# Indian Farmer

ISSN 2394-

A Monthly Magazine

Volume– 6 | Issue—1 | January - 2019 | Pages - 107

## Artificial Insemination in Equines

www.indianfarmer.net

# INDIAN FARMER

A Monthly Magazine

Volume: 6, Issue-1 January-2019

# Bio-pesticides: Safe and Ecofriendly alternatives

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## ABSTRACT

Injudicious use of chemical pesticides in agriculture has resulted in several adverse effects. The pesticide consumption in India has increased and with the growing awareness of public concern to the harmful effects of chemio-pesticides on human health and environment. The search for more safer, sustainable, and eco-friendly control alternatives i.e. Bio-pesticides became an urgent need for researchers and scientists worldwide Botanical pesticides and bio-control agents offer immense scope in the future. Bio-pesticides (also known as biological pesticides) are pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals. For example, canola oil and baking soda have pesticidal applications and are considered bio-pesticides. . These pesticides are very effective in the agricultural pest control without causing serious harm to ecological chain or worsening environmental pollution. The use of commercial pesticides kill, not only the target insect pests, but also beneficial insects like spiders, grasshoppers and others. Besides this, it leaves residues in the plant where it is sprayed, and is harmful to the person spraying. If inhaled, pesticides can cause cancer in the long run.

## INTRODUCTION

A substance used for destroying insects or other organisms harmful to cultivated plants or to animals pesticides. Though there can be benefits using pesticides, inappropriate use can counter productively increase pest resistance and kill the natural enemies of pests. Many users are inadequately informed about potential short and long-term risks, and the necessary precautions in the correct application of such toxic chemicals are not always made. Pesticides can contaminate unintended land and water when they are sprayed aerially or allowed to run off fields, or when they escape from production sites and storage tanks or are inappropriately discarded. Natural occurrence of diseases caused by micro-organisms is common in both insects and weeds and is a major natural mortality factor in most situations. Use of micro-organisms for pest control involves their culture in artificial media and later introduction of larger amounts of inoculums in to the field at appropriate time. Many fungi and bacteria can be handled in this way but

insect viruses have the limitation that they have to be raised in living insects. As the bio control agents (microbial pathogens) are applied on the targeted pests in much the same way as chemical pesticides, they are often termed as bio-pesticides or natural pesticides. Bio-pesticides are made of living things, come from living things, or they are found in nature. They tend to pose fewer risks than conventional chemicals. Very small quantities can be effective and they tend to break down more quickly, which means less pollution.Thesec pesticides are certain types of pesticides that are derived from natural materials like plants (Botanical origin ), bacteria, fungi and virus (Microbial origin) and certain minerals. When used as a component of Integrated Pest Management (IPM) programs these bio-pesticides can greatly decrease the use of conventional pesticides, while crop yields remain high. The Bio-pesticides control pests / diseases either selectively or with broad spectrum approach. Bio-pesticides are usually inherently less toxic than conventional pesticides. Bio-pesticides are generally target specific and affect only the target pest and closely related organisms vis-à-vis broad spectrum, conventional pesticides that may also affect organisms such as birds, insects and mammalsThese pesticides are those biological agents that are used for control of weeds, insects and pathogens.The micro-organisms used as bio-pesticides are viruses, bacteria, protozoa, fungi and mites. Some of the bio-pesticides are being used on a commercial scale. Most important example is the soil bacterium, *Bacillus thuringiensis* (Bt). Spores of this bacterium possess the insecticidal Cry protein. Therefore, spores of this bacterium kill larvae of certain insects. The commercial preparations of B. thuringiensis contain a mixture of spores, Cry protein and an inert carrier. This bacterium was the first bio-pesticide to be used on a commercial scale in the world, and is the first bio-pesticide being produced on a commercial scale in India.

## TYPES OF BIO-PESTICIDES

1. **Microbial pesticides**

Microbial pesticides consist of a microorganism (e.g., a bacterium, fungus, virus or protozoan) as the active ingredient. Microbial pesticides can control many different kinds of pests, although each separate active ingredient is relatively specific for its target pest[s]. For example, there are fungi that control certain weeds and other fungi that kill specific insects. The most widely used microbial pesticides are subspecies and strains of *Bacillus thuringiensis*, or Bt. Each strain of this bacterium produces a different mix of proteins and specifically kills one or a few related species of insect larvae. While some Bt ingredients control moth larvae found on plants, other Bt ingredients are specific for larvae of flies and mosquitoes. The target insect species are determined by whether the particular Bt produces a protein that can bind to a larval gut receptor, thereby causing the insect larvae to starve.

**2. Plant-Incorporated-Protectants**

(PIPs) are pesticidal substances that plants produce from genetic material thathas been added to the plant. For example, scientists can take the gene for the Bt pesticidal protein, and introduce the gene into the plant's own genetic material. Then the plant,

instead of the Bt bacterium, manufactures the substance that destroys the pest. The protein and its genetic material, but not the plant itself, are regulated by EPA.

**3. Biochemical**

Biochemical pesticides are naturally occurring substances that control pests by non-toxic mechanisms. Conventional pesticides, by contrast, are generally synthetic materials that directly kill or inactivate the pest. Biochemical pesticides include substances that interfere with mating, such as insect sex pheromones, as well as various scented plant extracts that attract insect pests to traps. Because it is sometimes difficult to determine whether a substance meets the criteria for classification as a biochemical pesticide, EPA has established a special committee to make such decisions.

## ADVANTAGES OF BIO-PESTICIDES

- Bio-pesticides are usually inherently less toxic than conventional pesticides.
- Bio-pesticides generally affect only the target pest and closely related organisms, in contrast to broad spectrum, conventional pesticides that may affect organisms as different as birds, insects, and mammals
- Bio-pesticides often are effective in very small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems caused by conventional pesticides.
- When used as a component of Integrated Pest Management (IPM) programs, bio-pesticides can greatly decrease theuse of conventional pesticides, while crop yields remain high.
- To use bio-pesticides effectively, however, users need to know a great deal about managing pest

## DISADVANTAGES OR LIMITATION:

- High selectivity or host specificity
- Requirement of additional control measures.
- The correct time of application.
- Delayed effect or mortality.
- Storage problem.
- Difficulty of culturing in large quantities.
- Short residual effectiveness.

## RECENT ADVANCEMENTS AND FUTURE PROSPECTS

Biopesticide is a promising alternative to chemical pesticide. Biopesticides can replace at least in part some of the hazardous chemical pesticides when incorporated into ICM practices. Although potential of biopesticides for promoting sustainable agriculture has been known for years, their demands have increased now in view of the organic farming to produce safe and healthy food. Pest management in an ecofriendly manner is no longer a dream now. The tools and techniques of molecular biology and biotechnology facilitate producing biopesticides in crop plants itself in a safe and sustainable manner . In addition to the continuous search for new biomolecules and improving efficiency of

the known biopesticides, recombinant DNA technology is also being used for enhancing efficacy of biopesticides . Better understanding of genes from microorganisms and crop plants has enabled isolation of genes effective against particular pest, and they are being deployed to control insect pests and diseases. Fusion proteins are also being designed to develop next-generation biopesticides. This technology allows selected toxins (not toxic to higher animals) to be combined with a carrier protein which makes them toxic to insect pests when consumed orally, while they were effective only when injected into a prey by a predator . Several other innovative approaches are being applied to develop biopesticides as effective, efficient and acceptable pest control measure.

## CONCLUSION

Biopesticide is a potential tool to be utilized for environmental safety. More rational approaches would be required to popularize biopesticide as one of the important inputs for safe and sustainable agriculture. Training on production and quality control to manufacturers, organizational training to extension workers and farmers to popularize biopesticides would be essential for better adoption of biopesticides. As environmental safety is a global issue, we need to create awareness among the common men to switch-over to biopesticides for their pest management requirements. Biopesticides are expected to provide predictable performance, and they must do so in an economically viable manner for their better acceptability and adaptability. To be readily acceptable by the end users, biopesticides must be efficient enough in controlling the targeted pests. Deployed properly, biopesticides have tremendous potential to bring sustainability to agriculture and environmental safety. Development of bio pesticides industry has to be treated as a strategic, comprehensive and forward-looking task. The ongoing population and the growing need of the population need more supply of the crops and other products. The increasing concern of consumers and government on food safety has led growers to explore new environmentally friendly methods to replace, or at least supplement, the current chemical-based practices. The use of bio-pesticides has emerged as promising alternative to chemical pesticides. Bio pesticides have a precious role to play in the future of the Integrated Pest Management strategies.

# Coloured vegetables: Eating a rainbow

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Vegetables are generally contain little fat, cholesterol or sodium and provide complex carbohydrates, fibre and nutrients. Most are low in calories and they contain natural sugar, as opposed to refined sugar, which can cause abrupt fluctuations in your blood sugar level. Different colours indicate different nutrient profiles, so focus on getting a little of each colour in your diet every day to maximize the nutritional benefits.

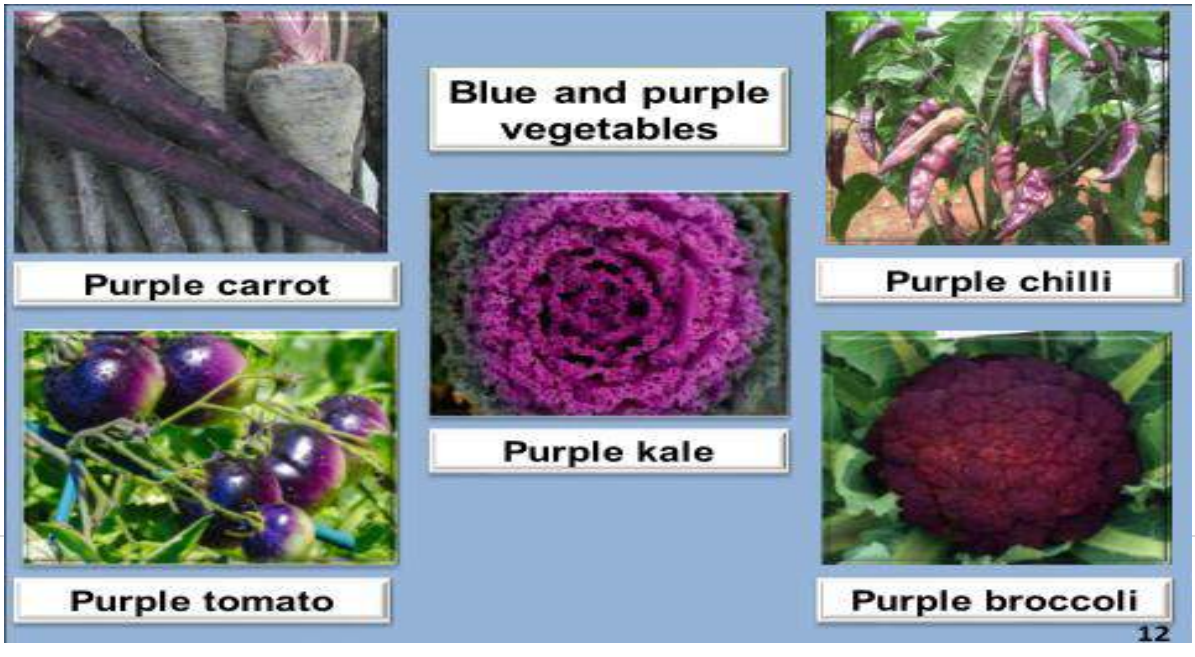
**Table 1: Groups of coloured vegetable crops**

| Colours | Vegetables |
|---|---|
| Green | Artichoke, Asparagus, Broccoli, Chinese cabbage, Green onion , Cucumber, Squash |
| White | Cauliflower, Garlic, Onion, Turnip, White corn |
| Red | Beetroot, Radish, Tomato, Watermelon, Bell pepper red |
| Yellow/orange | Pumpkin, Yellow tomato, Butternut squash, Sweet potato |
| Blue/purple | Egg plant, purple carrot, Purple cabbage, Purple chilli |

(Singh, 2012)

## BLUE AND PURPLE VEGETABLES

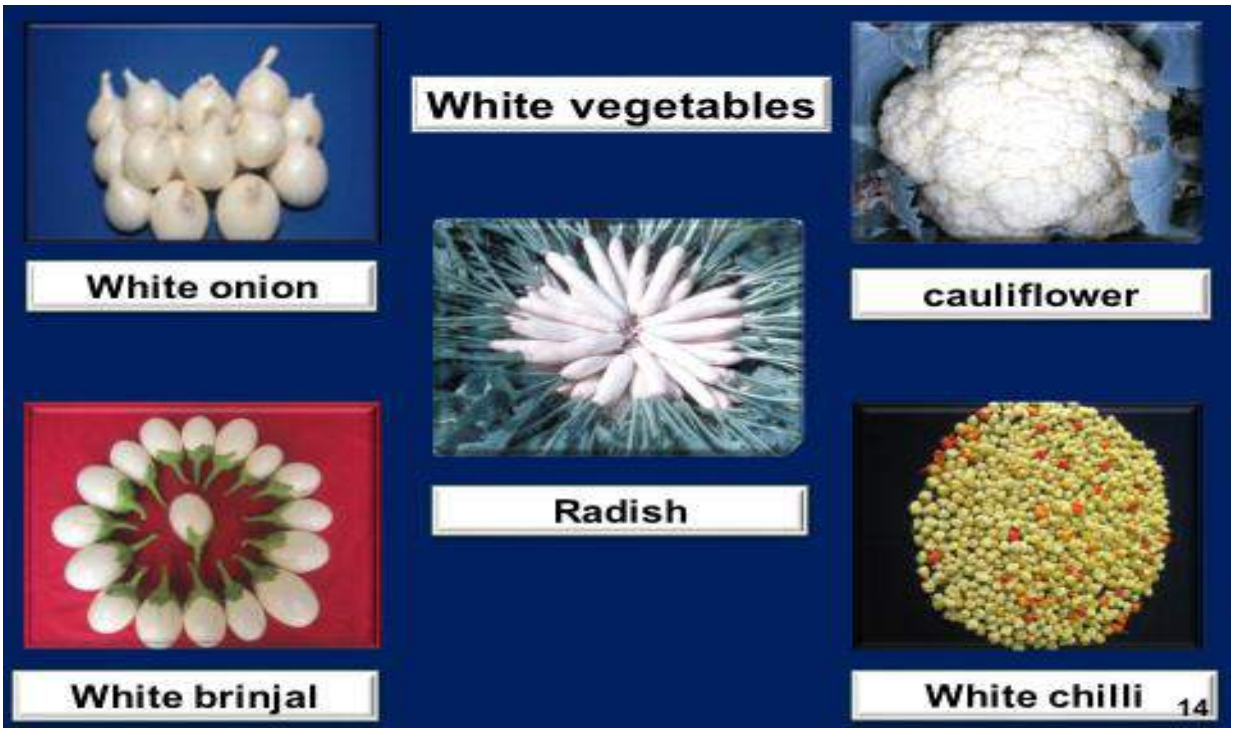
The various vegetables, like egg plant, purple carrot, purple chilli etc rich source of



phytonutrients known as anthocyanins (which is a flavonoid). These phytonutrients are effective in the control of obesity. This group also contains carotenoids, vitamin-c, fibre, ellagic acid and improves the calcium absorption. All these are antioxidants and anti-cancer agents.

## WHITE VEGETABLES

White vegetables are important source of key nutrients (especially fibre, potassium and




magnesium), Beta glucans, epigallocatechin gallate, quercetin, lignin and other micro constituents. The health benefits of white colour foods should not be underestimated and can increase shortfall of nutrients in our diet. These vegetables help to lower the blood pressure, maintain the good heart health and activate natural killer B and T lymphocytes.

## Red vegetables

The red colour in vegetables are due to the presence of lycopene, which belongs to the carotenoids group. These vegetables found reduce the risk of cancers of the prostate, pancreas and to a certain extent, of the stomach and also protect against oxidation damage, especially due to ultraviolet light exposure and tobacco smoke.

Examples; Tomatoes, carrot, Beet, Amaranthus etc

## ORANGE AND YELLOW VEGETABLES

Orange and yellow vegetables get their colour from lutein and zeaxanthin, carotenoids. These also contain antioxidants like vitamin-A and C. Yellow peppers, pumpkin etc have good quantities of these beneficial substances. These vegetables helps to reduce age related macular degeneration and helps in promote collagen formation.

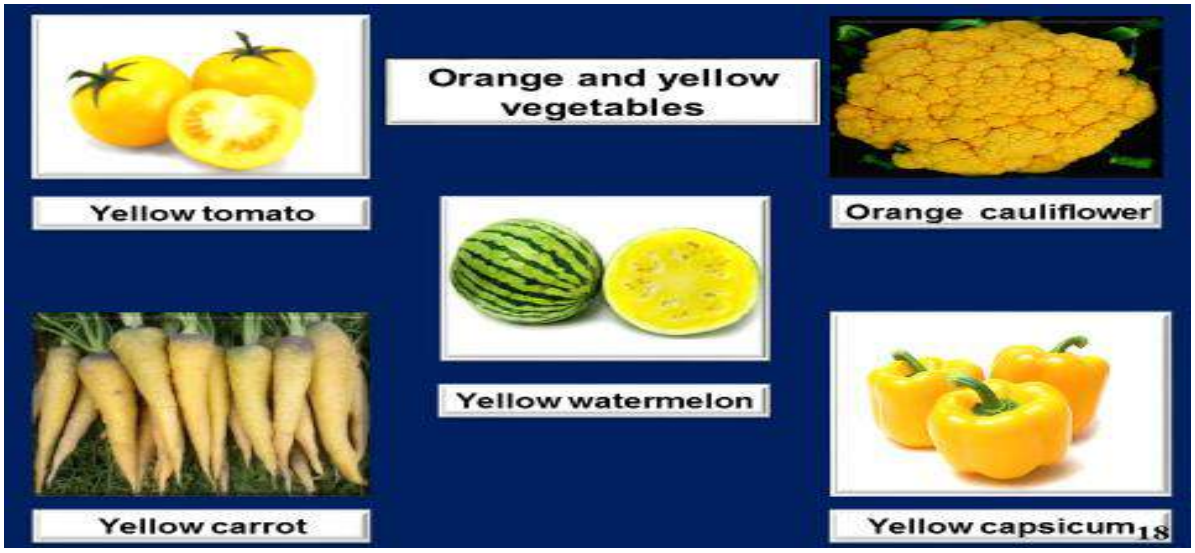




**Table 2: Nutritionally rich vegetable varieties**

| Crops | Nutritional quality | Varieties |
|---|---|---|
| Tomato | Vitamin - C | CO 3 |
| Muskmelon | Vitamin - C | Arka Jeet |
| Carrot | High β carotene | Pusa Kesar, Pusa Meghali |
| Pumpkin | High carotene | Arka Chandan, Jammu Special |
| Onion | Quercetin | Arka Pitambar |
| Tomato | High carotene | Caro-Rich, Caro-Red |
| Cauliflower | B-carotene | Pusa Beta Kesari 1 |
| Potato | B-carotene | Bhu Sona |
| Sweet potato | Anthocyanin | Bhu Krishna |

## CONCLUSIONS

- Great opportunity and scope to breeders
- Rich source of nutraceuticals and their edible colours
- Sustain fresh market and nutraceutical industry
- Nutritional Security to the growing population
- Exploitation of various nutritionally rich underexploited vegetables

# Needs of doubling farmer's income

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The per capita income of those involved in agriculture is almost one third of an average Indian. Further, within the agriculture sector, the inequitable distribution of landholdings (85 per cent of small farmers/marginal farmers cultivating in 45 per cent of area) makes the small and marginal farms the poverty hotspot of the country. Hence, every effort to inclusive growth has to address the income enhancement in agriculture and those weak, within the sector. The Government of India announcement of doubling farmers' income by 2022, having a direct impact on almost half of the population, comes as an endorsement of the above strategy, aiming for a sense of income security to farmers in a time bound manner.

## WHY DOUBLE FARMERS' INCOME?

- Past strategy for development of the agriculture sector in India has focused primarily on raising agricultural output and improving food security.
- The net result has been a 45 per cent increase in per person food production, which has made India not only food self-sufficient at aggregate level, but also a net food exporting country.
- The strategy did not explicitly recognize the need to raise farmers' income and did not mention any direct measure to promote farmers welfare.
- The net result has been that farmers income remained low, which is evident from the incidence of poverty among farm households.
- Doubling real income of farmers till 2022-23 over the base year of 2015-16, requires annual growth of 10.41 per cent in farmer's income. This implies that the on-going and previously achieved rate of growth in farm income has to be sharply accelerated. Therefore, strong measures will be needed to harness all possible sources of growth in farmers' income within as well as outside agriculture sector.

## WHAT IS THE GREATEST CHALLENGE OF INDIAN AGRICULTURE TODAY?

There are two major challenges before Indian agriculture today

**Ecological challenges**

- The conservation of our basic agricultural assets such as land, water, and biodiversity is a major challenge.
- How to make agriculture sustainable is the challenge.
- Increasing productivity in perpetuity without ecological harm is the need of the hour.
- In Punjab, and in other Green Revolution States, the water table has gone down and become saline.
- The growing population pressure

**Economical challenges**

- Need to devise ways to lower the cost of production and reduce the risks involved in agriculture such as pests, pathogens, and weeds.
- The expected return in agriculture is adverse to farmers. That's why they are unable to repay loans.
- Addressing the ecological challenge requires more technology while the economics requires more public policy interventions.
- Raise the current MSP (minimum support price).

**What are the ways to improve the incomes of farmers?**

**Existing issue**

- All kinds of excuses have been given by governments for not implementing these recommendations like food price inflation. Farm loan waivers are posing a bigger burden on the government exchequer compared to what higher pay for farm produce will incur. At the same time Government has a goal of doubling the farmer's income by 2022.
- Implementation of Swaminathan Commission Report is important to achieve to improve farmers income.
- Recommendation of MS Swaminathan's Report

**1. Irrigation**

Enables farmers to have sustained and equitable access to water
Increase water supply through rainwater harvesting and recharge of the aquifer. ("Million Wells Recharge" programme)

**2. Agricultural productivity**

Substantial increase in public investment in agriculture related infrastructure particularly in irrigation, drainage, land development, water conservation, research development and road connectivity.

A national network of advanced soil testing laboratories with facilities for detection of micronutrient deficiencies.

### 3. Credit and insurance

Expand the outreach of the formal credit system to reach the really poor and needy.

## CONCLUSION

Farmer incomes are protected through the Minimum Support Prices (MSPs) announced for a variety of crops every year. Thus, research, extension and introduction of high-yielding variety seeds, better fertilizers and focus on mechanization is necessary for over all development if agriculture.

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# Hydroponics: A new frontier towards sustainable agriculture

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## ABSTRACT

Hydroponics, soilless culture, is a new frontier in agriculture and it is a very much effective technique to sustain production vis-à-vis quality of the crops. This system has various advantages over conventional crop production system such as it provides much higher yield per unit area; utilizes better space; manages water and nutrient more efficiently; reduces incidences of pests and diseases; provides better quality of produced crop yield and it is eco-friendly in nature. Owing to having these advantages, this technique now-a-day becomes very popular to the resourceful farmers. The major concern of hydroponics is the requirement of high establishment cost. But this is ultimately replenished due to higher yield with superior quality of the produce. So, under changing climate and depleting natural resources, this system can be a viable option for the agrarian community to combat these problems and thus the system will be sustainable.

**Key words:** Hydroponics, Sustainable production, Yield and Quality

## INTRODUCTION

Hydroponics, soilless culture where plants are grown in nutrient solution instead of soil with the anchorage provided by any inert media like gravels, sawdust, etc., means working of the water literally i.e., water works for the growth and development of plant. Roots of the plants are dipped either in the continuous flowing nutrient solution or static nutrient culture solution. The idea of growing plants without soil began with the experiment for the identification of essential elements of plants made by two German scientists, Sachs (1860) and Knop (1861). Later in the early 1930s, W.F. Gericke of the University of California put laboratory experiments in plant nutrition on commercial scale and termed these nutria-culture systems as hydroponics (Resh, 2004). This marked the beginning of commercialization of hydroponics. Further with the ingress of plastic revolution of 1960s, its applicability among growers accelerated, making it a viable and economic system. Under normal conditions, it takes 800-1000 years to form one cm soil. Also with the total land area of 14.4 billion ha of which the land presently devoted to agriculture is 11% (1.5 billion ha), it seems quite impossible to feed the growing population of 7.5 billion (Bruinsma, 2003). With the commencement of industrialization and urbanization, the agricultural land is being shrinking with a rapid

pace. This slow rate of soil formation and the faster rate of soil depletion due to over farming and other faulty practices, there is a need for a technology which produces more food in less space. From ages, human always have been searching for the idea of betterment and ease of living. Hydroponics is one of the ideas which can be used to grow more food in less space and without exhausting the quality of the land. It helps in eliminating the problems that comes in soil based farming such as poor fertility of soil, non-availability of arable land, soil borne diseases, etc.

Hydroponics has many advantages over conventional farming as it is fully controlled and automated system. But the most advantageous feature of the system is its high yield per unit land. Also it is a soilless system, so does not depend on the availability of fertile land for the crop production. Considering the disadvantages of the system, it has high initial investment as compared to the traditional farming. Also regular monitoring and extra-care is required due to the sophistication of the system, a high degree of management skills are needed for successful production. Not going into the details of cultivation practices and methods used in hydroponics, this article will only be focusing on the advantages and the factual aspects of it.

## MULTIFARIOUS ADVANTAGES OF HYDROPONICS

Soilless cultivation is an advantageous technique in agriculture due to its various benefits. Some of the key advantages are as follows:

- High yield per unit land
- Utilizes better space
- Efficient water and nutrient management
- Reduced incidences of pests and diseases
- No need for weed control
- Better quality of yield produced
- Eco-friendly

## SCIENTIFIC BASIS BEHIND SUCH MIRACLES OF HYDROPONICS

Hydroponics allows growers to cultivate plants in the most controlled and automated system so they provide the most ideal conditions for the plant. However, the most attractive incentive for the farmer to switch from the soil based farming to the hydroponics is its yield advantage. The productivity of the plant increases many folds in soilless culture due to the fact that the nutrient which is needed by the plants is readily available as and when required in the water solution. In contrast, in soil based system much of the energy of the plant is used in drawing the nutrient from the soil solution. Thus, hydroponically grown plants are able to explore its full yield potential. Maximum density crop yield is obtained due to the fact that the period between the harvest of one crop and the sowing of next crop is cut short because of the elimination of land preparation step and thus, increasing the total cultivation time for the crop growth (Savvs, 2003). The time needed for the sterilization of soil take more time than sterilization of containers and nutrient solution. Time is saved as the next crop for planting can be performed 24 hours after sterilization. Hydroponically grown crops

grow 50% faster than the soil based crops leads to the early onset of the harvest and ultimately more cycles of the crop are taken in a year. As the system is automated and controlled the crop will not be season bounded i.e., yield will be obtained round the year. Suitable farmland on this earth is limited. Moreover there is an annual loss of 10 million ha of arable land. Traditional farming require a lot of space for the crop production but the commercial hydroponics tends to consume only $1/5^{th}$ of the land needed for the same amount of plants being cultivated on the farmland. The space is saved by adjusting the spatial arrangement of the structures used in the hydroponic system so that plants occupy lesser horizontal space. Hydroponic system comes in different designs including the vertical stacking system that take up very small amount of space. Vertical hydroponic system can be used in both indoor as well as outdoor gardening. The structure is designed in such a way that plants could be grown on different stacked levels. Now-a-days it is gaining popularity in the urban areas where there is not enough ground to fulfill the planting needs of the people. Urban agriculture and zero acreage farming are also related with the same system (Thomaier *et al*., 2014). As the soil is replaced by sterilized nutrient medium, the entry of soil-borne pathogens is downsized. Also with the closed monitoring and controlled system, it is easy to detect the surrounding variables and manage them. Sterilization of the planting material and the containers is quite easy, fast and inexpensive compared to the soil based cultivation. One of the most distinguished feature distinguishing soil cultivation from soilless culture is morphological plant development is absence of root hairs in cultivated plants. The total amount of root surface area and root volume is greatly reduced compared to that in soil culture. Moreover a root depth of 18-20 cm is usually sufficient in hydroponics but a greater root depth is required under soil conditions (Schwarz, 1995). So with fewer roots, most of them are active and therefore more resistance against the pathogens.

One of the most important advantages of the hydroponic system is that it eases the strains on the environment. It can be set up to recycle nutrient and water, greatly reducing the resources necessary to grow food. Plants grown hydroponically can use only 10% of water compared to the field grown ones as water is recycled in this technique. Plants take up only necessary water, while run-off ones will be captured and return to the system. Many experiments conducted for the nutrient and water recycling in a closed hydroponic system shows that there is 42% less water consumption , almost half of the nutrient consumption and total of 36 % cost is being saved (Christie, 2014). Aquaponics is the new way which is helpful in recycling of the resources as well as generating good net returns. It is the combination of aquaculture and hydroponics. It is an integrated system where the waste of one acts as a substrate for the other. Fish tank and the growing beds for the plants are interconnected to supply the water. The excreta of the fish rich in nitrogen goes to the growing beds for nutrient supply and in return, plants and some microbes clean up the water goes to the fish tank. This provide a mutually benefit environment for both the crop and the fish. Thus, recycled water and nutrient saves the energy, yielding two crops; fish and plants simultaneously (https://www.cropking.com /catalog/ aquaculture-and-aquaponics).

## SEVERAL ENVIRONMENTAL BENEFITS OF HYDROPONICS SYSTEM OVER THE CONVENTIONAL FARMING

Conventional farming with injudicious use of resources often disrupts the ecological system. Heavy use of pesticides and fertilizers pollutes the land causing harmful effects on the crops. When these chemicals along with the runoff water reaches to the water bodies it further leads to the formation of algal bloom and accelerate the process of eutrophication, threatening the aquatic life. This accounts for the increased nitrate level and presence of heavy metals in the drinking water making it not suitable for consumption. Some of the key benefits are as follows:

- Soilless media provides less opportunity for weeds and pathogen to invade the system cutting down the use of herbicides and pesticides to a great extent.
- Lesser amount of fertilizers required due to high efficacy of the system.
- No fertilizer losses occur due to leaching, runoff or fixation in the clay minerals results in less soil and water pollution.
- As the toxic agrochemicals are not used in the system, the crop produced hydroponically is healthier and free from chemicals such pesticides and insecticides which causes cancer and other health related problems.
- Soil erodibility is reduced due to the elimination of land preparation and tillage practices.
- Reduction of the gases harmful to the atmosphere emitted from the farm machinery used for the land preparation, planting, harvesting and also reducing the need of long distance transport by trucks for its dispose as it is cultivated and harvested in the place where it is going to be consumed.

## SPECIAL UTILITY OF HYDROPONICS ON NON ARABLE LANDS

Hydroponics is now becoming apparent invading the various dimensions of gardening. The use of hydroponics widens the range of growing the plants in the barren and arid lands of the world. The cultivation of crops can also be possible in the places where the water is scarce or water is not fit for irrigation (saline water) because the nutrient solution used in hydroponics can be adjusted and constantly replaced. The use of hydroponics in the non arable lands was first explored during the world war. The scarcity of food for the U.S. troops in the non arable rocky islands in the pacific was solved by providing its personnel with fresh vegetables grown by practicing hydroponics on large scale in that island which was normally incapable of producing such crops (Resh, 2004). In Tokyo, the land is extremely valuable with the surging population. To feed the population while preserving the valuable land mass, the country has turned to the hydroponic rice cultivation. Rice is grown in the underground vaults without the soil. With perfectly controlled environment, four cycles of harvest is taken annually in contrast to the traditional single harvest per year. Hydroponics also has been successfully used in Israel despite of having arid and dry climate.

It seems more advantageous when we talk about colonization in the space, i.e., mars or moon. As we haven't yet found the soil in the space which supports the normal growth of the plants and hence hydroponics is the only possible option left for the

cultivation of crops outside the earth. It has an important place in the various space programs. NASA has also been working on growing plants hydroponically in space. The purpose of this project is to supplement food to the astronauts far from the earth. It also helps in cleansing the air by releasing oxygen and capturing carbon dioxide from the space craft through plants natural processes (Sardare and Admane, 2013).

## CONCLUSION

Hydroponics, the soil less culture, is one of the best techniques for augmenting yield with superior quality without deteriorating the natural resources. Owing to having many advantages over conventional farming, it can be very much beneficial for the resourceful progressive agrarian community. The major concern of this technique is that it demands high establishment cost at the beginning which is replenished afterwards. So, in the context of climate change and depleting natural resources particularly soil and water under ever shrinking land resources due to urbanization and industrialization pressure, hydroponics can be a viable option to the farmers.

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# Nanopesticides: Its Scope and Utility in Pest Management

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**Abstract**

Pesticides have become one of the inevitable parts in Indian agriculture. The higher dosage of these chemicals on per hectare basis has led to many environmental and health hazards. The development of a new scientific area, nanotechnology has led to the development of nanopesticides. These chemicals contain the carrier molecule or the active ingredient in nano size. Several formulations viz., nanoemulsions, nanosuspensions, controlled release formulations, solid based nanopesticides have been developed by the research community. The smaller size of the chemicals helps in proper spreading on the pest surface and thus, a better action than conventional pesticides. Meanwhile, we should have a better understanding on the ill effects of these nano-pesticides after their application.

***Keywords***: *Active Ingredient, Carrier molecule, Controlled release, Nanoparticles*

The importance of pesticides has been increasing over the last few decades driven by the need to improve overall agricultural productivity, in order to safeguard adequate food availability and sufficiency for the growing global population. Every year in India pests and diseases eat away on an average 15- 25% of food produce. Past three financial years (FY14-16) have been a challenging year for crop protection chemicals market in India as well as throughout the world. As per Economic Survey of India, agriculture sector has grown by 4.1% in FY17. In order to offset the growing demand for food grains either the area under the production should be increased or productivity of the existing land should be improved. As the arable land is limited, increasing productivity is the only option available. This can only be achieved through usage of high yielding varieties, fertilizers and pesticides. As the crop yield increases, the incidence of pest attack rise which leads to increased demand for pesticides.

The conventional group of insecticides have several major dis-advantages like high dosage per unit crop, drift hazards, operational hazards and residues in environment, plants and in marketable produce, they also affect non-target vegetation and non-target organisms. So, they need to be replaced by an alternative pest control strategy that can overcome the above lacunas.

Nano-pesticides are one of the alternatives to overcome the lacunas of conventional group of insecticides. Nano-pesticides are plant protection chemicals, in which either the active ingredient or the carrier molecule is developed through nanotechnology. As it really indicates, the Greek origin word *'nano'* means dwarf. The major aim in the development of nano-pesticides is to lessen the environmental hazards of a pesticide active ingredient through improving the efficacy of a chemical. The absolute small size of the particles is the benefit here. The size of a nanopaticle generally ranges 1-100 nanometer and a nanometer is one billionth of a meter. When the size gets this small, particles reach a very large surface area and thus more volume of pesticides get contact with the pests. The ability of nanoparticles to permeate is due to their extremely small size and shape. Like other pesticide formulations, nano-pesticide formulations will also constitute the active ingredient, the carrier molecule and surfactants. The major benefits of these nanoparticles includes the improved solubility active ingredients, better stability of formulation, slow release of active ingredient and improvement in mobility caused by smaller particle size and higher surface area. The mode of action against target pests is expected to be enhanced with nanoparticles, as opposed to bulk materials. Moreover, nano-formulations provide systemic properties, uniform leaf coverage and improved soil properties to support their constructive use in agriculture.

## FORMULATIONS OF NANO-PESTICIDES

The research in nanotechnology has led to the development of different nano-formulation which can be applied in crop protection *viz.,* nano-insecticides, nano-herbicides, nano-fungicides and nano-nematicide. Nano-pesticides are formulated according to their intended purpose as formulations improving solubility, slow release of active ingredients, prevent degradation *etc*. For achieving these purposes, modifications in the chemical nature carrier molecule have been modified and classified as organic polymer-based formulations, lipid-based formulations, nanosized metals and metal oxides, clay based nanomaterials *etc*. Some foremost nano-formulations are mentioned in this article.

**Nano-emulsions**: Generally an oil-in-water (O/W) emulsion is more common as a nano-emulsion where, active ingredient of the chemical is dispersed as nanosized droplets in water, with surfactant molecules confined at the pesticide-water interface. Nano-emulsions get further classified based on the quantity and type of surfactants, as thermodynamically stable and kinetically stable. If the pesticide is partially soluble in the aqueous phase and spontaneous formation of a stable emulsion happens when surfactant, pesticide, and water components are brought together, that is a thermodynamically stable nano-emulsion. The insolubility of the active ingredient make the pesticide and surfactant to initially form a two-phase system and thus, a continuous shearing make them to mix together and pesticides droplets in the nano-emulsion will remain dispersed for an extended period of time and so are considered to be kinetically stable. *Eg:* Oil in water nanoemulsion of neem oil has been developed for insect management using Tween 20 as the surfactant.

**Nano-suspension**: Nano-suspensions, also termed as nano-dispersions, are formulated by dispersing the pesticide as solid nanosized particles in aqueous media. In nano-dispersions, the surfactant molecules get confined at the particle surface where polar portions extending into the aqueous solution and the non-polar portions associating with the solid pesticide. *Eg:* Aqueous dispersions of nano-permethin, novaluron and β-cypermethrin have been developed by researchers.

**Polymer based nano-particles:** Polymer-based pesticide nanocarriers are majorly deployed in the slow and controlled release of active ingredients to the target site. Moreover, they can serve to improve dispersion in aqueous media and also as a protective reservoir. Nano-encapsulation, nano-spheres, nano-gels, nano-fibers, *etc* are some of them falling in this category.

**Nano-encapsulation:** Nano-capsules or nano-encapsulation are heterogeneous reservoir type structure containing an inner central cavity which confines the hydrophobic or hydrophilic active ingredient, surrounded by a polymer coating or membrane. The active ingredient in neem-azadiractin formulation can be protected through this formulation. *Eg:* Controlled-release nano-formulation of the neonicotinoid insecticide *i.e.,* acetamipirid and imidacloprid have been developed.

**Nanospheres:** These are homogeneous vesicular structures, in which the bioactive ingredient is uniformly dispersed throughout the polymer matrix. *Eg:* Polymer stabilized bifenthrin nanoparticles are developed as nanospheres.

**Nanogels:** These are also known also hydrogel nanopartciles. These are formulated by cross linking of polymeric particles having hydrophilic groups, thus absorb higher quantities of water. Chitosan nanogel is an example for this.

**Nano-fibres:** Nano-fibres are developed through electrospinning, thermal induced phase separation. Researchers have developed electospun nano-fibers loaded with the chemical, (Z)-9-dodecenyl acetate, an ingredient of pheromone which get embedded in the polymer matrix for the management of many lepidopteran insect pests.

## SOLID NANOPARTICLES AS NANO-PESTICIDES

In addition to the above formulations, solid nanoparticles can also be used as nano-pesticides. The inert dusts, such as silica, alumina, and clays cause damage to the wax coating on the insect cuticle through both sorption and abrasion. This physical damage can cause to lose water and thus resulting in dehydration to the insect. Nano-silica particle can be suggested as an eligible candidate among solid nanoparticles due to its additional benefit to aid in increasing tolerance to abiotic and biotic stresses by the plant. However, high dosages have to be applied for a better result which can adversely affect the grain properties. Nanostructures alumina was also reported to have pesticide properties. Moreover, nano-clays developed from montmorillonite were also shown to have pesticidal function but low toxicity.

Among metals, silver, titanium oxide and copper are most preferred as nanoparticles. The bactericidal and viricidal activity of silver nanoparticles makes them favourable by nanotechnology researchers. The low toxicity, inherent charge, larger surface area and crystallographic structure increase its preference. The use of titanium

dioxide to crops has proved effective antimicrobial and antifungal activity. Nano-copper formulations can cause cell wall damage of bacterial cells and found effective against pomegranate bacterial blight at very low concentrations. Cell wall damage was observed in nano-copper treated bacterial cell.

From past one decade, considerable research has been made in the field of nanotechnology. Yet, it is only recently we are beginning to recognize how nanoparticles can impact on our lives and lead to both positive and negative results. Research in nano-pesticide development is being taken up in a faster rate but, this subject matter has not reached the public awareness or regulatory authorities so far. By and large, innovation all the time results in both benefits and problems for human and environmental health. The current level of knowledge regarding environmental fate does not allow us to a fair assessment of the advantages and disadvantages that will result from the use of nano-pesticides.

**However, the major advantages of use of nano-pesticides over conventional pesticides are:**

- Nanotechnology offers a tool for developing novel formulations of eco-friendly pesticides as majority of nano-pesticide formulations are highly target specific.
- Generally, targeted delivery and controlled release of nano-pesticides can improve pesticide utilization and reduce residue and pollution. For example, Nano-microcapsule formulations have slow release and protection performance because they have been prepared using light-sensitive, thermo-sensitive, humidity-sensitive enzyme-sensitive and soil pH-sensitive high polymer materials to deliver pesticides
- Nano-pesticide formulations improve adhesion of droplets on plant surface (reduces drift losses) which intern improves the dispersion and bio-activity of active ingredient *(a.i.*) of pesticide molecules. Therefore, Nano-pesticides will have high efficacy compared to the conventional pesticide formulations (*i.e.,* D-Dust, G-Granule, P-Pellet, EC-Emulsifiable Concentrate, WP-Wettable Powder, WDG-Water Dispersible Granule, *etc.*) and due to their small size, improvable pesticide droplet ductility, wettability and target adsorption when sprayed in fields has made these nano-pesticides provide efficient and environmental friendly advantages
- Nano-pesticides are extraordinary means for setting up an eco-friendly and sustainable agriculture system because it reduces the overall chemical usage, decreases the toxic residues and enhances the overall crop protection.

## THE LIMITATIONS IN THE USAGE OF NANO-PESTICIDES:

- The risk that nano-particles (nano-pesticides) may pose to human and environment health is not yet fully understood.
- Nano-pesticides may also create new kinds of contamination of soils and waterways since nano-pesticides are apparently much more persistent and have higher degrees of toxicity when compared to their traditional counterparts.

Therefore a better understanding of the fate and effect of nano-pesticides after their application is required. It is a good thing that all necessary safety precautions are taken before deciding to go ahead and use new technologies on a large scale.

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# Semen sexing – A tool for enhancing productivity of indigenous Cattle

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India is the largest producer of milk in the world and produced 155.5 million tonnes milk during the year 2015-16 to achieve the projected demand of 191.3 million tonnes of milk by 2020, for that there is need to increase the number of elite cattle by shifting the sex ratio towards females using sex sorted semen. India has vast cattle genetic resources but the milk productivity is low due to Limited availability of superior breeding bulls, Wide gap exists between the production and demand of total doses of semen, Large number of unproductive young bulls, ban on slaughter of cattle and Limited availability of elite bulls. Dream of Livestock farmers is production of calves of desired sex so that there is need to pre-select the gender of young one in indigenous and dairy cattle. Sex determination at an early stage reduce the management cost, Increase the genetic progress from the daughter-dam Path and Producing good male germplasm from Elite bulls for Future breeding. Currently no agency is producing sexed semen in India. Sexed semen is not available for all breeds of indigenous cattle in India, presently it is available for only HF and Jersey breeds.

## NEED OF SEMEN SEXING

Through this technique we can produce a calf of a specific sex. Production of unwanted cattle males can be minimized as they cannot be slaughtered in India. Production of superior breeding bulls as country has limited elite cattle bulls (< 0.1% of total). Combination of super-ovulation and insemination with sexed semen further increases the desired calf crop. Replacement costs can be reduced to ensure required number of daughter's production for progeny testing programme in shortest time, thus increased genetic gain. Reduce dystocia cases by preventing production of male calves. In in-vitro fertilisation programmes, one dose of sexed sperms can be used to produce many embryos of desired sex, increased bio security and lower disease risk.

## SEMEN SEXING TECHNIQUE

Fluorescence-activated cell sorting, using flow cytometry is the only method proven to be commercially available with good accuracy (90%). This technique depends on difference in DNA content (3 - 4.2%) between X and Y bearing spermatozoa for sorting. The dye (Hoechst 33342) that binds specifically to the DNA content of X and Y bearing sperms. The X- sperm glow brighter than the Y. Currently the spermatozoa concentration in each sexed semen dose is 2 million/insemination. Thus, with the available technology, 14 doses each of X and Y sex per hour can be produced per instrument leading to production of 336 doses of each sex per instrument, if it runs continuously for 24 hours

## ISSUES THAT NEED TO BE ADDRESSED BEFORE INDIGENOUS PRODUCTION OF SEXED SEMEN

The authenticated data on differences in DNA content between X and Y spermatozoa in crossbred and several indigenous breeds is not available so flow cytometry based sex sorting technology requires to be well standardized before its application on indigenous breeds.

## POLICY MAKING

Once sexed semen is available, majority of stakeholders will like to use it for producing female, which will lead to decreased availability of quality males, which are already in shortage, hence, we need to frame a stringent policy for using sexed semen, otherwise uncontrolled use of sex sorted semen would skew the sex ratio towards one sex and lead to unforeseen problems.

## AI STRATEGIES WITH SEX SEMEN

The conception rate depends on the following factors:

- Standardize the lower dosage of spermatozoa
- Bull fertility
- Quality of semen
- Semen preservation
- Semen handling during AI
- Site of deposition
- Sperm dosage
- Skill of the inseminator
- Good quality heifers and the cows with excellent reproductive and productive performance

## DRAWBACKS ASSOCIATED WITH SEMEN SEXING IN INDIAN CONDITIONS:

- Commercial availability of the sorting technology
- Lower sorting speed and efficiency

- High cost of maintenance
- Higher cost of sexed semen
- Lack of skilled manpower
- Lack of good quality ejaculates from indigenous cattle
- Low conception rates
- Lack of availability superior bulls with good fertility
- Delayed sexual maturity of heifers
- Lack of availability of sexed semen
- Lack of awareness about Sex semen to farmers
- The major problem is that it needs highly specialized, non-portable equipment which is quite costly for routine use which cost around 4 to 5 crores.

## FUTURE CHALLENGES AND POSSIBILITIES:

- To reduce the cost of sperm sexing
- To develop two or more nozzled flow cytometer
- Isolating a protein marker characteristic of X or Y sperms
- Animal Recording
- Correct parentage identification
- Correct semen product identification
- Progeny records
- Potential solutions to increase fertility rate:
- Increase sperm number
- Change dye
- Pulse laser
- Decrease sorting pressure
- Semen preservatives
- Timing of AI
- Extreme care during handling
- Slaughter of cow is banned in most of the states in India and extra males are very difficult to dispose so, sex selection towards female will help in producing near about 92 to 95 % female and strengthen the food production and nutritional security of our country. Production of superior male through sex selection will further contribute in improving the production potentiality of indigenous cattle.
- Increased bio security and lower disease risk
- Selective culling
- Reduce dystocia cases by preventing production of male calves

# Status and Future Prospects of Artificial Insemination and fertility of Goats in India

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Livestock plays a crucial role in economy of the country contributing 27-32% of agricultural GDP (CIRG Annual Report, 2018). Goat rearing is the second most important activity of livestock sector after cattle. There are about 102 breeds of goat in the world. The total Goat population in the country is 135.17 million numbers in 2012 (19th Livestock census). Total registered breeds in India are 34 (NBAGR, 5th September, 2018). Country stands first in milk production and second in meat production (CIRG Annual Report, 2018). Goat rearing requires less space as compare to bovines so it is more convenient and economical for landless and marginal farmers. For rapid growth of goat population, cryopreservation of buck semen started in India and draft is prepared by Government of India (Minimum standard protocol) for Buck semen. Commercial use of frozen-thawed semen is relatively limited in caprine reproduction and is still to be explored extensively for wider use in India. Fresh, refrigerated and frozen methods of semen preservation and 3 techniques of insemination (vaginal, cervical and intrauterine) are basically used worldwide in goats (Chemineau and Cognie, 1991, Leboeuf *et al.,* 2000). In Indian context, conception rate reported by various authors given below in table.

**Table 1: Conception rate reported by different Authors in India:**

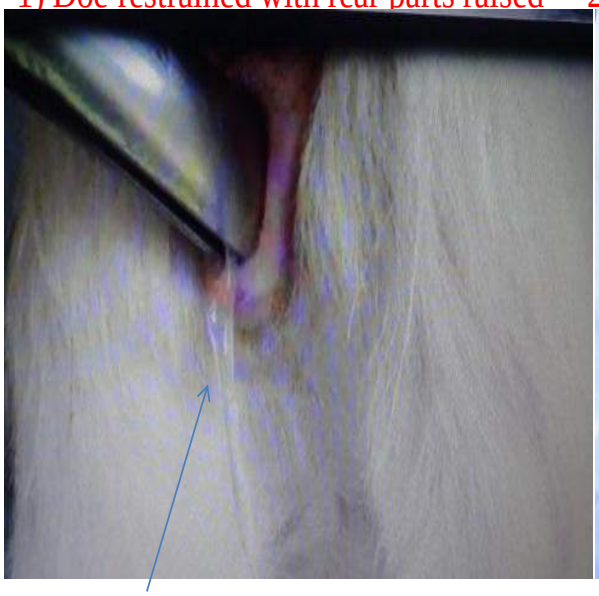
| SN | Breed | Conception rate (%) | Authors |
|---|---|---|---|
| 1 | Assam Hill (AH) goat and their crossbred (CB; Beetal x Assam Hill goat) | 88 | Doley *et al.* (2018) |
| 2 | Black Bengal | 47.26 | Karunakaran *et al.* (2015) |
| 3 | Jamunapari | 53.0 | Kharche *et al.* (2013) |
| 4 | Kashmir local goats | 71.4 | Bhattacharyya *et al.* (2012) |
| 5 | Sirohi | 36.4 | Sharma, (2004) |
| 6 | Jamunapari | 81 | Chauhan *et al.* (1991) |

## ARTIFICIAL INSEMINATION IN GOAT AND CRITICAL POINTS

1. First of all ensure that doe is actually in heat or not. This can be judged by observing the visual signs of heat such as (Mounting behaviour, tail wagging, swelling of vulva, vaginal discharge and more vocalisation) and a history is taken from the goat rearing farmer or animal handler about the symptoms and behaviour changes he noticed.
2. For better conception and to prevent the spread of disease during AI, care should be exercised to ensure that all the AI equipment is as clean as possible.
3. Restrain the doe in such a manner that hind quarter should remain in some elevation. The hind quarters could also be held up by holding the hind legs up with flex hocks so that reproductive tract can be easily accessible for AI. Clean the perineum region to remove feaces and dirt around it. Given photograph depicting the AI procedure in goats.

1) Doe restrained with rear parts raised

2) Insertion of Lubricated speculum



3) Oestrus mucus in the doe

4) Insertion of loaded AI gun through the speculum

**Photo taken from**: A training manual on artificial insemination in goats V.T. Tsuma, M.S. Khan, A.M. Okeyo and M.N.M. Ibrahim 3 March 2015 Agricultural Innovation Program for Pakistan (AIP)

The 14th Annual Review Meet of AICRP on Goat Improvement held at NAU, Navsari (Gujarat) on Sept 29, 2014, ICAR-Central Institute for Research on Goats AICRP on Goat Improvement Makhdoom, Farah, Mathura 281122 UP, INDIA according to which different Unitwise breed specific suggestions were made for goat improvement. Breed specific Goat Units in India given below.

## DIFFERENT GOAT UNITS IN INDIA (BREED SPECIFIC) UNDER AICRP, 2014

1 Assam Hill Goat Field Unit, Khanpara (Assam)
2. Black Bengal Field Unit, Kolkata
3. Black Bengal Field Unit, Ranchi
4. Gaddi Field Unit, Palampur
5. Ganjam Field Unit, Bhubaneswar
6. Malabari Field Unit, Thrissur
7. Marwari Field Unit, Bikaner
8. Osmanabadi Field Unit, NARI, Phaltan
9. Sangamneri Field Unit, Rahuri
10. Sirohi Field Unit, Vallabhnagar
11. Surti Field Unit, Navsari
12. Barbari Farm Unit, CIRG Makhdoom
13. Jamunapari Farm Unit, CIRG Makhdoom
14. Sirohi Farm Unit, CSWRI, Avikanagar

## FUTURE PROSPECTS

To propagate superior quality buck male germ plasm rapidly, there is need to give more focus on buck semen cryopreservation and artificial insemination in Indian context. Attention should be given towards semen evaluation and cryopreservation so that efficient and economical semen preservatives may be developed and better conception rate in field condition may be obtained. In addition, some novel techniques such as embryo transfer, in vitro fertilisation and sex sorted semen should be adopted to increase the efficiency of reproduction in goats. Further studies needed in terms of marker based selection of breeding bucks used for breeding and cryopreservation in near future. Gradually buck semen stations coming in existence in India. BAIF Development Research Foundation, actively involved in Bovine semen production and certified as 'A' grade semen station by Central monitoring unit, Government of India (2018) which recently started Buck semen station at Wagholi, Pune to harvest and preserve the best quality semen and make availability of cryopreserved buck semen for Artificial insemination at farmers door.

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*Note- Photo used in this article is basically to demonstrate the AI procedure in more systematic way which is well referenced in article and Author not claim as their personal.*

# Soil management with mulches for sustained crop production

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**Abstract**

Mulching is the technique in which the process or practice of covering the soil/ground is being followed to make congenial conditions for crop growth, development and efficient production. Mulch technically means 'covering of soil'. This practice is most significant in protecting the roots of the plants from heat, cold besides micro climate acceleration, reduce salinity and weed control. It exerts decisive effects on earliness, yield and quality of the crop. Mulching is applicable to all type of crops especially in horticultural crops. Mulching can bring out the effective change in increasing horticultural crop production.

## INTRODUCTION

Mulching is a method of using cut leaves, straw, leaf litter etc. to cover the bare soil while still farming and growing crops on it. The word mulch has been probably derived from the German word "molsch" means soft to decay, which apparently referred to the use of straw and leaves by gardeners as a spread over the ground as mulch. The practice of applying mulches to soil is possibly as old as agriculture itself. Mulches are used for various reasons but water conservation and erosion control are the most important objects in agriculture in dry regions. Mulches when property managed definitely aid wind and water erosion control. Other reason for high mulching is followed includes soil temperature modification soil conservation nutrient addition, improvement in soil structure weed control and crop quality control.

### Why Mulch?

Mulching helps protect your soil from environmental factors like rain, wind, sun and human agricultural practices which cause compaction, erosion and nutrient loss. A thick layer of mulch can also help to suppress weeds and raise the soil temperature during the cool shoulder seasons. In nature, soil is almost always covered by either plants, such as in grasslands, or decaying debris, such as on the forest floor. As organic material slowly decomposes, it returns valuable nutrients to the soil. Mulched plants have better vigour and, consequently, have improved resistance to pests and diseases.

## ADVANTAGES OF MULCHING

**Soil structure**

A mulch preserving the soil structure, earthworms, organic matter and leaving surface residues to protect the soil surface and increase infiltration will reduce wind and water erosion more than any other crop production technique yet devised. The organic surface cover stabilizes the surface aggregates through reduced crust formation and surface sealing, resulting in less run off. It not only keeps soil particles in place but reduces herbicide and nutrient leaching. It can also reduce the costs needed to keep the watersheds clean from erosion.

**Soil quality**

The most important factor in determining soil quality is soil organic matter. The organic matter consists of living organisms, fresh and decomposing residue. Soil organic matter is made up of about 60% Carbon.

**Soil temperature**

Soil mulching with organic material is one way of soil water protection and also helps maintain a constant soil temperature in soil layer within the root system of crops. Mulch reduces soil warming in summer and cooling in winter. It prevents the extremes of temperatures. The cooling effect of soil in summer promotes root development. In general, mulch, by maintaining proper moisture and decreasing soil warming in summer months as well as reducing the daily temperature fluctuations, improves soil conditions for plant growth and development.

**Add organic matter**

Organic mulches return organic matter and plant nutrients to the soil and improve the physical, chemical and biological properties of the soil after decomposition, which in turn increases crop yield. Soil under the mulch remains loose, friable and leading to suitable environment for root penetration. The organic mulches not only conserve the soil moisture, but they also increase the soil nutrients through organic matter addition.

**Weed control**

Soil coverage with organic mulches can suppress weed infestation. Mulching the soil helps to prevent light from penetrating to the soil underneath, thereby limiting weed's ability to grow. Weeds also have a difficulty in penetrating through thick layers of mulch, and those that do are generally very easy to pull out because they are loosely rooted.

**Pest and disease control**

Mulch cover can play a neutral role or reduce the risk of insect pest attack to crop plants by preventing direct movement of insects from soil to plants, but sometimes mulch can increase the risk of insect invasion. Changes in cropping systems affect insect pests and their natural enemies. Most insect populations were significantly influenced by ground cover. Organic mulches might provide hiding places to harbor populations of

natural enemies. Mulch maintains optimal soil environments, which in turn supports healthy plants that are less susceptible to opportunistic pathogens.

**Stimulate soil micro-flora**

Mulching stimulates soil micro-organisms such as algae, mosses, fungi, bacteria, actinomycetes and other organisms like earth worms etc., owing to loose, well aerated soil conditions, uniform moisture and temperatures thus resulting in a more rapid breakdown of organic matter in the soil and release of plant nutrients for crop growth. Under the mulch layer earth worms proliferate and help to improve the soil aggregate stability and infiltration etc. The variation in the microbial load of the different organic mulches on bacterial population could be due to their different chemical composition and their decomposition rates

**Water conservation**

The conservation of soil water storage through mulching is one of the important purposes. When soil surface is covered with mulch helps to reduce evaporation and increase infiltration of rain water during growing season. Mulches greatly retard the loss of soil water. As a result, higher and uniform soil water regime is maintained reducing the irrigation frequency

**Plant growth and development**

Mulching provides a favourable environment for growth which results in more vigorous, healthier plants which may be more resistant to pest injury. Increase in soil temperature and moisture content stimulate root growth which leads to greater plant growth. Therefore, mulched plants usually grow and mature more uniformally than unmulched plants.

**Promote early harvest**

Warm season vegetables such as cucumbers, muskmelons, watermelons, eggplant, peppers, usually respond to mulching in terms of early maturity and higher yields. An early maturity is probably due to maintenance of favourable temperatures during growing season. Black mulch applied to the planting bed prior to planting will warm the soil and promote faster growth in early season, which generally leads to earlier harvest.

**Improve quality and yield**

Mulch helps keep fruits clean from contacting the ground, reduces soil rot, fruit cracking and blossom end rot in many cases. Fruits tend to be smoother with fewer scars. Properly installed plastic mulch helps keep soil from splashing onto the plants during rainfall, which can reduce grading time. The yield, keeping quality and chemical composition of vegetables may be improved by mulch.

## MATERIALS USED IN MULCHING

There are two type of materials used for mulching.

**Dry mulch**

The most common materials used in the dry mulching are hay, leaves, straw, barks, shells, woodships. Most of this materials will act as a direct organic matter addition to soil.

**Wet/ Live mulch**

Living mulch involves seeding a crop that protects and improves the soil. The crop can either cover the ground in between other plants, or be sown as a cover crop, meaning that it will be cut down before going to seed so that other annuals can be planted in its place. The cuttings can be left on the soil as a regular mulch, or put in the compost to help build soil that way.

**Types of mulch**

Many types of mulch exist; the type we use will depend on preferences, situation, and location. There are two generic types of mulches, organic and inorganic. Organic mulches are anything that are found in nature and can be broken down by soil organisms. Inorganic mulches are anything man-made, or anything like rock that cannot be broken down by soil organisms. Inorganic mulches will have a much longer life span than organic mulches, but will usually not have a very natural look or give anything back to the soil.

**Organic mulch**

Organic mulches are derived from plant and animal materials such as straw, hay, groundnut shells, leaf mold, compost, sawdust, woodchips and animal manures. The organic mulch should be applied at the rate of 5 t $ha^{-1}$ immediately after germination of crop or transplanting of vegetable seedling to obtain maximum advantage from the organic mulch.

***Compost***

Well-composted organic material can be good yearly mulch, but must be reapplied often, as it breaks down into the soil quickly. Composted manures also work well around nutrient loving plants like roses.

***Shells, hulls, other by-products***

These are often specific to the area in which you live. Things like crushed shells, coffee grounds, rice hulls and ground corncobs are often used in areas that produce an abundance of such by- products. A good way to recycle, otherwise it will go as unused materials.

**Dry leaves**

Leaves, an easily and abundantly available material, are good for mulching. Though leaves are good for protecting dormant plants during winter by keeping them warm and it help to initiate germination during cold season but dry but due to light weight they may be blown away even by light wind. To reduce these problems to used stone, bark or any other material that help to reduce wind problem.

***Bark clippings***

These are good mulch materials as they are long lasting and allow proper aeration to the soil underneath. Wood bark has capacity to hold more water and bark mulch material is used in both the region very dry and very wet because if rain is too much the bark will absorbed excess water and reduce waterlogged condition. When it rains too little, the wood chips will release the water they've been holding, providing your plants with water even in dry times. Hardwood bark clippings contain more

nutrients than soft wood but bark clippings are not easily and abundantly available and some bark products may cause phytotoxicity.

***Straw***

Paddy and wheat straw and other crop residues like stubbles, groundnut shells, cotton shells etc; are the commonest mulching materials used as mulches on soil surface for moisture conservation. Though straw is poor in nutrient value but after decomposition, it makes soil more fertile. Straw mulches reduce both the amount of energy absorbed by the soil and its movement above the soil and hence reduce evaporation.

***Saw dust***

Saw dust, obtained during finishing operation of wood and furniture is very poor in nutritive value as it contains only half the nutrients of straw. It decomposes slowly. Being acidic in nature, it should not be used in acidic soils.

**Inorganic mulch**

Inorganic mulch includes gravels, pebbles, stones and plastic mulch which accounts for the greatest volume of mulch used in commercial crop production. The plastic materials used as mulch are poly vinyl chloride or polyethylene films. Owing to its greater permeability to long wave radiation it can increase temperature around the plants during night in winter. Hence, polyethylene film mulch is preferred as mulching material for production of horticultural crops.

***Gravel, Pebbles and Crushed stones***

These materials are used successful for dryland fruit crops. Small rock or stone layer of 3-4 cm place on soil surface to provides good weed control, reduced evaporation and facilitate infiltration of rain water into the soil. But they reflect solar radiation and can create a very hot soil environment during summer.

***Plastic mulch***

Plastic mulch is now used worldwide to protect crops from unfavorable growing conditions such as severe weather, insects, and birds. Utilization of plastics in agriculture started in the developed countries and is now spreading to the developing countries. Early utilization of plastic was in cold regions, and plastic was mainly used for protection from the cold. Now plastic is used in all kind of climates, soils, and seasons for its numerous benefits in addition to enhanced soil temperatures. The use of covering techniques started with a simple system such as mulching, and then row covers and small tunnels were developed and finally plastic houses.

**Photo-degradable plastic mulch:** This type of plastic mulch material is easily destroyed by sun light in a shorter period.

**Bio-degradable plastic mulch:** This type of plastic mulch film is easily degraded in the soil over a period of time.

**Color of film:** Films are available in variety of colors including black, transparent, white, silver etc. But the selection of the color of plastic mulch film depends on specific targets. Generally, the following types of plastic mulch films are used in horticultural crops.

***1. Black plastic***

A solid sheet of polyethylene effectively controls annual weeds. The disadvantage of black plastic is that water and oxygen cannot pass through this material. The soil should be moist prior to laying this synthetic mulch. It warms the soil and perennial weeds may be suppressed by black plastic. Black plastic films do not allow the sunlight to pass through on to the soil.

Photosynthesis does not take place in the absence of sunlight below black film. Hence, it arrest weed growth. Before lying of plastic mulch, the soil should be moist otherwise it warms the soil. All colour of plastic mulch control weed growth except clear plastic. Black, brown, clear plastic warm the soil, whereas white plastic cools the soil. Blue, green and silver plastic also produced greater yield than black plastic.

***2. Clear plastic***

This mulch which increases the soil temperature more than black plastic will not able to control weeds since sunlight can reach the soil surface. Soil temperature during the day time under clear plastic can reach 8-14ºF higher at the 2" depth and 6-14ºF higher at the 4" depth than bare soil at the same depths due to a greater (85-95%) solar radiation transmittance. Clear plastic absorbs very little solar radiation. Water droplets that condense on the underside of clear plastic allow solar light (short wave radiation) in, but block outgoing, long wave infrared radiations (heat). This heat normally is lost to the atmosphere from bare soil. Incoming solar radiation however makes weeds a major problem under clear plastic, unless controlled with a herbicide or fumigant.

***3. White plastic***

Light is reflected back into the atmosphere or the plant canopy from a white plastic mulch, resulting in slightly cooler (-2º F at 1" depth) soil temperature. White plastic mulches can be used to establish crops in the summer when a reduce d soil temperature might be beneficial.

***4. Silver/aluminium***

Reflective silver or aluminium mulches also give cooler soil temperature. They tend to repel aphids, which can serve as vector for various viral diseases.

**Selection of mulch**

It depends upon the specific purpose to be achieved such as weed control, rising of soil
temperature or cooling it down, disease control, enhance plant growth etc.

## HOW TO APPLY MULCH

For smothering weeds and retain soil moisture, a 2-3 inch layer of mulch is necessary. Less than 2" of mulch will penetrate enough light and allow weed seeds to germinate. Before laying mulch, the following precaution should be taken-

- It should be laid on a non-windy condition.
- The mulch material should be held tight without any crease and laid on the bed.
- Borders (10cm) should be encored inside the soil for about 7-10cm deep in small furrows at an angle of 45º.

- The mulch material should be punctured at the required distances as per crop spacing and laid on the bed. The seeds/seedlings should be sown/ transplanted in the holes.
- Do not use sawdust, wood or bark chips directly in the vegetable garden. Wood takes years to decompose and sawdust can create an imbalance of Nitrogen in the soil. Instead use these mulches in pathways around the garden where they can suppress weed growth.

## CONCLUSION

Soil mulching with organic material is an important element of integrated and ecological cultivation of plants. One of the most significant advantage of mulch is the addition of organic matter to the soil, especially by nutrient-rich mulch and a favorable effect on the physical and chemical properties of soil, and hence on crop productivity. retention of organic matter on the soil surface favorable effect on the growth and development of plant and increase vegetables yield.

Straw mulch

Live mulch

# Importance of Microminerals in Fodder Cropping System *viz-a-viz* Dairy Cattle

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Microminerals are defined as those elements which are used in small quantities as against macrominerals which are used in large quantities. This definition applies for both plants as well as animals. Despite their lower concentration, microminerals play crucial role in the growth and development of the plants and animals. There are 16 important plant elements which are necessary for the growth of plants. According to Arnon and Stout (1954) these plant minerals are called as essential elements. In the absence of any one of these essential elements a plant fails to complete its life cycle, the disorder caused can be corrected by the addition of that element. Out of 16 essential element 7 nutrients viz. Iron, Manganese, Boron, Zinc, Copper, Molybdenum and Chlorine are used by field crops in very small quantities.

Similarly, in case of animals, 17 minerals are used for the normal metabolism which are categorized in macro and trace minerals. The trace minerals are present in concentration below 50mg/kg and required in the diet at levels of 100mg/kg feed (Mc Donald et al, 2004). They include Chromium, Cobalt, Copper, Fluorine, Iodine, Iron, Manganese, Molybdenum, Selenium, and Zinc. In recent literature metals like Boron, Vanadium and Nickel are also considered as trace minerals.

| Elements | Plants | Animals |
|---|---|---|
| Macro | Calcium (Ca), Magnesium (Mg), Nitrogen (N), Phosphorous (P), Potassium (K) and Sulphur (S). | Calcium (Ca), Chloride (Cl), Magnesium (Mg), Phosphorus (P), Potassium (K), Sodium (Na) and Sulphur (S) |
| Micro | Boron (B), Chlorine (Cl), Copper (Cu), Iron (Fe), Manganese (Mn), Molybdenum (Mo), And | Copper (Cu), Iodine (I), Iron (Fe), Manganese (Mn), Selenium (Se) and Zinc (Zn) |

**Table 2: Role of some micronutrients in plants and animals**

| SL. no | Micronutrients | Plants | | Animals | |
|---|---|---|---|---|---|
| | | **Function** | **Deficiency** | **Function** | **Deficiency** |
| 1. | Iron (Fe) | Chlorophyll formation, absorption of other nutrients. Essential for the synthesis of proteins contained in the chloroplasts. | Chlorosis between the veins of leaves, the veins remaining green. | The oxygen transporter in red blood cells and the red color in muscles. Iron is also necessary for white blood cells in disease immunity responses. | Causes anemia and failure to produce red blood cells. |
| 2 | Manganese (Mn) | Catalyst in oxidation and reduction reactions within the plant tissues. Helps in chlorophyll formation, supports movement of iron in the plant, counteracting the bad effect of poor aeration. | Leads to chlorosis in the inter veinal tissue of net veined leaves and parallel vein leaves. In cereals it produces grey streak, white streak dry spot and lip spot, marash spot, streak disease and pahala blight in sugarcane, yellow diseases in spinach and beans. | Essential for Bones, connective tissue and genetic proteins. | Poor growth and skeletal deformities in newborn calves and reproductive abnormalities, including anestrus, in adult cows. |

| | | | | | |
|---|---|---|---|---|---|
| 3 | Boron(B) | Constituent of cell membrane and essential for cell division. Acts as a regulator of potassium/calcium ratio in the plant, helps in nitrogen absorption and translocation of sugars in plant. | Yellowing and resetting in lucerne, snakehead in walnuts, die back and corking in fruits, corking and pitting in tomatoes, hollow stem and bronzing of curd Cauliflower, brown heart disease in table beets, turnips etc. | Stunted growth when deficient boron diet is provided | |
| 4 | Zinc (Zn) | Constitute of several enzyme system which regulate various metabolic reaction in the plant. Associated with water uptake and water relation in the plant. | In younger leaves, interveinal chlorosis leading to a reduction in shoot growth and the shorting of internodes. Mottle leaf, little leaf etc.in the case of trees, the buds of severely deficient maize plants become white, interveinal chlorosis and mottled leaf occur in citrus. | Involved in several enzymatic reactions associated with carbohydrate metabolism, protein synthesis and nucleic acid metabolism. | Impaired spermatogenesis and development of secondary sex organs in males, reduced fertility and litter size in multiparous species, parakeratosis in pigs |

| | | | | | |
|---|---|---|---|---|---|
| 5 | Copper (Cu) | Act as "electron carrier" in enzymes, helps in utilization of iron in chlorophyll synthesis. It neutralizes the harmful conditions in certain peat soils when applied in large quantity. | Variation in deficiency symptoms occurs in case of copper e.g. multiple bud formation, staining and splitting of fruits, dieback of shoots, the marginal or spotted necrosis and chlorosis of leaves. | Enzyme component and catalyst involved in steroidogenesis and prostaglandin synthesis | Loss of hair pigmentation, loss of hair around the eyes, anemia, and general ill thrift and suppressed immunity. In severe cases, persistent diarrhea may also occur. |
| 6 | Molybdenum (Mo) | Acts in enzyme systems which bring about oxidation reduction reactions. Essential for the process of atmospheric nitrogen fixation. | Reduces the activity of the symbiotic and non-symbiotic nitrogen fixing microorganisms. Produces whiptail in cauliflower, broccoli and other Brassica crops. | Involved in iron metabolism and enzyme reactions. | Reproductive disorders such as decreased libido and sterility in bull calves caused by tissue damage and reduced spermatogenesis delayed puberty, reduced conception rate, and anestrus |
| 7 | Chlorine(Cl) | It requires for proper plant development e.g. sugar beets, carrots, lettuce, barley, wheat, cotton and clovers. | Wilt, chlorosis, necrosis, and an unusual bronze discoloration on tomatoes. | Essential for body fluid regulation. | Excessive intake as NaCl can lead to health problems in animals |

| | | | | |
|---|---|---|---|---|
| 8 | Selenium (Se) | No known function but this mineral can accumulate in some plant species. Sulphur may interfere with selenium uptake in crop production. | An anti-oxidant that works in conjunction with vitamin E to prevent and repair cellular damage in the body, regulates metabolism, reproduction, circulation and muscle function. Selenium also protects the body from heavy metals by forming complexes to render them harmless. | Increase the incidence of embryonic death and uterine infections and can decrease fertility |
| 9 | Iodine(I) | Some plant species reputed to accumulate this element. | Major role in thyroid function. | Goiters in newborn calves |
| 10 | Chromium(Cr) | Unknown | Blood sugar regulation and can enhance weight gain in livestock. Component of Glucose tolerance factor (GTF) | |

| | | | | |
|---|---|---|---|---|
| 11 | Vanadium (Vn) | Present in plants such as dill, parsley and corn - role unknown | An Active in a number of chemical reactions in a body. A co-factor in blood sugar and fat metabolism. | |
| 12 | Nickel (Ni) | Role in plants unknown. Present in nuts, beans and peas. | Co-factor for certain enzyme systems like urease and methanogens (F430) in rumen. | |

## REASONS FOR DEFICIENCY OF MICRONUTRIENTS IN PLATS AND ANIMALS

Soil condition causes micronutrient deficiency in case of plants

- highly leached acidic sandy soils;
- soils with a high-water table;
- soils with a very high content of organic matter e.g. peat and muck soils of Kerala;
- calcareous and saline-alkaline soils very high in pH e.g. UP, Punjab and Bihar;
- intensively cropped soil with high doses of commercial fertilizers;
- application of high doses of lime at one time.

In case of animals several factors affect the availability of micronutrients which includes species of plant, variety of forage, portion of the plant (leaf: stem ratio), quantity of exchangeable minerals in the soil, season and climate of harvesting, level of fertilization, soil pH, and harvest conditions. Harvesting and storage losses also contribute to mineral variability. Over conditioning or weathering of forages will increase the amount of leaf loss and leaching of nutrients resulting in greater mineral losses. Lush spring pasture is low in Mg and can result in grass tetany in cows. Forages that are very mature are more lignified than young immature plants. Nutrients that are bound in lignin are no longer available for digestion.

**Table 3: Range of micronutrient concentrations required for normal plant growth and animals**

| Micronutrients | Plant Concentration in ppm (parts per million) | Animal (ruminants) Concentration in mg/kgof dry matter |
|---|---|---|
| Iron (Fe) | 0.5 to 5.0 | 30-40 |
| Manganese (Mn) | 0.1 to 0.5 | 25-40 |
| Boron(B) | 0.1 to 1.0 | 0-5 |
| Zinc (Zn) | 0.02 to 0.2 | 40-50 |
| Copper Cu) | 1. to 0.05 | 1.2-15 |
| Molybednum (Mo) | 0.01 to 0.05 | - |
| Chlorine (Cl) | - | - |
| Selenium (Se) | - | 0.1 |
| Iodine(I) | - | 0.5-0.15 |

Source: G.E.J Fisher(2008)

## METHODS OF SUPPLEMENTATION OF MICRONUTRIENTS IN PLANTS AND ANIMALS

Plants:

a. Soils Application: - The require quantities of materials are broadcast or placed by adding dry soil or fine sand before planting the crop e.g. B,Cu,Zn.
b. Foliar Application: - Low doses of micronutrients are applied through sprays on plant foliage. Crops in younger stages require less solution, while crops more foliage or fruit trees like oranges, require more solution for spraying e.g. Fe,Mn,B.
c. Addition through mixed fertilizers: - Uniform of spreading of the micronutrients essential for different regions are added to the spread fertilizer or to fertilizer mixture used e.g. phosphates mixed with boron, molybdenum or zinc.
d. Seed soaking: - Low concentration of micronutrient solution is used to soak the seed for about 12 hours before planting e.g. Mo.
e. Seed coating: - Micronutrient mixed with a small amount of soil made into a pest is coated around the seeds, dried and then used for sowing e.g. Mo.

Animals

There are many ways of correcting a low supply or an imbalance of minerals to livestock. Most of these are effective if carried out carefully. They are itemized in the following scheme:

- Treat the soil
  - Fertilizers and sprays
- Treat the herbage
  - Herbage sprays
- Treat the animal
  - Metered water
  - Feeding blocks and licks
  - Supplementation through the feed
  - Injecting
  - Drenching
  - Dosing (e.g. of boluses)

The key in deciding which is the most appropriate for any particular situation lies in the following steps:

1. Establish through soil/plant/animal investigation that micronutrient supplementation into the system is necessary
2. Try to understand why the deficiency exists (low levels in soil; herbage species grown; production level of the animals)
3. Establish which elements must be supplemented after taking into account any interactions that may occur the positive impact of micronutrients when used in production systems.
4. Establish with the farmer which supplementation route best fits the system (for example, if the problem requires a quick solution, do not leave the farmer with a supplementation route where the elements are relatively unavailable and will take months or years to properly enter the whole of the system)

5. Balance the decision on supplementation route with the relative costs of different options
6. Implement supplementation and monitor effects
7. Change supplementation according to monitored results.

## CONCLUSION

Although micronutrients are required in very small quantities in both plants and animals but they play very important part in their growth and development. The deficiency of micronutrients in both living system can markedly reduce their yield, performance and profitability in agriculture production. So, farmers must focus on the micromineral balance as long-term gain can only be attained by monitoring micronutrient deficiency. These must be based on efficacious, appropriate, and cost-effective means of delivery.

# Effect of Climate Change on Agriculture

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***Abstract***
*Climate change, the consequence of the "Global Warming" has now broadcasting its impacts worldwide.Vulnerability to climate change may be serious problem in the developing world, where agriculture typically plays a giant economic role. Higher temperatures, changes in precipitation, and higher atmospheric $CO_2$ concentrations are the main scenarios.Climate is the principal determinant of agricultural productivity which directly impact on global food production.Increase in the mean seasonal temperature can reduce final yield by reducing the crop duration.There will be serious outbreaks of pests and diseases affecting the food security of the country. The net impact of food security will depend on the capacity of crop to combat global environmental change. The impact of climate change on agriculture subsisted by careful management of resources like soil, water and biodiversity will require.*

## GLOBAL CLIMATE CHANGE

It is an identifiable change in the climate of earth as a whole that lasts for decades or longer. When due to natural processes, it is usually referred to as global climate variability and usually refers to climate change when forced by human activities that change the atmosphere.

**Agriculture & Climate Change: A three-fold relationship**

I. Agriculture as a contributor to Climate Change
II. Impacts of Climate Change on Agriculture
III. Agriculture as a potential moderator of Climate Change

**Agriculture as a contributor to Climate Change**

- The primary sources of greenhouse gases in agriculture are the production of fertilizers.
- One of the biggest problems in industrialized agriculture is the massive overuse of fertilizers. More than 50 percent of all fertilizer applied to the soil ends up in the atmosphere or in local waterways.

- The combustion of fossil fuels such as coal, gasoline, diesel fuel and natural gas and waste management contributes to global warming.
- The second biggest direct emitter in agriculture is animals. Animals produce and emit large amounts of methane during digestion which is a potent greenhouse gas.
- Cutting down forests and other natural cover to provide agricultural land for grazing, growing animal feed and other crops, removes key 'carbon sinks' for that plants and soils that absorb carbon from the atmosphere and increases global warming.
- Residue burning also emits many green house gasses.

According to National Institute of Abiotic Stresses Management (2014) enteric fermentation contributes maximum in climate change among various agricultural sectors (Fig 1).

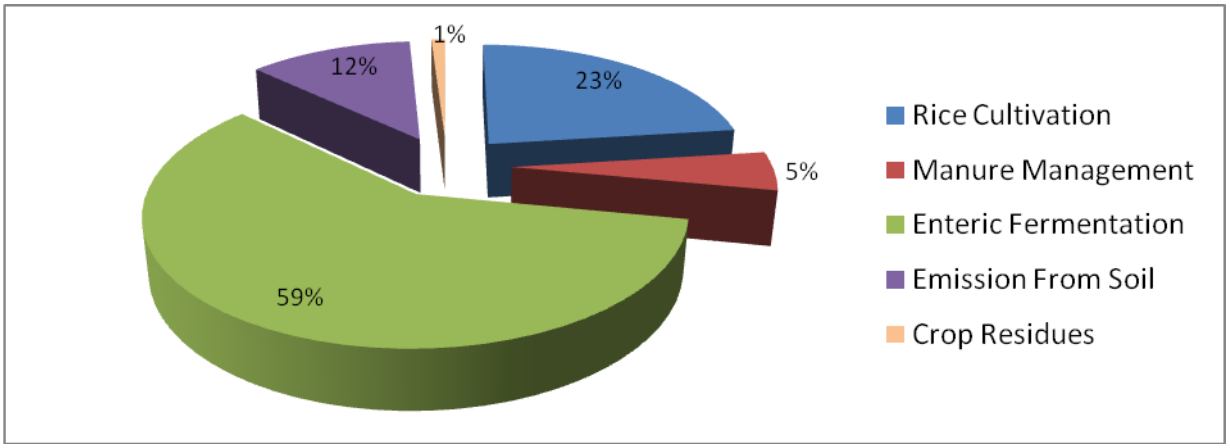


**Fig 1: Sectors of agriculture contributing to climate change**

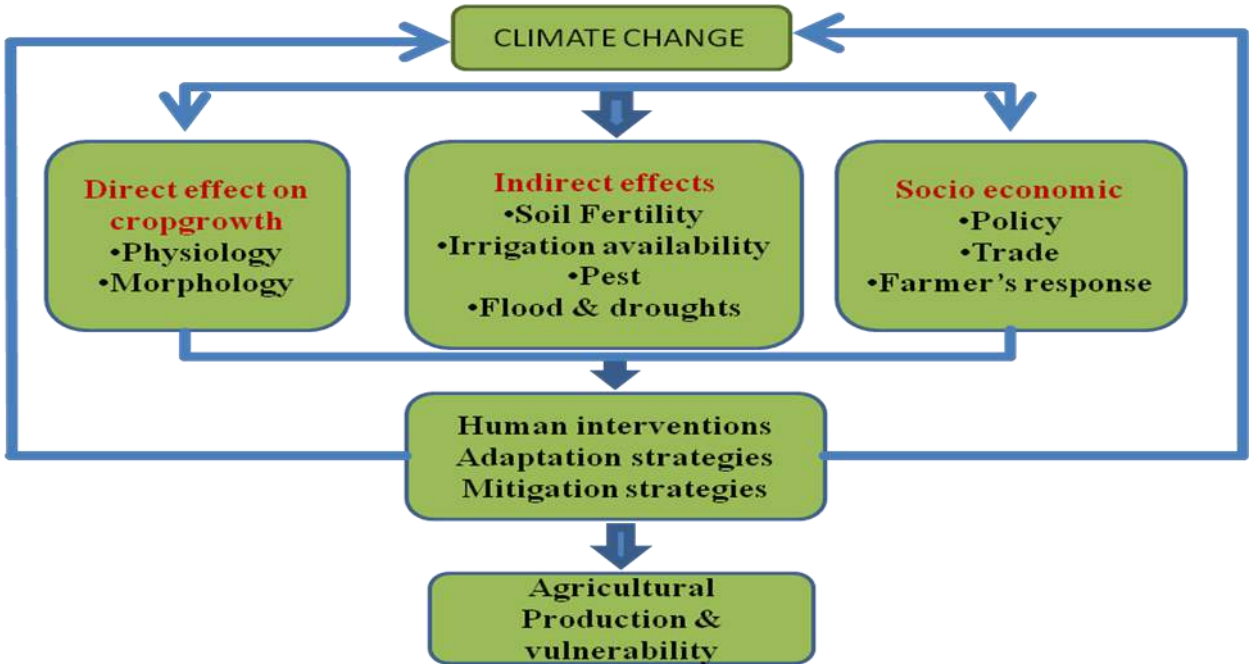


**Fig 2: Predicted climate change impacts on agriculture**

**Predicted climate change impacts on agriculture**

Interrelationship between climate change and its impact on agriculture is described shortly in Fig 2.

**Potential Impact of Climate Change on Rice Production**

- Rice yield was noticed to decrease by 10% for every 1ºC increase in growing season minimum temperature. (Peng et al., 2004)
- Heat stress leads to high sterility.
- Above 33 ºC sterility of rice increases drastically.
- Severe yield reduction.
- Grain quality (chalkiness) increases with high Temperature.

**Potential Impact of Climate Change on Maize Production**

- An increase in mean air temperature by 3°C above the present condition has considerable negative impact on maize yield (Lobell et al., 2013).
- Increase in $CO_2$ concentration up to 700 ppm has a positive effect on maize yield.
- Adverse effect of temperature rise dominates over positive effect of $CO_2$ concentration significantly when it is 3°C above the current temperature condition.

**Potential Impact of Climate Change on Soybean Production**

- Soybean yields could go up by as much as 50 per cent if the concentration of carbon dioxide in the atmosphere doubles.
- If this increase in carbon dioxide is accompanied by an increase in temperature, then soybean yields could actually decrease. If the maximum and minimum temperatures go up by 1°C and 1.5°C respectively, the grain yield comes down to 35 per cent. And if maximum and minimum temperatures rise by 3°C and 3.5°C respectively, then soybean yields will decrease by five per cent (Lal et al. 1999).

**Potential Impact of Climate Change on Sugarcane Production**

- The incidence of smut, ratoon stunting, brown and orange rust diseases are increased.
- Extreme climate events like drought, tropical cyclone has negative effect on production.
- The most important positive impact is reduction of incidence of frost.
- Marin at al. 2013, by using crop simulation models predicted that cane yield in 2050 could be 15–59% higher than that at the current average level.
- In the South Caribbean, sugarcane yield may decrease by 20–40% under a doubled $CO_2$ climate change scenario based on outputs of a crop model. (Singh and Maayar 1998).

## Potential Impact of Climate Change on pulse Production

- Due to low precipitation the area under pulse is progressively shifting towards Central and South India, where rainfall is not so unpredictable.
- The surface air temperature is rising alarmingly at a rate of 0.4 °C per century. Pigeon pea is very sensitive to abrupt fluctuations of temperatures either higher or lower extremes leading massive flower drop. (Kesava Rao et al., 2013)
- In experiment at Kanpur observed that high temperature coincides with the onset of reproductive phase adversely affected not only total biomass but also pod setting, seed per pod and pod weight.
- It is projected that yields in pulse having C3 mechanism of photosynthesis may increase by 10-25% when atmospheric $CO_2$ reach up to a level of 550 ppm.
- There is clear evidence that climate change is altering the distribution, intensity, and incidence of pests and diseases.
- The impact of pulse productivity may be less severe than cereal productivity.

**Potential Impact of Climate Change on Mustard Production**

- Mustard yield is likely to reduce in both irrigated and rain fed condition.
- High temperature during reproductive stage causes abnormal development of reproductive tissues, poor production of sink tissues, reduced supply of photosynthates and pod initiation. All of which lead to poor productivity mustard (Boomiraj et al., 2010; Kumar et al., 2010; Rana et al., 2011).

**Potential Impact of Climate Change on Soil**

Effects on-

- Soil erosion
- Acidification
- Salinization
- Biological degradation

**Potential Impact of Climate Change on Weed Growth**

- In drought situation C4 weeds have advantages over C3 crops under elevated $CO_2$ (Ward et al. 1999).
- Biomass accumulation from $CO_2$ doubling in C3 weeds: 79%-80% compared to ambient $CO_2$ (Patterson 1995)
- Elevated $CO_2$ under sufficient moisture condition will lead to higher C3 weed competitiveness (Tang et al. 2009).
- With increase in $CO_2$ level Weedy rice responds more strongly than cultivated rice, Problems of *Phalaris minor and Avena ludoviciana*in wheat would aggravate , *Cynodon dactylon* in rice and *Convolvulus arvensis*in wheat show a strong response in growth.

## Potential Impact of Climate Change on Insect

- Reduced nutrient quality of C3 plants might becompensated by increased feeding of many insect (DeLucia et al. 2008).
- Population densities of chewing insects would be unaffected or reduced, but do not increase(Whittaker, 1999)
- Sap sucker population densities might increase under increased $CO_2$ concentration (Whittaker, 1999).
- Due to temperature change some insects take several years to complete life cycle like Cicadas, Arctic moths etc and some develops quickly at certain temperature range like cabbage maggot, onion maggot, European corn borer, Colorado potato beetle, aphids, diamond back moth etc.
- Prediction is that, cutworm infestation will be more in future because they are sensitive to flooding and summer rainfall, which will increase in future.
- In higher $CO_2$ concentration Soybean crop had 57% more insect damage by Japanese beetle, Leafhopper, Root worm, Mexican bean beetle etc than earlier.
- Increases in temperature can modify host physiology and resistance.

**Potential Impact of Climate Change on Disease**

- High concentration of CO2 in the host tissue promotes the development of biotrophic fungi, such as rust. (Gautam et al. 2013)
- The severity of downy mildew damage was significantly reduced at high level of CO2. (Gautam et al. 2013)
- *Rhizoctonia bataticola* of chickpea and P*hytopthora drechsleri* of pigeon pea emerged as a potential threat.

## Agricultural strategy in mitigating climate change

There is several adaptation measures that the agricultural sector can undertake to cope with future climate change which include:

- Changing planting dates;
- Planting different varieties or crop species;
- Development and promotion of alternative crops;
- Developing new drought and heat-resistant varieties;
- Improved crop residue and weed management;
- More use of water harvesting techniques;
- Better pest and disease control for crops;
- Implementing new or improving existing irrigation systems.
- Farming practices and technologies should reduce greenhouse gas emissions and prevent climate change by:
- enhancing carbon storage in soils;
- preserving existing soil carbon;
- Reducing carbon dioxide, methane and nitrous oxide emissions.
- Reducing use of fertilisers

- Protecting the soil by cover crop
- Land restoration and land use changes
- Methane should be used

## CONCLUSION

Global climate change is not a new phenomenon rather we can say it is a reality & we can't stop this. Climate change embraces many threats; one of the important consequences is bringing changes in the quality and quantity of crop produce. It can be concluded that the agriculture sector is the most inclined to climate change as it will have a direct bearing on the living of 1.2 billion people. There is adrastic need for harmonize efforts to strengthen the research to informal size upof the impact of climate change.Crop and/or land use diversification may be one of the propositions.

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# Artificial Insemination in Equines

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## ESTRUS AND ESTRUS CYCLE IN MARES

The mare is seasonally polyestrus and has a reproductive season and a non-reproductive season, both of which are controlled by light. The non-reproductive season, known as anoestrus, occurs in the winter season when there is insufficient day light. The reproductive season begins in the spring when light levels increase and continues through the summer. Mares therefore cycle naturally from March/April through to September/October. The peak of the breeding season is in the months of April, May, June and July. Two other periods are known as the spring and autumn are the transitional stages. But in tropical countries like India, the breeding season often start early i.e from the months of March and lasts till the months of October. One occurs just before the mare becomes reproductively active in the spring and the other occurs just before anoestrus in the winter. During these periods mares are generally erratic in their cycles and sexual behaviour. The spring transition period coincides with increased daylight hours, increased grass growth and ambient temperatures. As the season progresses estrus cycle in mare becomes regular. Puberty in the filly occurs, on average, at one-and-a-half years of age. Spring-born fillies show heat as yearlings and those born later in the year generally do not cycle until they are two years old.

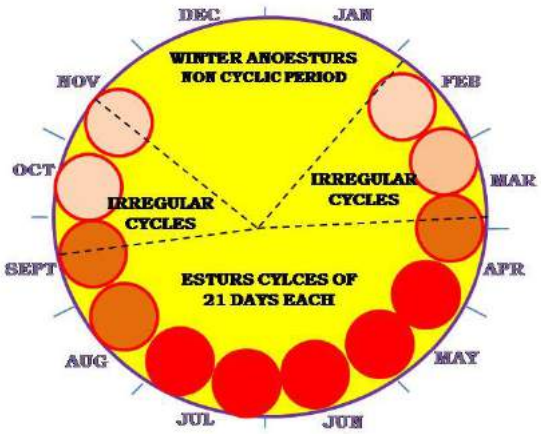


Fig. The breeding and non-breeding seasons for mares.

There are two different stages to the estrous cycle. These are generally distinguished by the mare's behavioral responses to the stallion. Estrus (heat) lasts an average of 5 to 9 days. Interestingly, the mare has the longest estrus period in comparison with any other domestic animal. Estrus is characterized by receptivity to the stallion. A mare showing classical estrous behavior will adopt an urination stance - squatting with legs spread and tail raised. She will lean towards the stallion, urinate in small volume frequently, and expose her clitoris by averting her vulva (winking) (Fig. A-C). Most mares cease estrus behavior within 24 to 48 hours following ovulation. This marks the beginning of the other stage of the cycle, known as diestrus, which lasts an average of 14-16 days. During diestrus, the mare rejects the stallion with behavior typically seen in the form of tail switching, squealing, striking, biting and/or kicking. These behaviorally defined divisions in the estrous cycle roughly parallel the events which are occurring in the ovary is termed the follicular phase and the luteal phase. However, these latter two phases are defined by the endocrine (hormonal) events punctuating the estrous cycle.


Fig. Classical signs of a mare in Estrus.

## SEXUAL BEHAVIOUR OF MARE AND ESTRUS DETECTION

Accurate detection of estrus is essential to the efficiency of any horse breeding program. An important factor in successful reproduction of horses is the ability to determine when the mare is ready to be bred. In order to breed the mare at the optimal time to achieve conception, it is imperative to be able to detect estrus, particularly if a technician skilled in rectal palpation and ultrasound monitoring is not available. For many, this simply involves recognizing estrus (the heat period) in mares so that they can be bred or inseminated at the appropriate stage of the cycle. However, many mare owners desire to have their mares foal at a specific time of the year. Conception rates are highest when mares are bred 1 to 2 days prior to ovulation. Although time of ovulation is difficult to predict without the use of ultrasonography, it most frequently occurs 24 to 48 hours prior to the end of estrus. Estrus generally has a range of 3 to 8 days. It begins with the mare showing a slight interest in the stallion and then increases in intensity until ovulation or shortly thereafter. Estrus ends abruptly one day after ovulation.

Palpation and teasing are the two best and most commonly used management tools being used in the detection of heat. Rectal palpation and ultrasonography will help define the time of ovulation, and thus aid in mating management. Parameters as follicular size,

follicular consistency, cervical size and consistency, and uterine tone can be monitored through rectal palpation. A mare with a large, very soft follicle that has an open cervix is a right candidate for breeding. On the other hand, a mare that has no or very small turgid follicles and a closed cervix would be a poor candidate for breeding. Most managers use a combination of teasing and palpation for estrus detection and breeding determination. Mares are teased and those showing signs of estrus are palpated to better define reproductive status. Mares can be individually teased or placed in teasing pens which are constructed to allow for group teasing. Increasingly, ultrasonography is being utilized for estrus detection and determination of ovulation. With real-time ultrasonography, veterinarians can determine follicular size, early ovulation, uterine changes characteristic of estrus, and abnormalities of the reproductive tract. Ultrasonography is a significant contributor to reduction of the number of breedings or inseminations required per estrus. Each mare responds and acts differently during estrus. Thus, day to day monitoring of teasing status and reproductive tract parameters is essential.

For successful insemination, a mares' sexual cycles must be monitored or controlled. Simple monitoring is done by physical examination or electronically by ultrasonographic imaging (Samper, 2000). Internally, mares will have an increase in clear, highly lubricating, low viscosity vaginal and cervical fluid. The pH in a diestrus mare is approximately 7, the pH of an estrus mare can be more alkaline or more acidic due to changes in vaginal mucous (Samper, 2001). The cervix will appear flat, and both the uterus and cervix are swollen and soft (Samper, 2000). The cervical orifice will dilate; at the beginning of estrus it will be one finger width wide, and by the end 3 fingers‟ width wide. The uterine horns will easily flatten with touch during palpation, as opposed to diestrus when uterine horns remain hard and incompressible (Samper, 2000). Endometrial folds will increase in number and become slippery.

## SIGNS OF MARE NOT IN ESTRUS/HEAT

- Rejection of stallion's presence (ears pinned, kicking, biting or pawing at stallion) or complete lack of interest in stallion.
- Not aggressive toward stallion, but looks away or is not interested.

Signs of a mare in Estrus/heat

- Shows interest by facial expression and may approach stallion; slow to show interest. Mare may raise tail or exhibit some winking (eversion of the labia of the vulva). Mare may show these signs at a distance, or in close proximity to stallion.
- More interest in stallion as demonstrated through facial expression, tail raising, flexion of pelvis (posturing), winking and clear discharges with urination.
- Intense interest in stallion as demonstrated by turning hindquarters to stallion, leaning towards stallion and exhibiting frequent winking and urination.

## FACTORS THAT CAN AFFECT THE MARE'S EXPRESSION OF ESTRUS

*Mares with Foals*: Mares may be protective to the foal and not exhibit estrus. It may require teasing the mare outside the stall/stable away from the foal (the mare may show

a sign of estrus after the stallion leaves). And mares in lactation due to hormonal inhibition they may not exhibit the estrus symptoms.

*Maiden Mares*: Mares that have never been teased before will require additional time to become familiar with the process. In some situations with maiden mares, you may need to lead the mare to the teasing area in order for the mare to learn the process.

*Timid Mares*: Some mares may not show estrus when being actively teased by the stallion but may do so as the stallion moves away. In a stall or pen teasing situation, these mares may show strong signs of estrus when the stallion is teasing the mares before or after them.

*Weather or Other Environmental Conditions*: Hot or cold temperatures, wind, or precipitation may reduce signs of estrus. Also, the presence of insects may distract a mare and keep her from expressing true estrous behavior.

*Stage of Breeding Season*: Early in the breeding season, some mares may not exhibit signs of estrus as readily as later in the breeding season.

Artificial insemination (AI) technique is being widely used in domesticated animals worldwide for rapid genetic improvement besides its several associated advantages like easy transport of semen and semen storage for years by cryopreservation, and control on spread of venereal disease transmission. The initial research on AI technique was started in horses and dogs, with first commercial application of AI in horses in Russia at the end of 19$^{th}$ century. But, in subsequent years, invention of combustion engine drove AI research towards its use in other farm animals which had comparatively greater earning potential. Development of AI in horses was further limited owing to have poor post thaw sperm motility and wide individual variation in stallion semen freezability besides implication of rule by the horse breed registries. Recent increase in interest for use of AI in horse is influenced by economic reasons, inspired with success in other species, horse breed registries allowing foals born through AI, realization for advantages of AI and new development in semen cryopreservation technology. AI in horses is usually performed either with fresh, chilled or frozen semen and the technique can be learned easily. For better results of AI in horses, attention is required to see reproductive competence of the recipient mare, proper handling of semen and the timing of insemination.

## ADVANTAGES OF ARTIFICIAL INSEMINATION

- Faster genetic improvement can be achieved through AI for using superior genetic merit and with introduction of new genetic material.
- Number of mares covered per stallion Increased in a season, thus making valuable stallions available to the ordinary mare owner.
- Mares suffering from skeletal abnormalities or weaknesses, laminitis etc or with nervous temperament can be bred using AI to overcome limitations for use of natural service.
- Mares with heightened immunological response to spermatozoa and that shows some degree of endometritis post coital can be benefited with smaller doses of spermatozoa used in AI than would normally be ejaculated at natural service.

- It encourages routine examination of mare's reproductive tract.
- Avoiding direct contact between the mare and the stallion remove risk of injury.
- Semen collection and its evaluation prior to AI allow problems to be detected quickly so that immediate remedy can be taken.
- Addition of antibiotics to semen extenders reduces chances of venereal disease transmission compared to natural service.
- Reproductive potential of sub-fertile stallions can be enhanced by treatment of semen for concentration, addition of supportive and protective factors for spermatozoa.
- Extension of stallion's breeding season can be possible using semen frozen during non-breeding season.
- Comparatively reduced cost of semen transportation without a geographical barrier and avoid hazardous movement of horse/mare.
- Provide assistance for preservation of rare breeds by reintroduction of stored semen from such breeds i.e. *ex situ* conservation.

## SELECTION OF SUITABLE MARE FOR AI

AI can be used successfully in all categories including, maiden, barren and mare with foal at foot. It is best to ensure reproductive competence of mare before use of AI technique to avoid disappointment of repeated insemination that may not be attributable to the technique but rather to the inability of the mare to conceive. Following criteria can be used to assess suitability when considering use for AI.

**History of the mare:** Past breeding parameters such as estrous cycle length and frequency, period of estrus, behavior and signs of estrus, incidences of dystocia and uterine infections should be investigated. Best results are obtained from mares with history of high conception rates.

**Temperament:** an uncooperative and highly nervous mare may make procedure of AI hazardous to all concerned and present considerable stress.

**Body condition:** It is generally believed that a mare with good body condition will be more likely to conceive than an over thin and over fat condition.

**Age:** Best results in terms of successful pregnancy come with mare age group between 5 to 12 years without any significant decrease in fertility. Older mares may build up infections, scar tissue, adhesions etc that causes reduction in fertility.

**Reproductive tract examination:** Examination of competence of reproductive tract should be done both externally and internally.

*External examination:* Poor perineal conformation is an indicative of reduced ability to conceive. An ideal height of pelvic floor is that 80 percent of vulva should lies below the pelvic girdle and 20 percent above it. As this proportion changes, the angle of vulva slopes and collect faeces in the ventral part of vulva. The poor conformation along with pneumovagina results in uterine infections.

*Internal examination:* Internal assessment procedure includes rectal palpation, ultrasonography and further more detailed examinations such as endoscopy, utrine biopsy and culture. Rectal palpation allows assessing tone, size and texture of uterine

body, horn and ovaries. Stage of mare's cycle and its suitability for AI can be assessed. Abnormalities such as ovarian and uterine cyst, tumours, pyometra, adhesions, delayed involution etc may be diagnosed. Use of ultrasonography provides assistance to improve accuracy for evaluation of reproductive tract. Size and shape of uterus and ovaries, accumulation of intrauterine fluid, cyst, appropriate time of insemination and pregnancy status can be determined. Endoscopy is comparatively invasive technique and has limited applicability for AI. This technique enables to take a biopsy sample of endometrial tissue from the uterus.

## PREPARATION OF THE MARE FOR INSEMINATION

Once considered for AI, the mare is first secured into travis and back racking is performed. This is followed by cleaning of perineal area thoroughly first with water and then most commonly using an iodine preparation such as Betadine. Tail is wrapped with sterile gauge and deflected to one side where it should remain throughout the insemination process to avoid contamination of the scrubbed area.

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### Preparation of semen for insemination

Once the mare is ready for AI, the frozen straws is picked up from the shipping container/storage container, dipped in water at 37$^{o}$ C for 30 second for thawing and loaded in a 5 ml sterile syringe. Usually eight to ten straws of 0.5 ml are thawed and cut to make an insemination volume of 4-5 ml to have sufficient number of progressive motile sperm (400-500 millions) per insemination (Fig. A -C).

### Thawing procedure

To use frozen semen for AI, straws are taken out from storage container, dipped in water bath kept maintained at 37°C for 30 second to 1 minute or thawing kit adjusted to 37°C In equines, large volume is needed for insemination so 8-10 frozen straws (0.5 ml) are taken out for thawing to make 4-5ml of volume. Straws are wiped with tissue paper to remove water and cut to load into syringe for insemination (Fig. A-E). A small drop from thawed semen is taken for evaluation of post thaw motility before use in AI. Semen samples having post thaw motility ≥35% is considered suitable for use in AI.


Fig. Removal and thawing process of semen straws


Fig. Cleaning and loading of semen from straws in to the inseminating syringe

**Time of insemination**

As ovulation approaches, the follicle feels very soft in per-rectal examination. The irregular shape of ovulating follicle with an ovulation point and size reaches between 45 to 55mm can be seen using ultrasound scanner. This helps in predicting the ovulation time and to decide the time of AI. Optimum time to inseminate the mare with fresh, chilled and frozen semen is 24 to 48 hrs before ovulation, 12 to 18 hrs before ovulation and 6 hours before to 6 hours after ovulation, respectively.

**Frequency of insemination**

Two or more AI with frozen semen per cycle usually results in higher pregnancy rates as compared to mares inseminated only once. Insemination need to be repeated at every other day when chilled semen is used or daily with frozen semen unless palpation or scanning of mare's ovaries is undertaken.

**Dose and site of insemination**

Usually eight to ten straws of 0.5 ml are thawed and cut to make an insemination volume of 4-5 ml to have sufficient number of progressive motile sperm (400-500 millions) per insemination. A total of 300 million progressively motile sperm per dose is also recommended for frozen-thawed semen. Post-thaw sperm motility in frozen semen samples should have at least 30% or more progressively motile sperm to be considered acceptable for AI in mares. Standard practice is to place semen in the uterine body. However, deep intrauterine AI with only 5 to 100 million progressively motile sperm may achieve an acceptable pregnancy rate.

Insemination techniques using low sperm numbers

As stated earlier, the current thinking is that the number of sperm reaching the oviduct may be only between 100 and 1,000. Once this discovery was made, it seemed a logical conclusion for researchers to investigate how few sperm may be necessary to achieve fertilisation when placed directly at the tip of the uterine horn during insemination. This interest stemmed from the increase in frozen semen usage. Semen from some stallions is notoriously difficult to freeze or in very short supply, and it would be of tremendous benefit if mares could become pregnant via inseminating much lower doses of sperm. The technique is termed low-dose insemination, and since the sperm are inseminated much further into the uterus than with conventional AI, the other term used to describe the technique is deep uterine insemination (DUI).

There are two methods for inseminating the sperm deep into the uterus. The first is to use a special catheter, which is guided up the uterine horn by placing one hand in the rectum of the mare and slowly advancing the catheter to the tip of the horn. The second method is to place an endoscope in the uterus and visualise the tip of the uterine horn. The semen can then be inseminated via a special catheter inserted down the channel of the endoscope. These two techniques will now be examined in more detail.

**Deep uterine insemination using a rectally-guided catheter**

The mare should be prepared for DUI in a clean, well-lit environment; stocks for restraint are essential. Light sedation may be useful in certain cases. The tail should be bandaged and tied out of the perineal region. Immediately prior to insemination, rectal examination should be performed to empty the mare's rectum of faeces and confirm either the presence of a large follicle about to ovulate or the site of a fresh ovulation.

The inseminator must decide the side of insemination (left or right) based on this rectal examination. The vulva and perineal area should be thoroughly cleansed with very dilute antiseptic solution or mild soap. This is then thoroughly rinsed off with fresh warm water and the perineal area dried with clean, soft, disposable (paper) towels. The inseminator should use a sterile obstetric glove (such as a glove turned inside out). In certain circumstances, a sterile surgeon's glove should be placed over the clean rectal glove. It may be necessary to place a small amount of sterile, nonspermicidal lubricant (such liquid paraffin) on the top of the hand around the knuckles.

A special catheter is used, which is long enough (75cm) to reach the tip of the uterine horn while still having one end protrude from the vulva. The catheters have a special rounded tip at the end so that they can be advanced up the uterine horn ipsilateral to the ovary with the large follicle or fresh ovulation, without catching on the folds that line the uterus. The catheter should be held with the tip behind the fingertip and the hand brought into the vulva. The external opening of the cervix should be located with the index finger and a finger inserted into the cervical canal.

The catheter is inserted alongside the finger and gently pushed forward. It is very important that the catheter reaches into the uterine body and does not remain obstructed in the cervix. This passage through the cervix is not always easy. The hand used to introduce the catheter is then withdrawn from the vagina and placed into the

rectum of the mare. The catheter can then be felt within the uterus and guided deeper into the uterus than can normally be achieved.

In fact, the catheter should be gently pushed until the tip is at the very tip of the uterine horn when it will be adjacent to the oviductal papilla. This is where the sperm should be deposited. The first straw of semen should be inserted into the catheter with the cotton plug towards the outside of the catheter. A steel plunger is used to push the straw to the tip of the catheter, where the open end lodges in the nipple-like protrusion at the end of the catheter. If more than one straw of semen is used for the insemination, the system described above provides an easy and effective way of delivering the semen by removing empty straws from the catheter without having to replace the catheter. Using this technique, satisfactory pregnancy rates have been achieved with sperm numbers of 50 million to 100 million.

**Deep uterine insemination using an endoscopic technique**

It is possible to place an endoscope into the uterus of a mare through the vagina and cervix in much the same way as an insemination catheter is passed. The rectum is evacuated and the side of insemination determined, in the same way as for the rectally guided catheter technique.

The perineal area is washed and cleaned and the mare lightly sedated. A 1.6m to 2m flexible video-endoscope, with a diameter of at least 11mm, is used. The endoscope is inserted into the uterus of the mare via the cervix. Air is then passed through a channel in the endoscope into the uterus, which allows the inside of the mare's reproductive tract to be visualised.

The operator can then gently steer the tip of the endoscope all the way up the uterus until the entrance of the oviduct into the uterus is reached. This area is termed the oviductal papilla. A special narrow catheter can be passed down a central channel within the endoscope. The tip of the catheter is exposed beyond the end of the channel so it can be visualised. By carefully steering the endoscope's tip, the catheter can be placed either very close to or touching the oviductal papilla.

Semen is then blown out of the catheter directly on to the papilla's surface. Using this technique, acceptable pregnancy rates can be achieved using as few as five million sperm. This represents a 100-fold decrease in the usual number of sperm needed. By depositing the sperm so close to the site of fertilisation, the distance the sperm need to travel is reduced. In addition, exposure to the potentially hostile uterine environment is reduced. These are the two most likely reasons why sperm numbers can be so drastically reduced.

## INSEMINATION PROCEDURE

The actual process of artificial insemination in a mare is not complicated, and can be learned very rapidly. Unlike artificial insemination in cattle, i.e, recto-vaginal method, in equine it is vaginal method of insemination. During AI perineal area is cleaned thoroughly most commonly using an iodine preparation such as "Betadine. Mare should be properly restrained. Tail is wrapped with sterile gauge and deflected to one side

where it should remain throughout the whole insemination process to avoid contamination of the scrubbed area (Fig.A-D).


Fig. Cleaning of mare perineum before subjecting for AI

Once the mare is ready for AI, the semen is removed from the shipping container/$LN_2$ container and thawed at 37° C for 1 minute and loaded in a sterile syringe. The inseminator will introduce his arm into the mare's vagina after applying proper lubricants (non-spermicidal lubricating jelly), gloved thumb is placed over the end of the pipette prior to it's introduction into the vagina, palpate the cervix, which should be found on the ventral surface of the vagina (Fig. A-D).


Fig. Steps for proceeding for AI

The closer the mare is to ovulation, the more relaxed the cervix becomes. In the center of the cervix will be found a small depression, which is the opening to the uterus after locating the cervical opening using index finger as shown in the following picture.

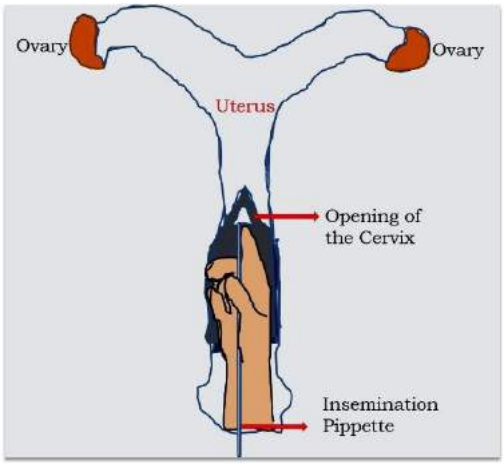


Fig.. AI procedure in equines

It is important not to force the pipette at any point, as internal damage may occur if that is done. The gloved thumb is placed over the end of the pipette prior to it's introduction into the vagina. This protects it from picking up any contaminants which may subsequently be inseminated into the uterus along with the semen. With the pipette introduced into the uterus as far as possible without any resistance, the plunger of the syringe is slowly depressed, introducing the semen. Before removal of the pipette, the syringe may be unhooked and rehooked so that 2 cc of air may be introduced behind the semen in order to clear the pipette of the remaining semen. It is important that excess air is not introduced into the uterus, and a very small portion of the semen should remain at the very end of the pipette when it is removed from the uterus. The arm should then be slowly withdrawn from the vagina. It is acknowledged that the best pregnancy rates are achieved when the semen is inseminated no more than 12 hours before or 6 hours after ovulation. Consequently, it has been suggested that monitoring by rectal palpation should be performed as often as every 6 hours, or by ultrasound every 12 hours.

## FACTORS INFLUENCING SUCCESS OF AI

Several factors affect the success of AI, including method of semen storage, the volume of semen and concentration of sperm in semen to be inseminated besides other considerations such as timing and frequency of insemination per estrous cycle. The technique and skill of the inseminator and fertility of the stallion or seminal quality also have an influence on the success of AI. It is acknowledged that the best pregnancy rates are achieved when the frozen semen is inseminated no more than 12 hours before or 6 hours after ovulation. Consequently, it has been suggested that monitoring by rectal palpation should be performed as often as every 6 hours, or by ultrasound every 12 hours.

## CONCLUSION

There are advantages and disadvantages involved with all techniques as with the AI technique. The advantages of AI in equines far ever than the disadvantages, and that many of the later can be addressed by applying appropriate regulation, training of personnel for correct use of the AI technique and good management of associated

activities. Factors which have a great impact on any artificial programme are the quality of semen, the breeding status of the mare and the management of the mare during the estrus period. During semen preservation the quality of the semen is severely compromised. Beside these this the contamination with pathogens and saprophytes severely hamper the outcome of artificial insemination.

# Institutions in integrated watershed management project

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## ABSTRACT

**Collective management of resources is a prerequisite for successful watershed management and it requires strong institutions. Intuitions played an important role in the implementation of gender mainstreaming policies in Integrated Watershed Management Project. Watershed committee, SHGs, NGOs, Gram Panchayats and Mahila Mandals are found to be working as a bridge between government policymakers and beneficiaries for the effective implementation of gender mainstreaming policies. This is especially true that these institutions played an important role in sensitizing community people about those aspects of rigidity and conservation which act as impediments to the development of women.**

## INTRODUCTION

Institutions are humanly devised restrictions that shape human behavior defined by Nkonya *et al* (2008). Knight (1992) found that institutions develop in response to social needs and interactions among many actors or groups of actors in a society like different social groups. Institutions are the rules and regulations which are framed by people themselves to guide human interaction in society (North, 1990). Institutions in rural areas play a key role in effecting change and transforming the lives of rural women. Their work ranges from addressing women's basic needs, advancing women's economic empowerment, promoting their political participation and leadership. Collective management of resources is a prerequisite for successful watershed management and it requires strong institutions. In the present study, it was clear from the review of literature that watershed management project involves diverse groups of institutions such as SHGs, NGOs, Gram panchayats, Line departments, Research bodies, Voluntary organizations, project implementing agency, User groups, Watershed committee etc. But there were five institutions namely SHGs, Watershed Committee, NGOs, Gram Panchayat and Mahila Mandal were selected for the present study. These intuitions have an important role in the implementation of gender mainstreaming policies in Integrated Watershed Management Project. There were five institutions namely SHGs, Watershed

Committee, NGOs, Gram Panchayat and Mahila Mandal were selected for the present study, to know their role in gender mainstreaming in IWMP. There were fourteen activities pertaining to gender mainstreaming was prepared after consulting the literature as well as experts. Responses of respondents were recorded on the basis of which institution does what pertaining to gender mainstreaming.

## ROLE OF INSTITUTIONS

Focused group discussion and observation were done besides survey to analyze the role of these institutions in gender mainstreaming. IWMP was started in 2009 to create awareness and providing solutions to various community problems related to their livelihood as well as farming related aspects. In a focused group discussion, efforts were made to understand the role of institutions working under Integrated Watershed Management Project in the generation of livelihood opportunities among women. Women identified several aspects of livelihood improvement i.e. agriculture, education, health, participatory communication and information sharing, governance, personality development and women empowerment. The participants explored the role of these institutions in these aspects very critically. Watershed committee, SHGs, NGOs, Gram Panchayats and Mahila Mandals are found to be working as a bridge between government policymakers and beneficiaries for the effective implementation of gender mainstreaming policies.

It was observed that institutions had an active and nurturing role in inclusion of women in governance, social and economic empowerment of women in the issues of concern. Institutions helped in bringing stakeholders together at one platform like experts, successful farmers, SHGs leaders, line departments, credit agency and farmers to communicate and understand each other. These institutions played an important role in generating a dialogue between stakeholders and beneficiaries and also helped to reach uneducated women farmers with the help of women social experts. It was found to play an important role in sensitizing community people about those aspects of rigidity and conservation which act as impediments to the development of women.

## WATERSHED COMMITTEE (WC)

Watershed committee has been working as a leading institution for women integration in watershed management activities. It was found out that women had received training in different fields like dairy, poultry etc. In the selected area for study under IWMP, it was observed that women's were members of the watershed committee. This fact is according to watershed guidelines which stipulated that at least one member of the watershed committee should be women. It guaranteed the active representation of women in decision-making committee. Watershed committee also played a significant role to provide financial allocations and capacity development support to women's groups. It was indispensable to provide income generating activities for women and also helped them to understand and express their needs and interest.

## SELF HELP GROUPS (SHGS)

SHGs are recognized as a powerful vehicle for the empowerment of women through participation in employment generating activities. On the basis of FGDs conducted in the study areas, the facts which emerged as follows:

- SHGs contributed to the planning and maintaining structures in micro-watersheds.
- The group functioned through exercising moral pressure on the members to remain together as a group.
- Women mostly faced credit or loan problems, to get over this problem SHGs played a significant role because the concept behind SHGs formation was saving and credit.
- SHG members pool in their savings on a regular basis to form group savings. This group fund was then rotated as consumption, production and investment credit amongst the members through norms formulated by group members.
- It creates mutuality and trust among the members and empowers women by enabling them to have their own savings and control over the use of their savings.

## NON-GOVERNMENT ORGANIZATIONS (NGOS)

NGOs were engaged in several activities. The NGOs which were operational in the study area were namely: Himalayan Action Research Centre (HARC), Himalayan Foundation and Hill Welfare Society. The NGOs helped women to work cordially under watershed management. These NGOs were doing the commendable job to integrate women in watershed activities. It provided training and imparted practical skills to women equip them with knowledge and high level of confidence. NGOs mainly deal with women leaders who transfer their knowledge to their fellow women.

## Gram Sabha

Gram Sabha was found to be a key player at the community level that provided the important feedback to district level authorities of the watershed committee. Gram Sabha played an important role in the exchange of information and knowledge between the communities, districts and other actors that were involved in the watershed management. It also helped women to identify their interest and priorities. Gram sabha helped women to empower socially and encourage them to participate in community activities. The most important change that was observed in women with the help of gram sabha that was they have become more vocal in expressing their needs and opinions.

From the overall view, it can be concluded that institutions have played a very important role in the integration of women in Integrated Watershed Management at the grass root level. The results are supported by Kunihira (2009) that NGOs were found operating several activities relating to drawing women closer to water and soil resources management and 31.1% respondents reported that NGOs are doing a commendable job to integrate women in WSM in Chahi sub-catchment. The starting point for most NGOs is training and imparting practical skills to women to increase their

knowledge and confidence to participate in water and soil resources management. Twelve percent (12.2%) of respondents said women groups have brought women actively in participating in water and soil resources management.

## CONCLUSION

Institutions in rural areas play a key role in effecting change and transforming the lives of rural women. Their work ranges from addressing women's basic needs, advancing women's economic empowerment, promoting their political participation and leadership. It could be concluded that there were several operating institutions in relation to water and soil resources management but active role being played by Watershed Committee, SHG and NGO institution towards gender mainstreaming.

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# Foreign Direct Investment for Indian Farmers: Prospects and Consequences

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**Abstract**
FDI is ainvestment where a company from one country making a physical investment into building a factory in another country. We should welcome the Government's move to liberalize the economy. Organized retail will provide farmers greater security. FDI will have positive prospects to farmers because farming conditions will improve; farmers will be at better financial levels, suicides will fall down. Also farmer will get more share in consumer's rupee, distress sell will be avoided. There will be increase employment opportunities.

## INTRODUCTION

"FDI is a responsibility for Indians and an opportunity for the world. My definition of FDI for the people of India is 'First Develop India'."- Narendra Modi, Prime minister of India.

Foreign private investment policy has been liberalised considerably since 1991 that resulted in rising inflows of both foreign portfolio investment (FPI) and foreign direct investment (FDI). However, volatile and capital gains-seeking FPI inflows are more than that of more stable and risk-sharing FDI for most of the years in the post-1991 reform period (Table 8). And the dominant share of the FDI inflows came through the discretionary route of Secretariat for Industrial Assistance (SIA)/ Foreign Investment Promotion Board (FIPB) approvals than the RBI automatic route owing to general and/or sectoral regulations. Under Press Note 18 (1998), foreign investors already in joint venture were required to – (i) get government permission for establishing wholly owned subsidiary in the same or allied fields even in areas listed under the automatic route; (ii) provide detailed circumstances of the necessity of such new venture; and (iii) prove that such a new venture would not jeopardize the interests of the Indian joint venture partner (Bhavani and Bhanumurthy, 2007).FDI is ainvestment where a company from one country making a physical investment into building a factory in another country.(DIPP, 2014)

FDI Provide Upper hand in technological advancement. Dairy Industry thus appear like a treasure island to foreign investors, because there is no FDI in dairy sector

in India at present time. Few evidences and debates reason that due to FDI in t=retail farmer's share in consumer rupee will decline. Eg. In USA it declined from 52 %1996 to 38 % in 2009. In India farmer gets 70 % share. Also, it can be argued that integration with global retail chains lead to turbulence. But in last 2 years, farmers got price hike over 30 per cent (Gupta, 2015).

## NEED OF FDI IN AGRICULTURE IN INDIA

1. To increase growth of the Retail sector in India especially unorganized sector
2. Push to infrastructure, improvement of supply chain
3. Push to productivity - The Farming Community in India
4. Boost Human Development Index.
5. Upgrade technology, employment and revenue

### FDI and agriculture on one horizon

1. Contract Farming:
    i. Provision of seeds, fertilizers etc.
    ii. Risk of price lies with the buyer.
    iii. Farmers get access to credit.
    iv. Training, teaching best practices, scientific farming.
2. FDI in machinery: more affordable, decreased rent.
3. Food processing industries will rise due to Increase in farm gate prices and Cold Storage facilities, increase marketed surplus.
4. Generate higher income for farmers: Shift in food consumption pattern harmonized & encouraged by processing industry.

### Some noises which recede FDI

i. Divide and rule strategy: Let Trader's and farmers fight. It's a ploy. As FDI in retail will benefit farmers. It has divided India's social, political and trading classes (thehindubussinessline.com)
ii. Big retailers' biz model:- Grow bigger and bigger till the market becomes an "oligopsony"
iii. Sorry example of Mexico: "vassal state". NAFTA has driven over 1.25 million farmers. Illegal immigration to the US, has more than doubled to nearly 6 million Mexicans.
iv. Subsidies prop farming: If big foreign retailers are expected to shore up our farmers as claimed by the publicity reports. Even a fraction of such a displacement, out from misguided policies; will cause social disruption on a vast scale.

### Effect of FDI for Marginal and Small Farmers

1. Lower share value: dictating production output by large retailers
2. Farmer's suicide: Due to lack of remunerative price, inefficiency in value and supply chain.
3. Resulting altered crop selection: Discretions made on them.

4. Stagnant crop price will prevail
5. Two routes for FDI for small and marginal famrers:
    A) Form producer companies and enjoy higher revenues
    B) Abandon small scale farming, accept jobs in retail, food processing and supporting industries

**Prospects of FDI in agriculture sector**

1. Get rid of sick PDS with inherent leakages and strengthen supply chain.
2. Contract farming: Thumps-up to agri-credit and insurance.
3. Espirit de corps: Motivated to team up with co-operatives allowing mechanization and multiple cropping.
4. An era of Indian Food Processing Industry
5. Opportunity to build a customer base for agriculturally rich states.
6. Scope for north-east farmers in horticulture.
7. Elimination of middle man from the system.

## CONSEQUENCES OF FDI

1. Kirana walas(not directly related to farming) and sabjiwala can get seriously hurt.
2. No regulatory measures in Indian bill to avoid flooding of foreign grain eg. Indonesian basmati rice.
3. Due to monsoon dependent agriculture contract farmers will be left stranded and have to depend on MSP due to consecutive bad seasons.
4. Illiterate famers affected by monopolistic practices and parasitic surplus extraction.
5. Aggressive pricing, as result of it offering pittance.
6. Increase in wage and affecting margin of farmers.
7. "Poverty in midst of plenty". As the economy expands dollar amount is a challenge.
8. Does impact farmers, indirectly e.g. land acquisition.
9. Increase in wage : Due to shift of landless agriculture laborers to other sectors.
10. Affecting marketing margin of farmers.

**Predicted effects from case study:** Monopoly of Monsanto: One can be jailed if produce other than BT cotton as cotton can be related to cotton farmers of Vidharba district who are increasingly committing suicide. Another example is Monopoly of sugar factory Varanasi. It proves that proves 25 million metric tonnes of sugar will be produced & Rs. 150 billion goes just as commission if it is considered throughout India.

**Analysis of strength and opportunity of FDI in agriculture sector:** It would provide opportunity to encourage diversification from cereals to fruits, vegetables & high value products. The proliferation of food processing industries & linkages will be achieved as result of it to increase the income of farmers. Exploiting the employment potential of food retail sector, aggregators and low level processors

would an add to provide strength to economy. The major impact will be that FDI will control Food Inflation by focusing on backward linkages in the system. Capital Infusion will be a scope because when one division will not do well, it might benefit from an infusion of new funds from the more successful divisions. Improvement in Supply Chain will arrest wages due to economics of scale of production. Thus, as result of this initiative of encouraging FDI in agriculture will pave the way for small retailers who will not be crowded out but become more innovative. Better remuneration with additional marketing window to farmers will be promoted to increase the benefit to farmers.

### Weakness- Threats due to FDI in agriculture sector

1. Hesitant welcome due to fear of losing unorganized sector management & control
2. Bringing Knife to gunfight approach
3. Uniform license regime established will drive Indian retailers away from permit.
4. University of California study: For every 1 new job created by Wal-Mart, 1.4 new jobs will be lost in India.
5. New store will kill 3 local jobs, every 2 it creates.
6. Indian retail will face problem of Chinese competition.
7. FDI will lead to unfair competition & large-scale exit of incumbent domestic retailers (Chari and Raghwan, 2012)
8. Presently Organized sector is underdeveloped & in nascent stage to compete

**Busting the myths of FDI in agriculture:** One of the biggest myth is that FDI in retail will kill small retailers (kiranas) and all retail formats will be adversely affected by organized retail in FDI. It is also heard that when FDI comes it would result in killing business of small time kirana stores and potential job losses in retail sectors.

**A synergistic effort to boost agriculture through FDI:** We should welcome the Government's move to liberalize the economy. Organized retail will provide farmers greater security (ICRIER study, 2008). The Government should consider FDI in processing sector and long term relationships with the foreign investors.

**Challenges to accept FDI: Challenges for FDI can be grouped under following sub-heads.**

1. Resource challenge: The resources are soundly available in the rural as well as the urban areas. The emphasis is to increase infrastructure 10 years down the line, for which the requirement will be an amount of about US$ 150 billion.
2. Equity challenge: The more urban areas have been selected, the poorer sections are inadequately exploited. Political challenge. Therefore it is important to make sure that the rural section has more or less the same amount of development as the urbanized ones.
3. Federal challenge: FDI, is the need to hasten up the execution of policies, rules, and regulations in all the states of India at par.

4. Political challenge: This challenge can be toiled out when foreign investors place frontward their persuasion for increasing FDI capital in various sectors like banking, and insurance (Anonymous, 2012).

**Dispute settlement**: Competition Policy in India is insular, 'command-and-control' model wherein the domestic industries have been fully controlled and protected from both private and foreign competition through private sector regulations, high customs duties, tariff rates and Quantitative Restrictions. The Monopolies and Restrictive Trade Practices Act 1969 has become out-dated in certain respects in the light of International Economic Development particularly to competition laws and there is a need to shift our focus from curbing monopolies to promoting competition (Bhavani, and Bhanumurthy, 2007).

Following policies can be useful for dispute settlement in FDI (Joseph et al., 2008)

1. Stringent rules against collusion & predatory price
2. FDI approval by central government as bottleneck
3. Code of conduct needed for organized sector
4. Labour market & regulation

**The role of extension (change- agents)**

1. Retail food dollar(respective currency): Measure the effect of retail power on farmers and farm workers is to look at the portion of each dollar spent on food at the supermarket -that goes back to the farm.
2. Per capita FDI inflow approach in context to farmers to consider FDI issues
3. Firehouse research as FDI is a burning issue
4. Situation analysis
5. Reducing systemic distortion: Economics of sale, market forces, international relations among farmers
6. Finding the network linkage with other policies
7. It has to do more with out-reach and salience

## CONCLUSION

FDI will have positive prospects to farmers because farming conditions will improve; farmers will be at better financial levels, suicides will fall down. Also farmer will get more share in consumer's rupee, distress sell will be avoided. There will be increase employment opportunities. FDI remains permanent in the host country because of the development in the infrastructures of the host country.

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# The world of Newcastle disease vaccines:

## A journey through the aisle

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*"Now.. fight Newcastle disease, a new way, an easy way"* read a newspaper advertisement in 1950s towards the promotion of live virus vaccine to protect poultry from Newcastle disease. Newcastle disease (ND) was regarded as a disease of economic importance ever since its simultaneous occurrence in various parts of the world between 1926 and 1930. In the late 1930s, there arose a necessity to develop a vaccine to control and prevent ND. The development of the first ND vaccine was initiated with the concept of attenuation (Iyer and Dobson, 1940). Since then, the world of ND vaccination evolved continuously with the help of traditional and modern technologies involved in vaccine production. The milestones in ND vaccine world is depicted chronologically in Figure 1. An ideal ND vaccine is now described as that which eliminates or decreases clinical disease, reduces virulent virus shedding during infection, confers longer duration of immunity, induces antibody-mediated, cell-mediated and mucosal immune responses; and imparts immediate onset of protection (Kapczynski *et al*., 2013; Dimitrov *et al*., 2017). Based on vaccine technology involved, ND vaccines can be categorised as live vaccines, thermostable live vaccines, inactivated vaccines and recombinant vaccines (sub-unit vaccines, edible vaccines, vectored vaccines, DNA vaccines, marker vaccines, VLPs).

### LIVE VACCINES

Live vaccines are whole-virus biological preparations. Administration of live vaccines could be done by mass vaccination (drinking water, pellets, aerosol or spray) and individual vaccination (oculo-nasal, eye-drop instillation, parenteral) methods (Senne *et al*., 2004). Live vaccines induce antibody-mediated, cell-mediated and mucosal immune response within two to three weeks post vaccination that lasts for three months (Al-Garib *et al*., 2003). The amount of virulent virus shed by poultry upon vaccination with

live vaccines has been comparatively lesser than inactivated vaccines (Cornax *et al*., 2012).

The use of live vaccines to induce protective immune response against ND was started with mesogenic vaccine strains Hertfordshire or H, which differs from the Herts'33 strain (Iyer and Dobson, 1940), Mukteshwar or R2B (Haddow and Idnani, 1946), Komarov (Komarov and Goldsmit, 1946) and Roakin (Beaudette *et al.,* 1949). These live mesogenic vaccine strains elicited protective immune response but posed certain limitations: (i) they were unsafe in chickens below eight weeks of age and (ii) they produced detectable pathogenic clinical signs in chickens upon vaccination (Meulemans, 1988). These limitations were alleviated by identification of lentogenic strains like Hitchner B1 (Hitchner and Johnson, 1948), La Sota (Beaudette *et al.,* 1949), Aspilin / F strain (Asplin, 1952), Clone 30 (Paparella, 1978), Ulster and V4 (Kim and Spradbrow, 1978). Lentogenic strains have been safer vaccines that produced effective immune response with mild pathogenic clinical signs in chickens upon vaccination (Goldhaft, 1980). Among the lentogenic strains, La Sota has been regarded as a better vaccine candidate in countries where ND is endemic, because of its ability to induce higher levels of neutralizing antibodies (Diel *et al*., 2012).

Though live vaccines are potential vaccine formulations, they necessitate the need to be maintained at refrigeration temperature (Winterfield and Dhillon, 1981). Maintenance of cold chain has been difficult during transport to remote areas. To the rescue, thermostable lentogenic strains like D58 (Kirubaharan and Palaniswami, 2003), V4 (Copland and Alders, 2005) and I2 (Alders, 2014) were identified and reported. The D58 lentogenic vaccine strain was isolated from healthy unvaccinated backyard chicken during the year 2003. It was identified as a thermostable lentogenic strain with a reported ICPI of 0.14 (Kirubaharan and Palaniswami, 2003). It is available in various formulations – spray, oculo-nasal instillation, drinking water formulation and as oral pellets. D58 strain elicited effective antibody-mediated, cell-mediated and mucosal immune response (Varalakshmi, 2005; Shilpa *et al*., 2014). The transcriptional cytokine response studies reported that D58 induced mild pro-inflammatory cytokines, chemokine and apoptotic gene mRNA levels. This mild pro-inflammatory response induced by D58 was correlated to the absence of tissue damage in proventicular and intestinal tissues. The transcriptional studies on pro-inflammatory cytokine further confirmed the fact that vaccination with D58 strain imparts lesser post-vaccination stress (Ranjani *et al*., 2018).

## INACTIVATED VACCINES

Inactivated vaccines are biological preparations that contain inactivated or killed virus along with adjuvants (Appleton *et al*., 1963). Adjuvants were used in inactivated vaccine preparations as immunogenic components, as killed virus by itself cannot be immunogenic. The most commonly used adjuvants include aluminium hydroxide and oil-emulsions. The oil-emulsion adjuvants (OEA) are more immunogenic than aluminium hydroxide (Cessi and Nardelli, 1974). These OEA based inactivated vaccines require individual administration by intra-muscular or sub-cutaneous route. Despite the

cost and labour involved in vaccine administration, inactivated vaccines have been used to revaccinate breeder and layer stocks at the point of lay that has been primed with live vaccine earlier. Revaccination using inactivated vaccines induces effective antibody-mediated immune response that provides protection during the entire period of lay with increased egg production and efficient transfer of maternal antibodies (Allan *et al*., 1978). Inactivated vaccines induce weaker cell-mediated and no mucosal immune responses.

## RECOMBINANT VACCINES

Vaccines that are produced by manipulating the gene of the pathogen by recombinant DNA (rDNA) technology is called recombinant vaccine. Recombinant vaccines for ND were ventured initially in the year 1988 with vaccinia virus (VV) as vector (Meulemans *et al*., 1988). The recombinant vaccines include sub-unit vaccines, gene deleted or modified vaccines, DNA vaccines and vectored vaccines.

## SUB-UNIT VACCINES

Sub-unit ND vaccines are those that contain only the immunogenic protein components of AAv1. The immunogenic genes F or HN are cloned into an expression system to produce large amounts of F or HN purified protein. Various expression systems like bacteria – *Lactobacillus plantarum* (Jiang *et al*., 2015), yeast – *Saccharomyeces cerevisiae (*Khulape *et al*., 2015)*, Pichia pastoris* (Kang *et al*., 2016), baculovirus (Nagy *et* al., 1991) and plants (Berinstein *et al*., 2005) have been used. The expression system to develop sub-unit vaccines has been chosen based on expression levels, need for post-translational modification, scale-up consideration and production costs. A plant-based sub-unit vaccine that was developed in suspension cultured tobacco cells to express HN gene of AAv1 was reported to be licensed by USDA in the year 2006 (Yusibov and Rabindran, 2008). Similarly, rice and maize expressing NDV F gene have been used as edible plant vaccines (Guerrero *et al*., 2006; Yang *et al*., 2007).

## GENE DELETED OR MODIFIED VACCINES

Gene deleted vaccines are vaccine preparations that involve gene deletion or replacement to develop a genetically attenuated vaccine by reverse genetics. With the advent of reverse genetics strategy, modifications in NDV genome were done to develop marker vaccines against ND (Marsh and Tannock, 2005). An immunodominant B-cell epitope of NP gene of NDV was replaced with a B-cell epitope of S – glycoprotein of Murine hepatitis virus (MHV). The immune response generated against S2 – MHV was used to differentiate between vaccinated and infected animals (DIVA) using S2 – MHV peptide ELISA (Mebatsion *et al*., 2002). Later, an immunodominant epitope identified at 443 – 457 amino acid position of NP gene of NDV D58 lentogenic strain was replaced with an immunodominant epitope of Classical Swine Fever (CSF) virus by reverse genetics strategy (Vidhya, 2016). This served as a DIVA vaccine, which utilised CSF-epitope peptide ELISA. Eventually, using reverse genetics strategy, development of antigen-matched vaccines was reported by replacing F or HN genes of the currently

circulating genotype with lentogenic F or HN genes (Kim *et al*., 2013). Such vaccines provided protection against the currently circulating genotype of AAv1, which was not fulfilled by the usual genotype I or II lentogenic or mesogenic vaccines (Ji *et al*., 2018).

### DNA vaccines

DNA vaccines are developed by cloning immunogenic F or HN gene in a bacterial plasmid under a strong mammalian promoter. The plasmid DNA consisting of F or HN gene elicited both antibody-mediated and cell-mediated immune responses (Loke *et al*., 2005). However, these vaccines cause insertional mutagenesis in the host DNA (Kurth, 1995).

### Vectored vaccines

Vectored vaccines are vaccine formulations that used certain virus as a vaccine modality deliver immunogenic genes of NDV. Though bacteria, yeast, baculovirus and plant-based systems were used as sub-unit expression systems of NDV antigen, replicative viral vectors induced life-long immunity. The viral vectors that were used in the construction of vectored ND vaccines include vaccinia virus (Meulemans *et al.*, 1988), Fowlpox virus (Boursnell *et al*., 1990), pigeonpox virus (Letellier *et al*., 1991), Herpes virus of Turkey (Morgan *et al*., 1992) and Avian Avulavirus – 3 (AAv3) (Kumar *et al*., 2011).

"Overall, Newcastle vaccines have kept the disease fairly well under control. However, one should realize that we are dealing with a sleeping giant" quoted Hitchner. This realization led us through the evolution of ND vaccines since 1940s.

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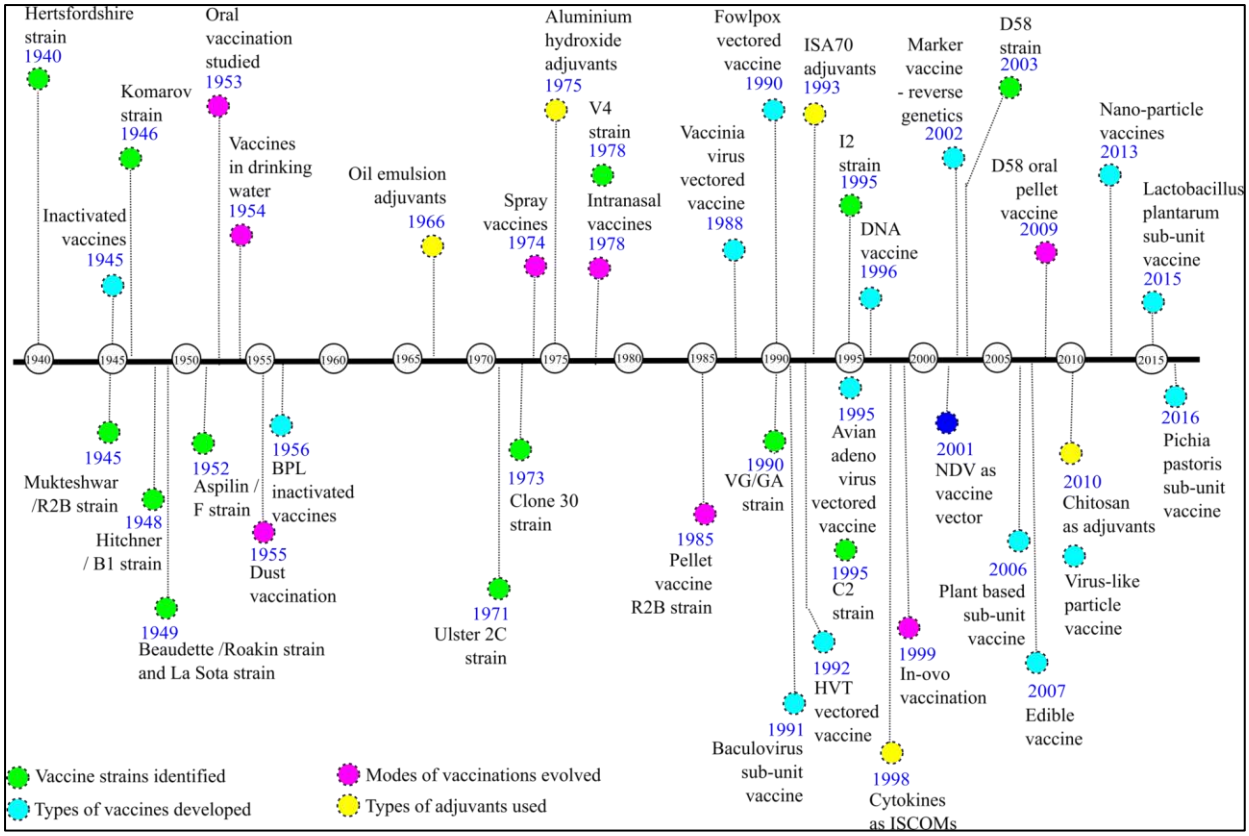


*Figure 1: Milestones in ND vaccine world*

# Fungal diseases and deficiency of mustard and their management

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Mustard and rapeseed plants are annual shrubs, leaves are compound and alternate. Flowers are radially symmetrical and consist of four green sepal and 4 yellow or white petals. Both the petals and sepals are separate and not fused. Stamens are 6. The fruit is a peculiar kind of capsule named siliqua. It opens by two valves, which are the modified carpels, leaving the seeds attached to a framework made up of the placenta and tissue from the junction between the valves. This crop accounts for nearly one-third of the oil produced in India, making it the country's key edible oilseed crop. Due to the gap between domestic availability and actual consumption of edible oils, India has to resort to import of edible oils. Rapeseed mustard is the major source of income especially even to the marginal and small farmers in rainfed areas By increasing the domestic production substantial import substitution can be achieved. Due to its low water requirement (80- 240 mm), rapeseed-mustard crops fit well in the rainfed cropping system. The spice is generally made from ground seeds of the plant, with the seed coats removed. The small (1 mm) seeds are hard and vary in color from dark brown to black. They are flavorful, although they have almost no aroma. The seeds are commonly used in Indian cuisine, for example in curry, where it is known as rai. The seeds are usually thrown into hot oil or ghee, after which they releasing a characteristic nutty flavor. The seeds have a significant amount of fatty oil. This oil is used often as cooking oil in India.

## DISEASES

### (1) Alternaria blight:

**Symptoms:**

- The disease attacks on the lower leaves as small circular brown necrotic spots which slowly increase in size.
- Many concentric spots come together and cover large patches showing brightening and defoliation
- Circular to linear, dark brown spot also develop on stems and pods, which are elongated at later stage.
- Infected pods produce small, discolored and shriveled seeds.

**Fig 1** – Alternaria musterd

**Survival and spread:**

- The disease is externally and internally seed born.
- The pathogen survives through spores (conidia) or mycelium in diseased plant debris or weeds.

**Favourable conditions**:

- Moist (more than 70% relative humidity) coupled with warm weather (12-25 °C) and intermittent rains favours disease development.

**Management**

- Use of healthy seeds for sowing should be preferred.
- Spray Mancozeb 75 WP at the rate of 2 kg in 1000 litres of water per hectare at 10 days interval as soon as the symptoms start appearing on the plants.
- Collect and burn the affected plant portions after the harvest of the crop.

**(2) White rust:**

**Symptoms:**

- Both local and systemic infections are observed.
- In case of local infection, white creamy yellow raised pustules appear on the leaves which later merge to form patches.
- In systemic infection and during humid weather, mixed infection of white rust and downy mildew cause swelling and distortion of the stem and floral parts due to hypertrophy and hyperplasia and develop "stag head" structure.

**Fig 2-** White Rust

**Favourable conditions:**

- Moist (more than 70% relative humidity) coupled with warm weather (12-25 °C) and sporadic rains favors disease development.

**Management**

- Early sowing before October or in October month

- Seed treatmet with *Trichoderma* powder (8-10 g/kg seed) and Metalaxyl 6gm/kg seed.
- Symptom of disease visible after 55-60 days after sowing if symptoms are above threshold then we can spray Ridomil and Metalxyl at the internal of 10 day if disease issevere.

**(3) Powdery mildew:**

**Symptoms:**

- Symptoms appear as dirty white, circular, floury patches on either side of the leaves.
- Under favorable environmental conditions, entire leaves, stems, floral parts and pods are affected.
- The whole leaf may be covered with powdery mass.

**Fig 3-** Powdery mildew

**Survival and spread:**

- The pathogen survives through cleistothecia present in the crop debris in the field.

**Favourable conditions**:

- High temperature (15-28 ºC) coupled with low humidity

**Management**

- Three sprays of aqueous suspensions of Triadimefon 25 WP (0.1%), Tridemorph 80 EC (0.1%), Dinocap 48 EC (0.075%) and Wettable Sulfur 80 WP (0.3%), at 15 day intervals, after disease appearance, controlled the disease effectively and increased seed yields. Triadimefon proved most effective and Wettable Sulfur most economical.
- Used resistant variety

**(4) Sclerotinia stem rot:**

**Symptoms:**

- Elongated water soaked lesions appear on stem near to the crown region, covered with cottony mycelial growth later on.
- Plant looks like whitish from distance at internodes or base.
- Premature ripening and shredding of stem, wilting and drying.
- Brown to black sclerotial bodies may also be seen in the later stage on the infected plant parts.

**Fig 4-** Sclerotinia stem rot

**Survival and spread:**

- The pathogen survives as mycelium in dead or live plants and as sclerotia in infected plant parts or on the soil surface or with seed as contaminant.

**Favourable conditions:**

- High humidity (90-95%) and average temperature (18-25 o C) along with wind current favours the disease development.

**Management**

- Seed treatment with Carbendazim + Mancozeb 2 gm or *Trichodermviride* 10 gm/kg.
- Spray Carbendazim 12% +Mancozeb 63% mix after 60 days sowing
- Maintain plant to plant distance
- Remove infected mustard plant

## II. NUTRITIONAL DEFICIENCIES

**Iron:**

- Chlorosis starts from the base and spreads towards the apical part of the lamina. In case of severe deficiency, leaves become bleached and wrinkle.
- Newly emerging leaves are completely bleached, Flowering, pod number and size pod number and size of pods is reduced and pods appear chlorotic (insufficient chlorophyll).

**Fig –** Iron deficiencies

**Measure:** Spray 0.5% ferrous sulphate solution 3-4 times at weekly intervals.

**Manganese**:

- Chlorosis in apical part of the middle leaves, followed by developing small greyish-brown spots which coalesce to form large necrotic lesions. Leaf lamina curl downwards.

- Flowering is also reduced and large percentage of flowers shed prematurely, resulting in poor fruit set and pod formation.

**Fig –** Manganese deficiencies

**Measure:** Spray 0.2-0.3 % manganese sulphate 2-3 times at weekly intervals.

**Copper**:

- Young leaves develop interveinal chlorosis. Chlorotic areas later turn papery and necrotic.
- Growth of plants is also reduced which is more pronounced at the time of flowering and thereafter. Inflorescence is very poorly developed.

**Fig-** Copper deficiencies

**Correction measure:** Spray 0.2% copper sulphate solution 2-3 times at weekly intervals.

**Zinc:**

- There is retardation of growth, deficiency symptoms appear after 20 days of sowing, the first true leaf is also affected. Leaves are small in size with pinkish margin.
- Interveinal tissues turn yellowish white to papery white, with veins remaining green. There is upward or downward cupping of leaves.

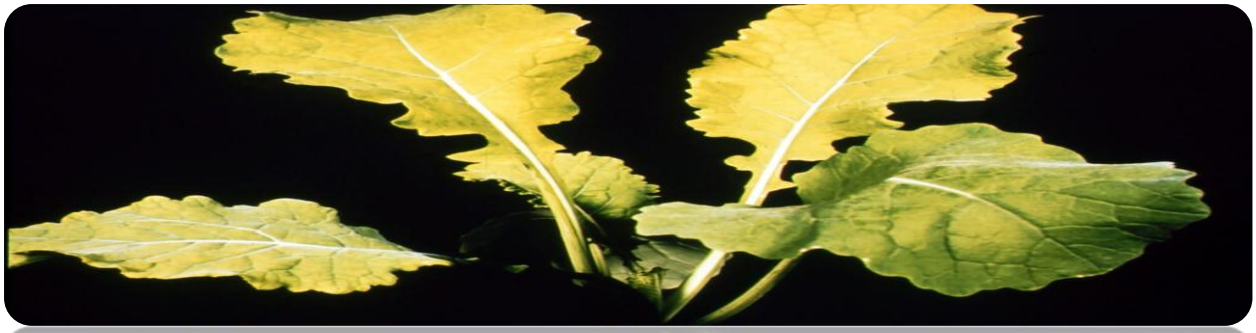

**Fig:-** Zinc deficiencies

**Measure:**

- Application of 8-10 Kg/acre at sowing time of zinc sulphate overcomes zinc deficiency.

- Zinc sulphate should be placed in the seed row adjacent to the seed at the time of sowing to attain its higher utilization efficiency.
- Zinc deficiency can also be corrected by foliar spray of 0.5 per cent zinc sulphate solution along with 0.25 per cent slaked lime.

**Sulphur:**

- Deficiency symptoms are shown on younger leaves.
- Chlorosis formation from leaf margins, spreading inward and/or develop purple pigmentation. Flowering is delayed, lacking normal pigmentation.
- Pods are borne on short peduncle and their development is restricted. Seed setting is poor and their maturity is delayed.

**Fig:-** Sulphur deficiencies

**Measure:-** Apply gypsum@ 100 Kg/acre in soil. Use sulphur containing fertilizers

# Low investment High Income in Agriculture and allied sector

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Indian agriculture is at a junction, with a number of challenges and enormous opportunities. The key challenges are small and declining landholdings, price volatility and climate risks. Growing demand for food in the domestic and global markets offers huge opportunities. The question is, how can we harness opportunities and overcome constraints to raise farmer incomes, especially small and marginal farmers. There are several mega flagship programmes, including the Pradhan Mantri Krishi Sinchayee Yojana, Soil Health Card scheme and Pradhan Mantri Fasal Bima Yojana to increase farm income. We are proposing a few "business-not-as-usual" areas to develop institutional arrangements so that small farmers can participate in these programmes and share the benefits of emerging opportunities.

The foremost requirement is investment in activities which create productive assets. The agriculture sector needs huge investment to transform and become more attractive and remunerative. Research reveals that compared to other sectors, investment in agriculture and allied contributes more to reducing poverty. As we all know India is a developing country. There are many sectors which help in standing our India in the category of developed countries. This can be achieved through more engagement in agriculture and allied sectors which leads to sustainable agriculture and helps in arising the financial status of farmer and put positive impact on GDP of our country. Agriculture allied sectors as, Mushroom production,Poultry,Fishery, Beekeeping (Apiculture),Sericulture helps in achieving our theme.

Mushroom Production- this sector is a vast emerging sector. This will provide more financial assistant to farmers. Mushroom is cultivated from very past in our country but the production level is not very high due to lack of awareness about production strategy.

For mushroom production three factors are necessary.

- ✓ Growing medium(straw)
- ✓ Temperature
- ✓ Humidity

| Mushroom Species | Time | Temperature | Relative humidity |
|---|---|---|---|
| Agaricus biporus (white button) | September-march | Early=22-25c | 80-85% |
| Pleurotus oyster (dhingri) | January-April/May | 18-25c | 85-90% |
| Calocybe spp. | June-September | 25-35c | 80-90% |

Above indicates that this provide income to farmers all around the year,work require less time and gives high return.

Conversion of mushroom into value added products like mushroom pickle and powder there by increasing the market value.

- ✓ This profession is easy and does not require high level skills.
- ✓ Family oriented profession.
- ✓ Less input more output.
- ✓ Output of crop waste used as input in mushroom production.
- ✓ Mushroom helps in reducing the diabetes.
- ✓ Labour required is less.

For development of large scale units government helps the entrepreneurs through many schemes. This profession is very good and efficient for small land holding farmers and earn extra money

## POULTRY

Rearing of poultry birds for production includes meat and eggs.This is very beneficial sector. Output of poultry i.e. waste act as input for farming as organic manure.For rearing of poultry birds for farmers or any entrepreneur require small training for taking care of poultry birds. Through these trainings entrepreneurs are able for rearing of poultry birds.

- ✓ Helpful in increasing financial status.
- ✓ Easy and less time consuming and does not require skilled labour.

In rural areas, mostly, poultry birds are reared but not on commercial scale. Now there is a need of doubling the farmer's income, so this is a major sector by which farmer status is improved. India stands 5$^{th}$ in the poultry production so it has a chance to be in 1$^{st}$ position. There are many breeds of poultry. Different breeds are available for different climate suited areas.

These are some breeds of poultry.

1. Assel (fighting purpose)
2. Punjab brown
3. White leghorn
4. Rhode Island Red
5. Karknath(black)

These are some breeds which are highly efficient and use as a commercial production.

- ✓ Initial investment is very less.
- ✓ Input cost(feed) required is less as compare to other livestock.
- ✓ Gives high return which improves the financial status.
- ✓ Family oriented profession.
- ✓ Provide employment to youth and become entrepreneurs.
- ✓ Reared period is 6-7 weeks.

Small farmers get benefitted from this profession. Government helps the individual in this sector through following schemes.

1. Poultry venture fund running by NABARD.
2. Pradhan Mantri Mudra Yojna.
3. Pradhan Mantri Kaushal Vikas Yojna.

## FISHERY

Fishery is an important sector of food production providing nutritional security to the food basket and contributing in agriculture export. Now-a-days fishery is an emerging sector. Fishery production is easy and require less capital which are very helpful in improving the financial status of farmers. Small farmers are also benefitted by this profession. small ponds are made deeply and water is accumulate in the pond and fish are reared. Market value of fish is high. Farmers can sell their fishes in local market also and get good money.In export point of view ornamental fish is highly suited for commercial production which have very high export value and market value.These are some breeds for fish farming .

1. Rohu
2. Catla
3. Grass carp
4. Talapia
5. Murrel
6. Ornamental

Ornamentals are very attractive to customers because of their colour variants and market value of ornamental fish is also very high.

- ✓ Common and favorite item in food and demand is more.
- ✓ Indian climate is suitable for fish production and fish growing business.
- ✓ Various fast growing fish spp. is available. This gives rapid return of investment.
- ✓ Initial investment is very less.
- ✓ Input cost is low.

Poultry and fishery is used as integrated farming system. output of poultry is used as input (feed) for the fishery. By this feed cost is reduced. For this profession individual require small training. farmers or entrepreneurs get training from krishi Vigyan kendras (KVK). And raise their financial status. Government helps by providing subsidies to start fish farming under Pradhan Mantri Kaushal Vikas Yojna. Farmers get good profit in just 2-3 months.

## BEEKEEPING (APICULTURE)

Rearing of honeybees for production of honey is called Apiculture. Honeybees help in pollination and are known as pollinators. Beekeeping is the maintenance of bee colonies, commonly in man-made hives by humans. Bee-keeper keeps honey in order to get honey and other products such as bee wax and royal jelly used in cosmetics which have high market value. Honey bees rearing does not require extra space. Farmers reared honey bees inside farms. Farmers are benefitted from honeybees by two ways;

- By getting honey from honey bees which has high market value.
- Polllinations: honey bees helps in pollination of crops which increase the quality and quantity of crops.

Farmers improve their financial status by accepting these bees. This profession require very less investment and gain more profit in very limited time. Fruiting depend on pollination and pollinators are must now a days pollinators population is reduced due to various factors like adverse climate, unavailability of flora etc. for orchard growers this business is very profitable and provide extra income by doing small care.

- Needs small care and very less capital investment.
- Require less space.
- No more labour is required.
- Family oriented profession.
- By doing small investment we get more income.
- Honey produced by honeybees have high market value and bee waxes are used in cosmetic industry.

## SERICULTURE

Rearing of silkworm for producing silk is known as sericulture. We get silk from silkworms. In garment industry market value of silk is very high. This profession is very easy and does not require more space and labour. Silkworms are reared in trays by feeding mulberry leaves. In India four types of silkworms are available.

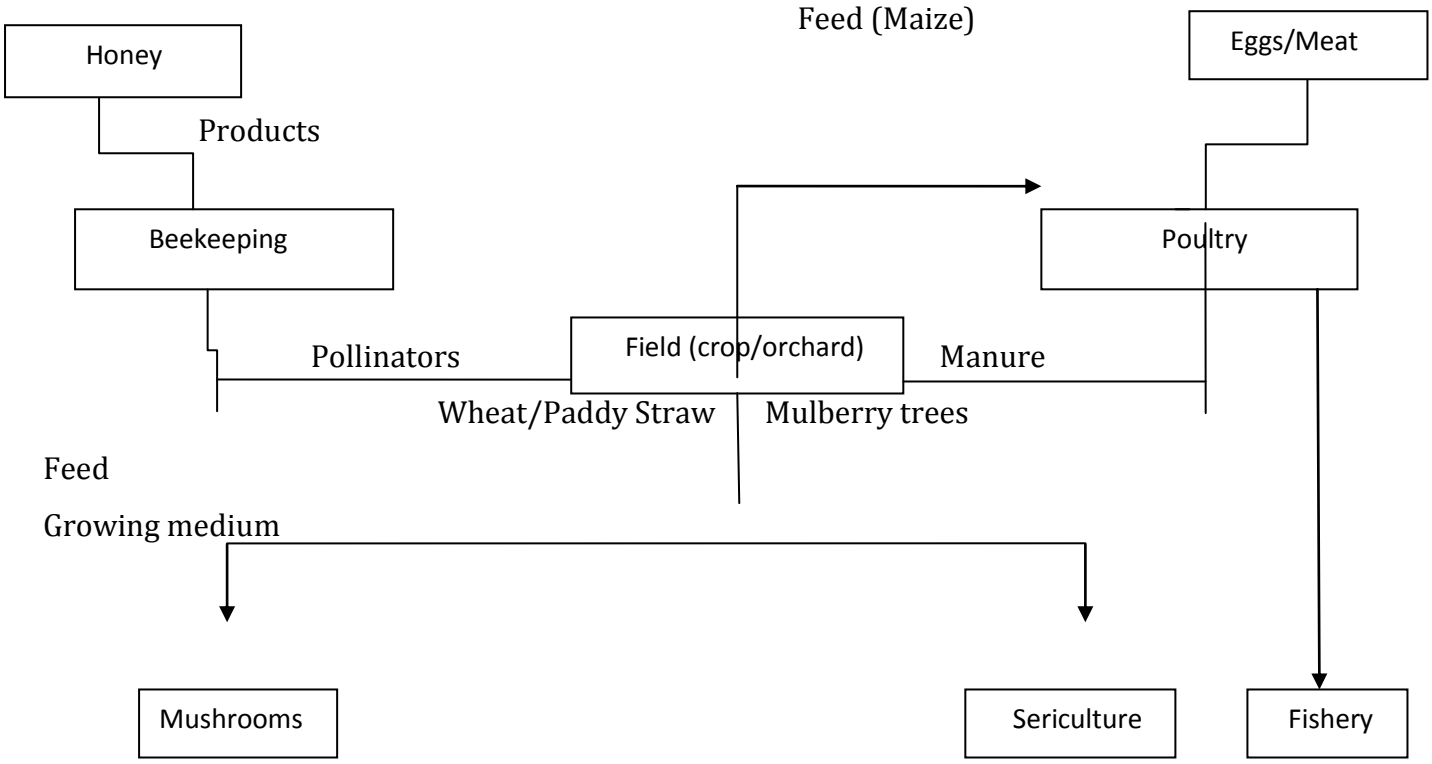
1. Mulberry silk.
2. Eri silk.
3. Muga silk.
4. Tasar silk.

Mulberry silk is very high quality silk and accepting as a commercial production. Mulberry silk is produced from *Bombyx mori* by feeding mulberry leaves to the larvae. There are larval stages in worms after which they leads to cocoon through which silk is spuned. Mulberryy leaves are easily available and free of cost. Farmers use these as a side business to raise their financial status. Farmers get silkworms from near sericulture department at vary less cost ,also get training from sericulture department and KVKs.

- ✓ Very less investment and high return.
- ✓ Market value is high.

- ✓ Family oriented profession.
- ✓ Space require is very less.

Government also provide funds as subsidies under Pradhan Mantri Kaushal Vikas Yojna. Integarated farming system and provide more return to farmers.




Above flow chart represent Integrated farming system through allied enterprise at very low investment. These all act as input output for each other. More important this leads to sustainable agriculture and helps in improving the ecological balance which results in doubling of farmers income.For rapid dissemination of information and for better awareness school should engage students in agriculture and allied activities School is a first place of startup of education to raise the literate individuals in our country, if agriculture related knowledge is provided to the students from school time, and then our agriculture turns into a path of vast development.

How this is helpful for our nation?

- ✓ Getting training, students gain knowledge about allied sector and how this will help in developing agriculture.
- ✓ Students belong from poor families mostly studied in govt. schools and there by getting training of these professions, these students can raise their family economic status.
- ✓ This strategy leads to women empowerment. Girls got training from their school time. This will be very helpful to live as independent and emerged as entrepreneur.
- ✓ This will rise to extra income for by student families. By this entrepreneurs are raised and unemployment is reduced

- ✓ This sector builds up interest about agriculture and allied sectors for taking agriculture science in higher studies.
- ✓ This sector needs less input but output generated by this is very high.
- ✓ This will help in solving the farmers issue about straw. Straw is used in mushroom production. If more straw is used more production is generated.
- ✓ This strategy generates employment for individual as trainees for providing trainees to students. Students also get knowledge about market structure of these professions by visit in markets.
- ✓ By getting training from schools students start production in their houses.

## CONCLUSION

From Extension to Education - Simply, providing information to farmer does not work, we have to educate our farmers/ the agripreneurs and even our agri-professional. Our Agricultural colleges must consider Industry lead research rather than conducting government grant based research. We need to move beyond NPK to secondary and Micro nutrient through an integrated nutrition management program - Our recommendation is -Moving from just being a "Farmer to Agripreneur. If a single individual entrepreneur in a remote place can deliver exponential returns to farmers without any budgetary support and used as a catalyst and not just a dole, doubling the farmer income is a laudable, but conservative goal over five years. Hence, the budget should shift its focus from just farmers to also include agripreneurs which will help the government achieve its goal of doubling farmers' income by 2022.

# Hydroponic: a Soil Less Culture used in Vegetable Crops

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Hydroponics is a subset of hydroculture, which is the growing of plants in a soil less medium, or an aquatic based environment. Hydroponic growing uses mineral nutrient solutions to feed the plants in water, without soil. For those of us who love growing plants these are exciting times indeed. We are no longer limited by climate or by season in the pursuit of our harmless pleasures. We can now grow virtually any plant at virtually any time of the year – the only limitation is our imagination. The simple, effective hydroponic systems now available, coupled with modern horticultural lighting, have transformed our hobby and freed us to grow our favorite plants where and when we choose.

## DIFFERENT TYPES OF HYDROPONIC SYSTEMS

When you think of hydroponics, you instantly imagine plants grown with their roots suspended directly into water with no growing medium. However this is just one type of hydroponic gardening known as N.F.T. (nutrient film technique). There are several variations of N.F.T. used around the world and it is a very popular method of growing hydroponically. What most people don't realise is that there are countless methods and variations of hydroponic gardening.

### Wicks System

Seen as the most simplistic hydroponic system. The Wick system is described as a passive system, by which we mean there are no moving parts. From the bottom reservoir, your specific Growth Technology nutrient solution is drawn up through a number of wicks into the growing medium. This system can use a variety of mediums, perlite, soil or coco.

### Water Culture

This system is an active system with moving parts. As active hydroponic systems go, water culture is the simplest. The roots of the plant are totally immersed in the

water which contains the specific Growth Technology nutrient solutions. An air pump with help oxygenate the water and allow the roots to breathe.

### Ebb and Flow System (Flood and Drain)

This hydroponic system works by temporarily flooding the grow tray. The nutrient solution from a reservoir surrounds the roots before draining back. This action is usually automated with a water pump on a timer.

### Drip System (recovery or non-recovery)

Dip systems are a widely used hydroponic method. A timer will control a water pump, which pumps water and the Growth Technology nutrient solutions through a network of elevated water jets. A recovery system will collect excess nutrient solution back into the reservoir. A non-recovery drip system will avoid this allowing the pH of the reservoir not to vary. If using a recovery system, be sure to check the pH level of the reservoir regularly and adjust using either pH up or pH down solutions on a more frequent basis.

### N.F.T System

The N.F.T system is at the forefront of people's minds when hydroponics is mentioned. Nutrient Film Technique uses a constant flow of your Growth Technology nutrient solution (therefore no timer is required). The solution is pumped from a reservoir into the growing tray. The growing tray requires no growing medium. The roots draw up the nutrients from the flowing solution. The downward flow pours back into the reservoir to be recycled again. Pump and electric maintenance is essential to avoid system failures, where roots can dry out rapidly when the flow stops.

### Aeroponic System

Aeroponic systems are seen to be a high tech method of hydroponic growing. Like the N.F.T system the growing medium is primarily air. The roots hang in the air and are misted with nutrient solution. The misting of roots is usually done every few minutes. The roots will dry out rapidly if the misting cycles are interrupted. A timer controls the nutrient pump much like other types of hydroponic systems, except the aeroponic system needs a short cycle timer that runs the pump for a few seconds every couple of minutes.

## RECENTLY INTRODUCED TECHNIQUES IN HYDROPONIC

**Lighting**

At the heart of any indoor garden is the lighting system. Over the last 10 years, advancements in horticultural lighting have been astounding:

- High intensity discharge (HID) lighting systems have seen some tremendous advancements and will continue to improve in terms of efficiency.
- Double-ended lighting systems will continue to grow in popularity over the next few years, as they offer multiple advantages over standard HID lighting systems, including increased efficiency and longevity.

- With its unique spectral output, sulfur plasma lighting is poised to become more common as a primary lighting source for indoor gardens in the years to come, as improvements to manufacturing techniques help lower the price of these systems.

**Nutrients**

Hydroponic nutrients are continually undergoing advancements. We are already starting to see specialty nutrients that "self-buffer" to the desired pH range. I believe we will continue to see an increase in these self-buffering nutrients, along with other time-release, fully soluble nutrients capable of maintaining more consistent ppm and pH levels. Nutrient manufacturers are getting better at combining various elements into stable, one-part formulas. I predict the number of complete, one-part nutrient formulas will increase, particularly as we see more novice gardeners trying hydroponics.

**Micro Growing**

Similar to the hydroponic appliances for kitchens, automated hydroponic systems aimed at growing microgreens, such as sprouts, will become more popular. The systems designed for producing microgreens and grasses won't stop in our kitchens, though—an increasing number of farmers are using hydroponic systems to grow fodder for their livestock. Hydroponic systems used for growing fodder are not only cost effective, but they also provide a superior food source for livestock.

**Sustainable Systems**

Aquaponics—the combination of aquaculture (fish farming) and hydroponic gardening—is a sustainable approach to food production because these systems use fish waste to feed plants and plants to filter the water for the fish in a perfect, natural circle. As we continue to deplete our resources, growing crops sustainably is going to become even more important and aquaponic systems are a great way to efficiently produce food on both a small and large scale. Chickens, rabbits, worms, crickets and other animals are also being integrated into sustainable hydroponic gardens. As more people experiment with different strategies, more of these unique biological hydroponic systems will be developed.

## APPLICATIONS

Some of the latest trends in hydroponic growing are not directly related to advancements to the systems themselves, but to the application of these systems. Restaurants and grocery stores are starting to incorporate hydroponic systems into their business models as a way to provide the freshest produce possible. Living salad bars allow businesses to provide fresh produce and set themselves apart from their competitors. The farm-to-table movement has many restaurants interested in setting up their own hydroponic farms to provide customers with fresh food on-site. Not only is this a great novelty to sell to customers, but it also makes good financial sense. Another growing trend in hydroponics is the rooftop gardening movement. I believe we will see more rooftop or vertical, wall-mounted hydroponic systems being incorporated into the specs of new buildings to increase urban food production.

## CONCLUSION

People are starting to realize our health is directly related to our diet. This, in turn, creates the demand for more fresh produce from our markets and restaurants. Hydroponic gardening is a practical solution for providing fresh food in dense urban areas. Whether it be on the rooftop or the outside wall of a building, we are sure to see lots of hydro gardens popping up in cities over the next few years. An increasing number of commercial farmers are unlocking the potential hydroponics offers as well. Over the next 10 years, we will see more commercial hydroponic farms established to meet the increasing demand for local, fresh produce.

More people are taking their health and food production into their own hands by setting up some sort of home garden. For many, the only option is a hydroponic system that can produce food in a small space. Home hydroponic systems, especially those that fit on a countertop or in a kitchen window, will eventually become commonplace. With all the benefits hydroponics offers, especially in urban areas, there is no doubt hydroponic gardening will be a major part of our society's food production in the future.

# Water Management in Conserving Bio-Diversity, Ecology and Environment

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Waste Water Management is one of the important burning evil in the prevailing society. Due to the present environmental conditions the water resources are day by day going depleted. So, to maintain this and sustain future generations managing, reusing and recycling of wastewater is necessary attempt. So, in this point of view village survey is conducted in 10 villages and other places including the cities around the college and different data &analysis were taken. The water that comes from the households in villages, towns and cities are to be managed by recycling them. The water that is reused and recycled includes from 7 to 12 litre capacity flush to total water required for basic necessary activities in the houses is recycled by this research project. The total water consumption may increase up-to more than the supply from the municipal corporation supply. From this research we could estimate that waste water from the 10 villages on reusing and we can save millions litres of water and some water can be used for different purposes.

As per the Government of India research studies and Environmental board studies given the society to follow 3 R`s i.e reduce, reuse and recycle out of which reduction is not possible to the maximum extent due to increasing globalisation and urbanization. So, reuse and recycling of water should be done to maintain future sustainability. This research aim is to create the Awareness to the government by constructing the tanks underground through inlet chambers, SHT's, SST's TWT's and then treating this water and reusing again.

This can be achieved easily without any problem even though India becomes the first populous country even then China.

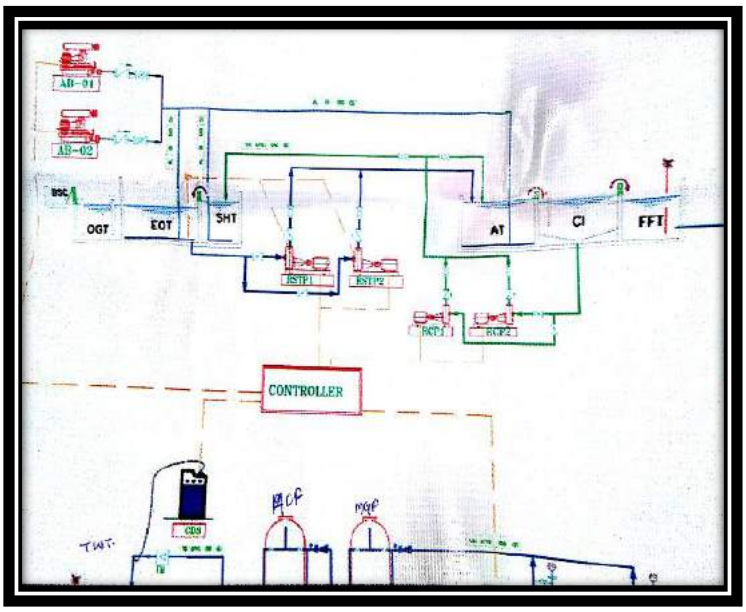
## BACKGROUND

- The data is collected from 10 villages and all the information is per govt records as per 2011 census.
- The waste they are producing is collected into the inlet chamber initially present in the underground and then it is transferred to SST`s, SHT`s and treated in TWT plants.

- The liquid is sent to TWT plant and treated and ph and other data are analysed.
- The water is having ph. Suitable as per dept records for agriculture.
- The reusing and recycling is done simultaneously and 87.5 crore lakhs of litre is being conserved.

## METHODOLOGY

Construction of underground Sludge settling tank, Sludge Holding tank and treated water plant by different enginnering principles .pipes of proper quality and PVC pipes for collection of sludge, fungal colony for decomposition of sludge.




**Design of the line diagram for the management of water

The surveyed information from the gramsevak of the 10 villages including 2 cities is as follows:-

| Sr No | Parameter | Sonai | Shanishingapur | Chandgaon | Vasuri | Kothur | Shirdi | Umbre | Brahmni | Ahmednagar | Rahuri |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Total Population No. | 15089 | 5,525 (Varies) | 10719 | 19213 | 14057 | 36004 (Varies) | 6944 | 9342 | 371900 | 39813 |
| 2 | Daily Requirement of Water (Lit.) | 5 Lakhs | Lakhs (Varies) | 3 Lakhs | 9 Lakhs | 6.5 lakhs | 20 Lakhs (Varies) | 5 Lakhs | 5 Lakhs | 70 000 Lakhs | 20 Lakhs |
| 3 | Consumption of Water (Lit./person/day) | 40-50 | 40 | 34-40 | 40 | 40 | 80 | 40-50 | 40-50 | 135 | 50 |
| 4 | Pacca houses (No.) | 4200 (approx.) | 300 | 1400 | 3223 | 2800 | 6300 | 927 | 1325 | 60000 | 7332 |
| 5 | No. of Toilets Req. (%) | 80 | 100 | 60 | 95 | 90 | 90 | 95 | 74 | 85% | 80 |
| 6 | Qty. of Waste produced (tons) | 1-1.5 | 2-2.5 | 2-2.5 | 4-5 | 4-5 | 40 (varies) | 2 | 1.5 | 80 | 8-9 |
| 7 | % of ... % of dry is high | Dry | Equal | Dry | 60% Dry 40% Wet | 70% dry 30% Wet | 70% dry 30% Wet | Dry | Dry | 40% dry and equal | Dry |
| 8 | Pipe line cost (Cr.) | .50 | 0.416 | 1.20 | 0.48 | 0.80 | Based on quality | Underground | Underground | Based on quality | Based on Quality |

STATISTICAL DATA OF MY RESERACH

From this we can clearly observe that there is approximately 95 %toilets register by the government and the record is taken from the gramsevaks and is made an agreement that the given information is true accordingly.

## RESULTS

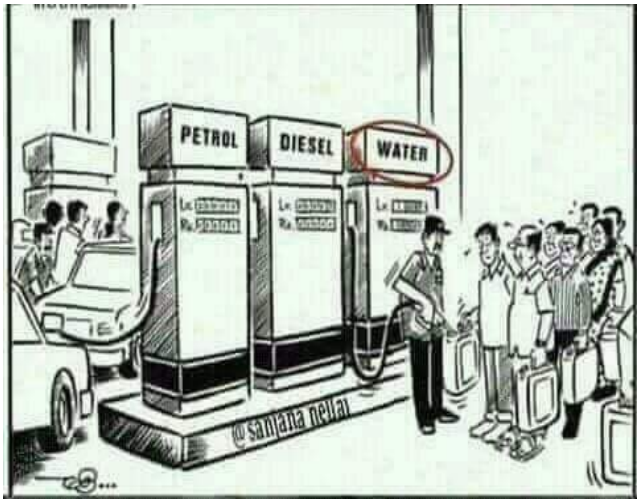
The total water required in villages : 38.5 Lakh lit. Supplied by MC

- 10 LAKH LITRE approx.by other sources.
- Total no. of pacca **houses in villages** :-13675 houses
- Total water that can be recycled :-28.75 lakh litres
- ****in more villages dry matter is mostly found .so, we can recycle by separating them by reusing in terms of fertilizers after decomposition.
- ***The required statistical chemical parameters of water for farming is
- BOD=<5, COD=<7.5, ph.=6.5-7.5< As per maharastra pollution control board it is suitable for agriculture purpose )
- So we can REUSE and RECYLE the waste water in this way and can be managed easily.

## CONCLUSION

Our results study is needed to be carried out in larger population

- WATER REUSED :- The water that is wasting through the flush is reused and hence 87.5 crore litres of water is reusing
- WATER SAVING:-The 2nd benefit observed by majority of farmers and others is they can sustain their future generations.
- USED AS FERTILIZER:-The sludge settled down is treated with microorganisms and that can be applied as fertilizer.
- IRRIGATION:- The water which is treated is then irrigated to the fields through FERTIGATION and drip.
- The people in the society by using this research technology in coming years in villages and towns which can be supplied easily by the government.
- They respond that they will surely reuse and recycle because of the prevailing scarcity of water.
- The results suggested that people in all these places are **THE MASTERS OF THE UNIVERSE, ONES MAKER, SUPREME** being their forth coming generations and **conserving the BIO-DIVERSITY**
    - That is we can see the water bunks by the side of the petrol bunks in which people will wait in the lines for filling their cans




*Source:- Internet cartoons regarding water bunks*

**Keywords:** Globalisation, 3 R`s, Saving water, Conservation, Biodiversity.

The photographs of the conduction of the research project is:-

**Photograph 1:- Along with the engineer and employyes in Ahemednagar while surveying the tanks and dimensions of it**

**<u>Photograph 2:-</u> Instrumental design IN THE UNDERGROUND by the engineer in the Ahmednagar ,maharashtra**

**Photograph 3:- STP plant visit in shirdi for information regarding the PH,EC of the polluted water**

**Photograph 4:-**

**Visit to grampanchayt offices and meeting gramsevaks in particular villages**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MES/ACS/206/2017

Date :- 26/9/2017.

**TO WHOM IT MAY CONCERN**

This is certify that **Mr. Alamuru Krishna Chaitanya** is participating in **AVISHKAR** research competition 2017, which is being held in MPKV, Rahuri during 3rd and 4th October 2017. He is working on **WASTE WATER MANAGEMENT PROJECT**. For this project data is needed from your office. Your help is highly acknowledged.

Thanking you

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# Management practices of evaporation and transpiration in dryland agriculture to sustain soil moisture and enhance water use efficiency

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Dryland agriculture refers to cultivation of crops entirely under natural rainfall. Dryland areas are characterized by low and erratic rainfall and no assured irrigation facilities. Dryland agriculture is important for the economy as most of the coarse grain crops, pulses, oilseeds and raw cotton are grown on these lands. In dryland areas receive rainfall between 50 and 120 cm. It is a form of subsistence farming in the regions where deficit of the soil moisture retards the growth of water consuming crops like paddy (Oryza sativa L.), sugarcane (Saccharum officinarum L.) etc. The success of dryland farming depends on the efficient use of the little moisture that is trapped in the soils of crop fields for growing crops and also the wise selection of crops that will suitably adapt to the farming conditions of dryland farming.

Increasing population as well as land and water scarcity has become the main challenges for food security which creates pressure on agricultural production. The farmers are required to increase resource use efficiency, in order to meet the growing food demand as well as to reduce the pressure on natural resources. Thus, consumers can get quality food at affordable prices. Another requirement is the increase in production; this to the background of meeting the demand along with protection of soil, water, biodiversity etc. and to contribute in the mitigation of greenhouse (Basch *et al.,* 2012). To achieve sustainability or sustainable intensification, many problems have to be solved including - land degradation, water stress, climate change, deforestation, overexploitation of resources etc. (Corine, 1994; Lopez-Bermudes *et al.,* 1998). In order to meet the growing food demand we can use dryland agriculture.

## MANAGEMENT PRACTICES OF EVAPORATION AND TRANSPIRATION LOSS IN DRYLAND AGRICULTURE

### A). Reducing Evaporation Losses

Soil moisture is the most limiting factor in dryland agriculture. It is lost as evaporation from the soil surface and as transpiration from the plant surfaces. Evaporation has to be arrested as it is not directly related to productivity whereas transpiration can be reduced to some extent without affecting productivity of plants. The evaporation losses can be reduced by mulches.

**Mulches**

About 60 to 75 per cent of the rainfall is lost through evaporation. These evaporation losses can be reduced by applying mulches. Mulch is any material applied on the soil surface to check evaporation and improve soil water. Application of mulches results in additional benefits like soil conservation, moderation of temperature, reduce soil salinity, control weed, improve of soil moisture and increase water use efficiency in cultivated land.

## TYPES OF MULCHES

**1. Soil mulch or dust mulch:** If the surface of the soil is loosened, it acts as a mulch for reducing evaporation. This loose surface soil is called soil mulch or dust mulch. Intercultivation creates soil mulch in a growing crop.

**2. Stubble mulch:** Crop residues like wheat straw or cotton stalks etc., are left on the soil surface as a stubble mulch. The advantages of stubble mulch farming are protection of soil from erosion and reduction of evaporation losses.

**3. Straw mulch:** If crop straw is used as mulch, it is called as straw mulch.

**4. Plastic mulch:** Any plastic materials like polyethylene, polyvinyl chloride are also used as mulching materials.

**5. Vertical mulching:** A modification of traditional mulching called vertical L mulching has been developed for heavy soils where infiltration is a problem. Trenches are dug at 5-10 cm intervals depending on slope and sizes of 30 × 60 cm across the slope on grade. They are filled with stalk materials (stubbles) which keep the cracks open and allow better water intake and improve infiltration and storage of rainwater in these soils.

**B). Reducing transpiration losses**

**Antitranspirants**

About 99 per cent of the water absorbed by the plants it which is lost in transpiration. It any material applied to transpiring plant surfaces for reducing water loss from the plant. There are four types of antitranspirant are used as; (1). Stomata closing, (2). Film forming, (3). Reflective, (4). Growth retardant.

**1. Stomata closing type:** Most of the transpiration occurs through the stomata on the leaf surface Fungicides like phenyl mercuric acetate (PMA) and herbicides like atrazine in low concentrations serve as antitranspirants by inducing stomatal closing. These might reduce the photosynthesis also simultaneously. PMA was found to decrease transpiration to a greater degree than photosynthesis in a number of plants.

**2. Film forming type:** Plastic and waxy materials which form a thin film on the leaf surface retard the escape of water due to formation of physical barrier. For example Mobileaf, hexadeconol, silico are some of the film forming type of antitranspirants. The

success of these chemicals is limited since they also reduce photosynthesis. The desirable characteristics of film forming type of antitranspirants are; (a) They should form a thin layer, (b) They should be more resistant to the passage of water vapour than carbon dioxide and the film should maintain continuity and should not break.

**3. Reflecting type:** These are white materials which form a coating on the leaves and increase the leaf reflectance (albedo). By reflecting the radiation, they reduce leaf temperatures and vapour pressure gradient from leaf to atmosphere and thus reduce transpiration. (1) Application of 5 per cent kaolin spray reduces transpiration losses.(2) A diatomaceous earth product (celite) also increases reflection of solar radiation from crop canopy.

**4. Growth retardant:** These chemicals reduce shoot growth and increase root growth and thus enable the plants to resist drought. They may also, induce stomatal closure. Cycocel is one such chemical useful for improving water status of the plant

**C). Organic manuring**

Organic manuring increases the organic matter in soil. Organic matter (SOM) include improvement of soil quality through increased retention of water and nutrients, resulting in greater productivity of plants in natural environments and agricultural ecosystem. Improves water infiltration and water use efficiency. Improves soil water-holding capacity and water absorption. SOM improves soil structure and reduces erosion, leading to improved water quality in groundwater and surface waters, and ultimately to increased food security and decreased negative impacts to ecosystems. The ability of soil to prevent nutrient leaching and increase soil aggregation. The ability of nutrients, water and air to flow through the soil. Soil organisms' habitat and access to nutrients. It acts as mulch, thereby minimizing the evaporation losses of moisture from the soil.

**D). Conservation tillage**

Conservation tillage is basically any system of cultivating that reduces soil or water loss when compared to conventional moldboard plowing, which turns over the soil completely. Most definitions specify that at least 30% of the crop residue must remain on the soil surface at the time of planting. It is designed to conserve soil, water, energy (as originally conceived), and protect water quality (again, as originally conceived).

Conservation tillage systems include a variety of techniques, including "notill" "minimum till" "ridge till" "chisel plow" and "mulch till". The Soil Conservation Service (now called the Natural Resources Service) refers to these systems as "residue management".

**E). Weed control**

1. Prompt weed control eliminates the competition of weeds with crops for limited soil moisture.
2. Transpiration rate from weeds is more compared to crops.
3. Effective weed control in dryland agriculture leads to increasing availability of soil moisture to crops.

## CONCLUSION

The application of mulch on the soil surface has particular advantage of soil moisture for evaporation losses soils reduced, effect of weed control. If transpiration is controlled, it may help in maintenance of favorable water balance in crop plant. The effect of mulches/antitranspirant better response of moisture balance due to enhance water use efficiency and increases production in dryland agriculture. It would appear that there is need to identify situations where availability of even moderate amount of residues or organic manure can be combined with reduced tillage to enhance soil quality and efficient use of rainwater.

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