--	--
2.	*A.flavus (Af2*	0.13	--	--	--
3.	*A.flavus(Af3)*	0.65	0.88	0.90	1.85
4.	*A.fumigatus(Afm1)*	0.77	0.68	--	--
5.	*A.fumigatus(Afm2)*	0.36	0.22	--	--
6.	*A.fumigatus(Afm3)*	--	--	2.72	1.65
7.	*A.fumigatus(Afm4)*	--	--	1.20	0.95
8.	*A.ochraceus*	--	--	1.30	--
9.	*A.terreus*	--	--	1.10	--

Table 2. Elaboration of aflatoxin B1 on medicinal seed

S. No.	Name of strain	W.s (µg/mg)	T.b (µg/mg)	T.c (µg/mg)	S.i (µg/mg)
1.	*A.flavus(Af1)*	12.9	0.46	0.12	6.82
2.	*A.flavus(Af2)*	4.18	0.36	0.73	0.56
3.	*A.flavus(af3)*	8.87	0.67	2.04	5.30
4.	*A.fumigatus(Afm1)*	1.10	2.56	0.78	0.40
5.	*A.fumigatus(Afm2)*	1.21	1.98	1.02	0.56
6.	*A.fumigatus(Afm3)*	0.98	0.15	0.18	0.68
7.	*A.fumigatus(Afm4)*	1.19	1.24	0.38	0.93
8.	*A.ocharaceus*	4.6	4.38	1.57	7.76
9.	*A.terreus*	1.33	2.82	3.62	0.93

W.S *Withania somnifera*, T. b *Terminalia bellarica*, T.c. *Terminalia chebula*, S.I. *Spheranthus indicus*. Table-showing differences in amount of aflatoxin B1produced by strainsin different seeds

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न्यू पाली रोड, जोधपुर- 342 005

प्रस्तावना

आंवला यूफोरबियेसी कुल का सदस्य है । इसका वानस्पतिक नाम *इम्बलिका ओफिसिनेलीस* पर्याय *फायलेन्थस इम्बलिका* है । आंवले का वृक्ष मध्यम उँचाई (25 से 30 फीट) का होता है । आंवला बर्फीले एवं अधिक नमी वाले क्षेत्रों को छोड़कर पूरे भारतवर्ष में पाया जाता है । संभवतः दक्षिण व मध्य भारत, श्रीलंका,

मलेशिया एवं दक्षिण चाइना इसके उद्गम के केन्द्र हैं । इसकी पत्तियाँ इमली की पत्तियों के समान छोटी-छोटी होती हैं । इसका वृक्ष प्रतिवर्ष अपनी खुरदुरी छाल को बदलता रहता है । शाखाओं पर छोटे-छोटे पुष्प, पुष्पक्रम में लगते हैं । इसे धात्री या आमलक के नाम से भी पुकारा जाता है । अंग्रेजी में इसे इंडियन गूसबेरी और संस्कृत में आमला या आमलकी कहते हैं । शब्द आंवला प्रायः इसके फलों को इंगित करता है जो हल्के हरे-पीले रंग के होते हैं तथा स्वास्थ्यवर्धक गुणों से भरपूर होते हैं । हजारों साल पहले से आयुर्वेद आंवला के महत्व पर प्रकाश डाल रहा है। आज भी आयुर्वेदिक चिकित्सक बहुत सी बीमारियों के उपचार में इस अद्भुत वनस्पति का

उपयोग बिना किसी हानिकारक प्रभाव के करते हैं । आंवला धरती पर विटामिन सी का सबसे समृद्ध प्राकृतिक स्रोत है । यह प्रसिद्ध आयुर्वेदिक चूर्ण त्रिफला का एक घटक है तथा लोकप्रिय आयुर्वेदिक यौगिक च्यवनप्राश का मुख्य घटक है।

रासायनिक संगठन

फल के 100 ग्राम गूदे में 14 ग्राम कार्बोहाइड्रेड,

1.2 ग्राम आयरन, 0.5 ग्राम प्रोटीन, 0.3 मिलिग्राम विटामिन बी तथा 600 मिलिग्राम विटामिन सी पाया जाता है ।

गुण

1. आंवला, स्वाद में कसैला, मधुर, शीतल एवं अम्ल युक्त होता है ।

1. 2. इसमें विटामिन सी प्रचुर मात्रा में पाया जाता है। पानी या पानी की भाप से पकाने तथा धूप में सुखाने से भी विटामिन सी का ह्रास नहीं होता है।
2. इसमें पाया जाने वाला विटामिन सी संश्लेषित विटामिन सी से अच्छा होता है।

औषधीय गुण

शरीर के संपूर्ण पोषण के लिए आवला महत्वपूर्ण फल है। इसका औषधीय महत्व इस प्रकार है -

1. शीतल तथा रूखा होने के कारण रक्त, पित्त और प्रमेह रोग को दूर करता है।
2. शरीर में तीनों वात, पित्त एवं कफ के असंतुलन को कम करता है।
3. पीलिया रोग में लाभदायक है।
4. आंवले का प्रतिदिन सेवन करने से बाल, काले, घने एवं मजबूत रहते हैं। यह बालों को सफेद होने व झड़ने से रोकता है।
5. गर्मीयों में लू लग जाये तो चने की सुखाई गई भाजी एवं आंवले का चूर्ण गलाकर, पैर के तलवे व नाखून, हाथ की हथेली एवं नाखून आदि पर रगड़ने से लू दूर हो जाती है।
6. आंवला बहेड़ा एवं हर्रा से बना त्रिफला चूर्ण कब्ज दूर करता है एवं भूख बढ़ाता है।
7. यह एजिंग प्रक्रिया को रोकता है।
8. सामान्य सर्दी – जुकाम को रोकता है।

9. यह न्यूट्रीशनल पावर हाउस होने के कारण रोग प्रतिरोधक क्षमता बढ़ाता है और शरीर में जीवनी शक्ति को संचित करता है।
10. यह मधुमेह के रोगियों में रक्त शर्करा को नियमित करता है।
11. शरीर में लौह तत्व के अवशोषण में सहायक होने से हीमोग्लोबिन स्तर में सुधार करता है।
12. इसमें पाये जाने वाले प्राकृतिक एन्जाइम मन्दाग्नि व अपच में उपयोगी हैं।
13. यह सीरम कोलेस्ट्राल को कम कर उच्च रक्तचाप को कम करता है।
14. इसमें एन्टी-इन्फ्लेमेटरी प्रक्रिया पाई जाती है। इसलिए बहुत से गेस्ट्रोइन्टिस्टाइनल इन्फ्लेमेशन जैसे गैसट्रिसटिस में उपयोगी है।
15. कफ एवं ब्रोन्काइटिस के उपचार में।
16. डायरिया के उपचार में।
17. इससे ऊर्जा प्राप्त होती है अतः लम्बी बीमारी के बाद आरोग्य लाभ में उपयोगी है।

व्यापारिक महत्व

1. विटामिन बी, विटामिन सी और आयरन अधिक मात्रा में होने के कारण इसके फलों का सत बहुत सी आयुर्वेदिक एवं होम्योपैथिक औषधियों के निर्माण में काम आता है।
2. आंवला, बहेड़ा व हर्रा से त्रिफला चूर्ण बनाया जाता है।
3. च्यवनप्रास बनाने में।
4. केश तेल बनाने में।
5. फलों से अचार, चटनी, मुरब्बा आदि बनाया जाता है।

आंवले की विकसित एवं विभिन्न किस्में

आंवले की निम्नलिखित उन्नत किस्में हैं – अगेती, बनारस, चकैया, फ्रांसिस (हाथीझूल) एन ए - 7, कृष्णा एन ए - 4 एवं कंचन एन ए - 5, BSR-1।

पौध तैयार करना

आंवले के पौधे बीज व वर्धी प्रजनन दोनों प्रकार से तैयार किये जाते हैं -

बीज से

आंवले के फल नवम्बर से फरवरी माह तक प्राप्त होते हैं। इसकी गुठली प्रकोष्ठों में बंटी होती है। एक गुठली में 3 से 5 प्रकोष्ठ होते हैं। प्रत्येक प्रकोष्ठ में काला या कत्थई रंग का त्रिभुजाकार एक बीज होता है। बीज प्राप्त करने के लिये फलों को पानी में गला कर गुठलियों को गूदे से अलग कर सुखाते हैं तत्पश्चात गुठलियों को तोड़कर बीज निकाले जाते हैं। बीजों की संख्या प्रति कि.ग्रा. 68000-89000 तक होती है। बीजों की अंकुरण क्षमता 1 से 6 माह तक 40 प्रतिशत से 65 प्रतिशत तक होती है। बीज कवच सख्त होने से अंकुरण में अधिक समय लगता है। अतः जल्दी, अधिक व एक साथ अंकुरण के लिये बुवाई पूर्व बीजों को उपचारित करना आवश्यक है। उपचार हेतु बीजों को सान्द्र सल्फ्यूरिक अम्ल में तीन मिनिट रखकर स्वच्छ पानी से अच्छी तरह धोकर जिब्रेलिक अम्ल के 500 पी.पी.एम. में 24 घण्टे तक रखते हैं। अन्य उपचार में बीजों को बोने से पहले उबले हुए गर्म पानी (आग पर से हटाकर) में डालकर कमरे के तापमान पर कम से कम 12 घंटे तक रखते हैं। उपचार पश्चात बीजों की रोपणी में बनी क्यारियों में या पोलीथीन थैलियों में या रूट ट्रेनर्स में भरे मृदा मिश्रण में बुआई कर देते हैं। बीज 1 से 1.5 से. मी. की गहराई में बोये जाते हैं। बीजों की बुआई का अनुकूल समय मार्च का अंतिम सप्ताह है। मार्च में बोये गये बीजों से प्राप्त पौधे जुलाई तक 50 से.मी. से 60 से. मी. की उँचाई प्राप्त कर रोपण योग्य हो जाते हैं। पौध रोपण जुलाई में करते हैं। बीजों से उगाये गये पौधों से फल 10 से 12 वर्ष पश्चात प्राप्त होते हैं।

वर्धी प्रजनन

वृक्ष के वर्धी भागों से मातृ वृक्ष के गुणों के समान वृक्ष तैयार करने की विधि वर्धी प्रजनन कहलाती है। आवलें के पौधे ग्राफटिंग एवं बडिंग द्वारा आसानी से तैयार कर सकते हैं। चूंकि बीजों से प्राप्त पौधों में बहुत सी विविधताएं पाई जाती हैं। इसलिए आंवले के पौधों को वर्धी प्रजनन से तैयार करना प्रारंभ किया गया है जो 05 या 06 वर्ष पश्चात ही फल देने लगते हैं। वर्तमान में आंवला की व्यापारिक रूप से खेती करने वाले किसान वर्धी प्रजनन द्वारा तैयार पौधे ही रोपित कर रहे हैं।

वर्धी प्रजनन से लाभ

वर्धी प्रजजन के निम्नलिखित लाभ है -

1. मातृ वृक्ष के समान गुणों वाले पौधों की प्राप्ति।
2. पौध तैयार करने में कम लागत एवं समय की बचत।
3. बीजों की अपेक्षा वर्धी प्रजनन से तैयार पौधों में उत्तरजीविता अधिक होती है।
4. फलों की जल्दी प्राप्ति।
5. इलाइट पोधों की प्राप्ति।

6. प्राथमिक अवस्था में ही ग्रेडिंग द्वारा रोगग्रस्त पौधों से छुटकारा।

वर्धी प्रजनन के लिये मुकुल (बड) एवं शाखायें लेते समय निम्नलिखित सावधानियाँ आवश्यक हैं

1. मातृ वृक्ष की उम्र 8 या 10 वर्ष तक होना चाहिये।
2. मातृ वृक्ष स्वस्थ्य एवं सुडौल होना चाहिये।
3. मातृ वृक्ष गांठों रहित होना चाहिए।
4. मातृ वृक्ष के फलों का रासायनिक विश्लेषण कर विटामिन सी का प्रतिशत ज्ञात कर लेना चाहिए क्योंकि विटामिन सी का प्रतिशत अधिक होना चाहिए।
5. मातृ वृक्ष के फलों में रेशे कम होना चाहिए।
6. मातृ वृक्ष के फलों की गुठली का आकार छोटा होना चाहिए।
7. मातृ वृक्ष से ली जाने वाली शाखायें लगभग एक वर्ष पुरानी होना चाहिये ।
8. जिस शाखा को ग्राफ्ट करना है उसे एक सप्ताह पहले पत्र विहिन कर देना चाहिए।
9. शाखा या मुकुल पूर्वान्ह (प्रातःकाल) में एकत्रित करना चाहिए।
10. ग्राफ्टिंग या बडिंग के लिये पोलीथीन की रिबिन (फीता) इस तरह बांधना चाहिए कि पानी की मात्रा पोलीथीन बंधे भाग में प्रवेश न कर सके ।
11. ग्राफ्टिंग, बडिंग हेतु लाये गये वर्धी भागों को छायादार स्थान में रखना चाहिए।
12. शाखाओं या मुकुलों को पौटेशियम परमेगनेट के 0.5 प्रतिशत घोल में डुबोकर साफ पानी से धो लेना चाहिए।

मृदा एवं जलवायु

चूंकि आँवला एक उप उष्णकटिबंधीय फल प्रजाति है इसलिए यह नम उष्णकटिबंधीय दशाओं में भी अच्छी वृद्धी कर सकता है और फलों का उत्पादन भी भरपूर होता है। यदि छोटे पौधों की अत्यधिक ठंड और गर्मी इन दोनों तापमानों से रक्षा कर ली जाये तो परिपक्व या पूर्ण वृद्धी प्राप्त वृक्ष, न्यूनतम तापमान 0 डिग्री सेन्टीग्रेड से अधिकतम तापमान 46 डिग्री सेन्टीग्रेड तक के तापक्रमों को सहन कर लेता है। इसी तरह यदि छोटे पौधों को गर्मियों में अत्यधिक सूखे व वारिश में पानी के ठहराव से बचा लिया जाये तो परिपक्व वृक्ष इन दोनों विपरीत दशाओं को सहन कर लेता है। आँवला पानी के निकास वाली लोमी मृदा में तेजी से वृद्धी करता है, यदि वृद्धि के शुरुआती 2 – 3 वर्षों में अधिक वारिश के दौरान पानी के निकास की उचित व्यवस्था कर दी जाये तो यह भारी क्ले मृदा में भी वृद्धि कर सकता है । आंवला वृक्ष बहुत अच्छे से मिट्टी व सिंचाई वाले पानी के पी. एच. 8.5 (क्षारीय) को सहन कर लेता है।

गडढे बनाना एवं पौध रोपण

पोलीथीन थैलियों में स्थानांतरित किये गये पौधों को जुलाई से अगस्त के प्रथम सप्ताह तक रोपित किया जाता है। पौधों की अच्छी बढ़वार के लिए रोपण से दो - तीन माह पूर्व अप्रेल - मई माह में निश्चित दूरी पर 100 x 100 x 100 से.मी. माप के गडढे तैयार कर लेते हैं । गडढों की दूरी स्थानीय जलवायु के अनुसार रखना चाहिए शुष्क क्षेत्रों में 4 मी., अर्ध शुष्क क्षेत्रों में 5 मी., नम तथा खेतों की मेड़ों पर 6 मी. रखना चाहिए । लगभग दो माह पूर्व गडढे तैयार करने से अप्रैल-मई माह का तापमान व शुष्क वायु, मिट्टी को भुरभुरा, वायुवीय तथा हानिकारक जीवाणुओं से रहित कर उपजाऊ बना देता है । गडढों की खुदाई करते समय यदि मिट्टी उपजाऊ नहीं लगे

तो गडढों को उपजाऊ मिट्टी, रेत एवं खाद के मिश्रण से भर देना चाहिए । मृदा मिश्रण (मिट्टीःखादःरेत) का अनुपात 1:1:1 होता है । ध्यान रहे कि गोबर का खाद पका हुआ होना चाहिए । गोबर का कच्चा खाद डालने से दीमक लगने की संभावना अधिक होती है । रोपण से पूर्व दीमक से बचाव के लिये 0.2 प्रतिशत एन्डोसल्फान का घोल प्रति गडढा डालना चाहिए । रोपित किये जाने वाले पौधों की लंबाई 50 से. मी. से 60 से. मी. के बीच होना चाहिए । रोपण के समय पौधों को जड़ के साथ कम से कम 03 से. मी. तक जमीन में दबा देना चाहिए । इस तरह दबाये गये पौधे भविष्य में वायु रोधक होते हैं अर्थात पौधे आंधी तूफान से उखड़ते नहीं है ।

थाला बनाना तथा निंदाई एवं गुड़ाई

पौध रोपण के 15 दिन पश्चात पौधे के चारों तरफ 1 मी. व्यास का थाला बनाना चाहिए एवं आवश्यकतानुसार निदांई एवं गुड़ाई करते रहना चाहिए ।

खाद, कटाई-छंटाई एवं सिंचाई

पौध रोपण के एक वर्ष पश्चात प्रति पौधा 20 किलोग्राम गोबर की पकी खाद (FYM) तथा 30 ग्राम नाइट्रोजन देना चाहिए । वृक्ष की वृद्धि के साथ प्रत्येक वर्ष 30 ग्राम नाईट्रोजन की अतिरिक्त मात्रा डालते रहना चाहिए । वृद्धि पश्चात फल देने वाले वृक्षों में प्रत्येक वर्ष वारिश के दौरान 30-40 किलोग्राम गोबर की पकी खाद (FYM) के साथ 250-500 ग्राम नाइट्रोजन (यूरिया), 400-700 ग्राम P_2O_5 तथा 150-200 ग्राम K_2O (पौधों के आकार को ध्यान में रखकर) का उपयोग करना चाहिए । यदि सिंचाई की सुविधा है तो इस खुराक को दो भागों में विभक्त कर पहला आधा भाग अप्रैल-मई में तथा दूसरा आधा भाग सितम्बर – अक्टूबर के दौरान डालना चाहिए । रोपण पश्चात जमीन में पौध स्थापित होने के शुरुआती वर्षों में नियत अंतराल पर सिंचाई करते रहना चाहिए । वृद्धि प्राप्त परिपक्व वृक्ष में आवश्यकतानुसार सिंचाई की जानी चाहिए । गर्मियों में 15 दिन तथा शरद ऋतु में एक माह के अंतराल पर सिंचाई करना चाहिए । सिंचाई करते समय पौधों के चारों और बने थालों को पानी से पूर्ण रूप से संतृप्त करना चाहिए । जब वृक्ष फल देना शुरु कर देते हैं तो शुरुआती वर्षों फल एकत्रीकरण के बाद कमजोर, बीमार, मृत एवं आड़ी – तिरछी शाखाओं को काटकर अलग कर देना चाहिए । पौधे को वांछित आकार देने के लिए जब पौधा 75 से.मी. से 1 मी. ऊंचाई का हो जाये तो प्रथम दो मुख्य पार्श्व शाखाओं को बढ़ने देना चाहिए तत्पश्चात ऐसी 5-6 पार्श्व शाखाओं को अलग-अलग दिशाओं में जो एक दूसरे से विस्तृत कोण बनाती हों मुख्य तने पर बढ़ने देना चाहिए । इस तरह पौधे की कटाई-छंटाई करने से वांछित उँचाई एवं छत्रक वाला परिपक्व वृक्ष प्राप्त हो जाता है ।

पौधों की सुरक्षा

1. आंवले के छोटे-छोटे पौधों को पाले से बचाने के लिए, पाला पड़ते समय टाट की पट्टियों से ढंक देना चाहिए ।
2. रोपण के पश्चात पौधों की उचित वृद्धि के लिये दो से तीन वर्ष तक पौधों की विशेष देखभाल की आवश्यकता होती है । अतः पौधों के चारों तरफ 1 मी. व्यास का थाला पूर्णतः बना रहना चाहिए ।
3. छाल बोरर द्वारा बनाये छिद्र को सितम्बर – अक्टूबर एवं फरवरी-मार्च के दौरान छिद्र में मिट्टी का तेल डालकर रूई व काली मिट्टी से

बने प्लग से बन्द कर देते हैं तथा फास्फोमिडान के 0.03 प्रतिशत घोल का छिड़काव कर देते हैं।

4. गाल मेकर को नियंत्रित करने के लिए प्रभावित शाखा को काटकर अलग कर देते हैं तथा मोनोक्रोटोफास के 0.1 प्रतिशत घोल का छिड़काव कर देते हैं।
5. आंवला रस्ट को डायथेन Z -78 या डायथेन M -45 के 0.2 प्रतिशत घोल का छिड़काव कर नियंत्रित करते हैं।
6. ब्लू मोल्ड द्वारा फलों पर बनने वाले नीले-हरे धब्बे को बोरेक्स या सोडियम क्लोड़ाइड के जलीय घोल का छिड़काव कर नियंत्रित करते हैं।
7. पौधों को दीमक से बचाने के लिये जुलाई के प्रथम सप्ताह तथा फरवरी के प्रथम सप्ताह में एन्डोसल्फान का 0.07 प्रतिशत का छिड़काव करना चाहिये।
8. पानी की कम सिंचाई करने पर दीमक लगने की संभावना अधिक होती है।
9. कोमल पत्तियों को टिड्डों तथा इल्लियों से बचाने के लिए पौधों पर मेलाथियान का 0.02 प्रतिशत का छिड़काव करना चाहिए।
10. साही चूहा (घूस) तथा जंगली सुअर से जड़ों को नुकसान न पहुंचे इसके लिए 10 ग्राम फोरेट प्रति पौधे की दर से डालना चाहिए।
11. पौधों की पशुओं से रक्षा हेतु ट्री ग्रार्ड या रोपण स्थल के चारों तरफ कंटीले तारो से फेंसिंग कर देना चाहिए।

दोहन एवं उत्पादन

बीजों से प्राप्त वृक्षों में फल 10 से 12 वर्षों के बाद आना शुरु होते हैं जबकि बडिंग या ग्राफ्टिंग से प्राप्त वृक्षों में 5 या 6 वर्ष बाद ही फल लगना शुरु हो जाते हैं। फलों का औसत उत्पादन लगभग 150 किलोग्राम/ वृक्ष/वर्ष होता है।

उपसंहार

आंवला प्राचीनकाल से औषधियों के रूप में उपयोग किया जा रहा है। आंवले का धार्मिक एवं आध्यात्मिक दृष्टि से महत्वपूर्ण स्थान है। कार्तिक माह में आंवला नवमी के पर्व पर महिलाऐं आंवला वृक्ष की पूजा-अर्चना करके वृक्ष की छांव में बैठकर भोजन करती हैं। ऐसा माना जाता है कि इस दिन आंवला वृक्ष के नीचे बैठकर भोजन करने से घर में सुख-शांति एवं लक्ष्मी का वास रहता है। आंवले के फल, पत्तियाँ, जड़ एवं बीज सभी औषधीय गुणों से परिपूर्ण है। इसके संरक्षण एवं संवर्धन के लिये हम सभी को प्रयास करना चाहिए । दशकों से डाबर, झंडू, ऊंझा, धूतपापेश्वर, हिमालया, वैद्यनाथ आदि फर्मास्युटिकल फर्मों द्वारा च्यवनप्रास एवं अन्य औषधियों के लिए कच्चा एवं पका आंवला खरीदा जाता रहा है। ग्रामीण जन ज्यादा फल एकत्रित करने के लालच में शाखाओं को ही वृक्ष से काट देते हैं। वन विभाग, स्वयं सेवी संस्थाओं एवं वन सुरक्षा समितियों को चाहिए कि वे ग्रामीण जनता के बीच जाकर संगोष्ठियों का आयोजन करें एवं आंवले के गुण एवं उपयोगों का महत्व बताकर आंवले के फल एकत्रीकरण एवं पौध रोपण का प्रशिक्षण दें जिससे इस बहुमूल्य वृक्ष का वनों, खेतों एवं बाग-बगीचों में संरक्षण एवं संवर्धन किया जा सके।

Know your biodiversity

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Taxus baccata

Taxus baccata is valuable for extraction of 'taxol' which is used in preparation of anti-cancer drugs. It belongs to family Taxaceae and order Pinales. It is native to western, central and southern Europe, north-west Africa, northern Iran and south-west Asia. The generic name '*Taxus'* is derived either from Greek word 'Taxon' (Bow) or Persian word Tachs (bow). A mummy from the Chalcolithic age, around 4000 BC, was found with an unfinished bow made form this plant. It is commonly known as Yew, English Yew and European Yew.

It is evergreen tree grows up to 25 m. Branches spreading. Bark is major source of 'taxol'. Leaves linear flat, acute, rusty yellow beneath. Male flowers with a stalked whorl of 3-8 anthers on a palate disc. Female flowers with a solitary ovule on a cup shaped disc. Fruits (arils) are fleshy cup like structure bright red in colour when ripe. Seeds black. Flowering and fruiting time is March –July.

Yew is often found near Churchyards and temples because of religious sentiments of people. It releases gaseous toxins (taxine) in the summers, which is capable of causing hallucinations. Wood of *Taxus baccata* is classified as softwood and hardest among the softwoods. Wood posseses remarkable elasticity hence in older time used for making bows. It is also used string musical instruments e.g violin, guitar because of its quality of sound and beauty. In India local people use bark as tea substitute. Wood is also used for making furniture and high demand in market for decorative value. Geeen twigs are used to decorate houses in religious festivals. Due to its dense, dark green, mature foliage it is also used in landscaping.

In Ayurveda, bark and leaves are used in the treatment of fever associated with cold, oedema and rheumatism. In Homoeopathy shoots and berries are used in treating headache, rheumatism, disease related to Kidney. The young twigs contain active principle called 'Taxol' which is accredited as a potential anti cancer drug. It is effective in treatment of ovarian, skin, breast, kaposi's sarcoma (AIDS related cancer) and colon cancer. All the parts of this plant is toxic and poisonous except the fruit pulp known as arils which is generally eaten by birds. Seeds should not be eaten because of the presence of poisonous alkaloids.

It is known to be tolerant to shade, high temperature and low moisture stress but because of unsustainable exploitation and fragmentation it showing widespread decline in population. This plant is categorized as rare, endangered and listed

in Appendix II of Convention on International Trade in Endangered Species of wild Fauna and Flora (CITES). Hence formulation of suitable strategies for the conservation and sustainable utilization is needed to save this valuable tree.

Myophonus caeruleus

Myophonus caeruleus is commonly known as Himalayan Whistling-Thrush or Blue Whistling-Thrush. It belongs to family Muscicapidae and order Passeriformes. It is known for its loud human-like whistling song at dawn and dusk. Its distribution is in Himalaya and extending into Southeast Asian countries. In India it is found in temperate, subtopical and tropical moist montane forest. It is particularly fond of such as run through deep rocky gorges with abrupt moss-covered banks overgrown with ferns and other vegetations and with large boulders lying helter-skelter in wild confusion. It is least concern in IUCN Red list category.

It is a blue-black or dark violet blue bird with brighter blue wings and tail. It is generally seen singly on rocks and dense forest in Himalayan regions. Inner webs of the flight and tail feathers are black. In good light it appears spotted all over which glistering blue. It has strong black legs and stout yellow bill. Both the sexes are similar in appearance. It makes altitudinal movements in Himalaya and moves down in the winter.

The breeding season is April -August and frequently two successive broods are raised. It lays 3-5 eggs at a time which is pale clay in colour sometimes pinkish or with buff tinge, sparsely and faintly covered all over with pale reddish freckles, spots and blotches. Both the sex takes part in building the nest, incubation and care of young one.

The Blue whistling-Thrush is found singly or in pairs. It generally flies from one part of the stream to another and it hops from one stone to stone. It feeds upon the aquatic insects, snails, earthworms, crabs and wild fruits. Sometimes it digs wet mud banks for food. The nest is strongly built cup of moss, lichens with a copious admixture of mud, lined with moss or fern roots. It is placed on a ledge of rock near or overhanging a mountain stream. But sometimes it is built on a ledge inside a natural cave or within a house, bungalow or outhouse.

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