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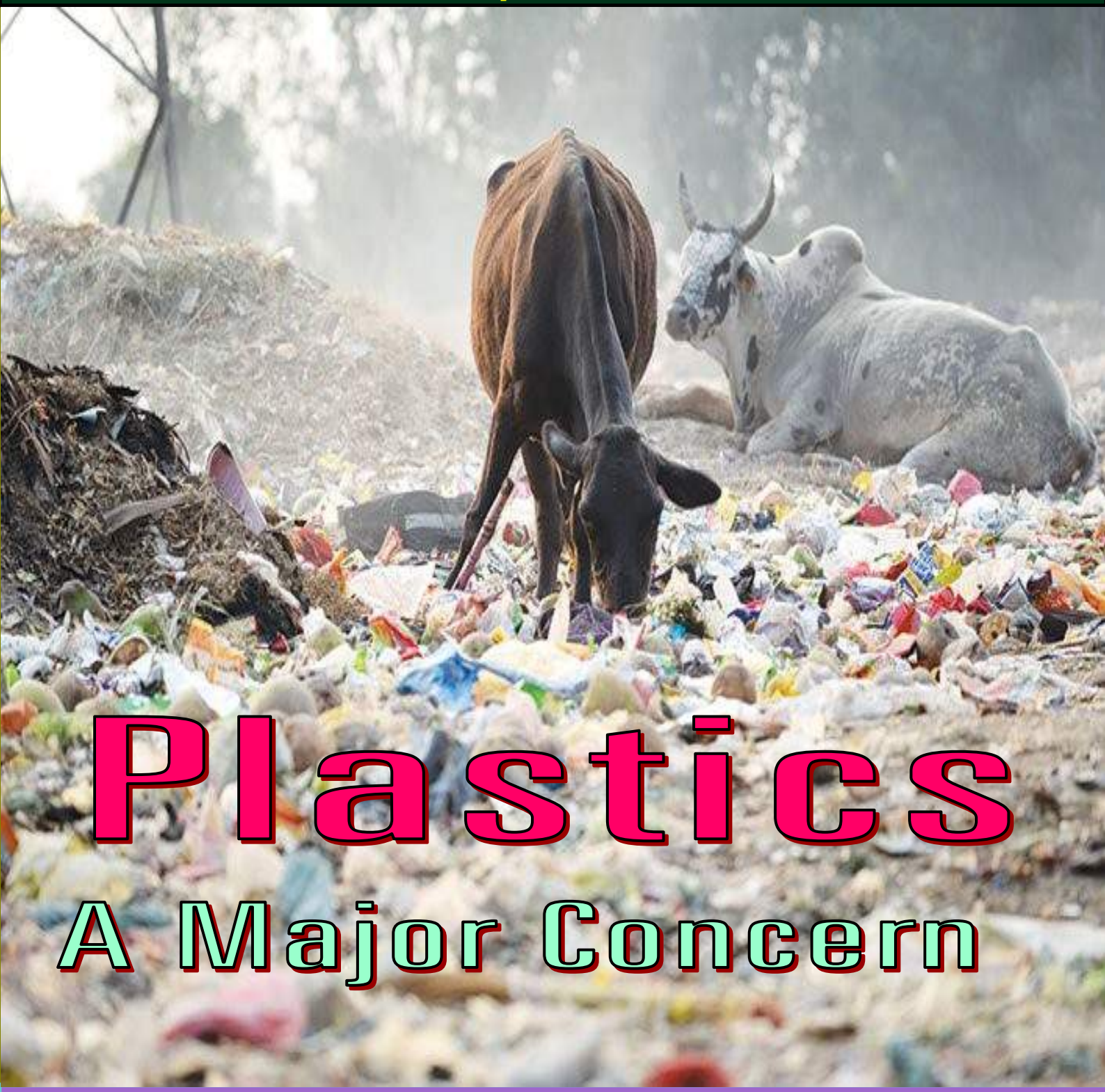

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Anthrax - Public health significance

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Anthrax is a highly fatal, acute and febrile zoonotic disease caused by *Bacillus anthracis*, a gram-positive, rod-shaped bacterium that affects mainly large domesticated animals. Cattle and sheep are highly susceptible to anthrax followed by horse, mules and pigs. Man acquires the disease accidentally through contact with infected animals or their products, often by the cutaneous route and rarely by the respiratory or gastrointestinal routes (Freidlander, 1999). Anthrax is a concern of public health in India where 70 per cent of population depend upon agriculture as source of income. The resistant spores of anthrax have earned the status of potential bio- terror weapon. The possibility to create aerosol from spores makes *B. anthracis* a lethal biological weapon. According to CDC norms, *B. anthracis* is placed in high priority- Category A due to its ease of dissemination, high mortality rates, epidemic potential and requires special preparedness.

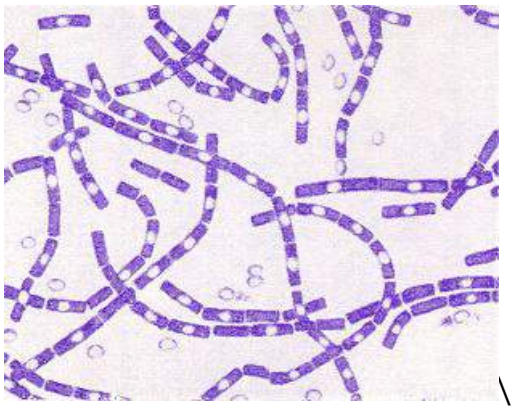
EPIDEMIOLOGY:

Anthrax mainly occurs in herbivores like cattle, sheep, and camels, horses, etc. and resulting in severe disease with a high mortality rate (Shafazand et al, 1999). Among birds only ostriches are known to be susceptible to anthrax (Huchzermeyer, 1998). Affected animals will have bleeding from natural orifices resulting in contaminated of pasture, soil or water sources by organism which can persist in the environment after gets sporulated.

The disease is endemic in south Asia and Bangladesh (Thapa et al. 2014). In India, endemic areas of disease are Karnataka, Tamil Nadu, Andhra Pradesh, West Bengal, Orissa, Maharashtra and Jammu and Kashmir. Outbreaks of anthrax generally occur after the climatic change where alkaline soil pH and dry periods provides the microenvironment for the survival of spores and increased exposure to susceptible hosts. The high sheep population and unrestricted migratory patterns leads to outbreak of disease in Andhra Pradesh and Karnataka. Environmental and human factors like free range system of rearing, relatively poor awareness of the disease, the presence of leather tanneries and the soil leads to anthrax outbreaks in Vellore and Tiruvannamalai districts of Tamilnadu (Gunaseelan et al.2011).

Three major forms of anthrax occur in humans: inhalation, gastrointestinal and cutaneous. Human to human transmission of anthrax is unlikely to occur and there is no evidence of spread to health workers caring for patients with the disease.

Bacillus anthracis



ANTHRAX SYMPTOMS IN SHEEP

VIRULENCE FACTORS:

The ability of *B. anthracis* to cause disease depends on two important virulence factors:
The anthrax toxin: encoded by plasmid pXO1 which composed of three proteins: edema factor (EF), lethal factor (LF) and protective antigen (PA) which acts as the receptor binding component mediating entry of either EF or LF into target cells (Koehler et al. 1994). The three components of anthrax toxin act in binary combinations to produce two distinct reactions. An individual protein is non-toxic to animals. The anthrax toxin hinders the immune response by the host against the infection.
The capsule: encoded by plasmid pXO2, a poly-D-glutamic polymer that interferes with phagocytosis. The endospores of *B. anthracis* enter the body through abrasions, inhalation or ingestion and infection gets started which then phagocytosed by macrophages and carried to the regional lymph nodes. Inside the macrophages the spores germinate and become vegetative bacteria (Guidi-Rontani et al.1999) that are then released from macrophages and reach the blood stream, after multiplying in the lymphatic system, causing massive septicaemia. Both virulence factors are expressed by the organism in this process and the resulting toxaemia has systematic effect that lead to the death of the host.

CLINICAL MANIFESTATIONS:

IN ANIMALS:

The clinical symptoms like severe mucosal congestion leading to haemorrhages from mouth, anus and nasal cavity which considered as pathognomonic signs of anthrax. In addition to that, there will be elevated body temperature (40-41.6°C in Cattle), dyspnoea, generalized oedema, excitement, depression, anorexia, convulsions, staggering gait, diarrhoea, dysentery, abortion, blood stained milk. In herbivores, the disease is hyper acute resulting in sudden death within 10-24 hrs due to septicaemia and toxaemia .The gastro-intestinal form is more common. Cutaneous anthrax occurs through bite of mechanical vectors or wound contamination.

IN HUMANS:

***Cutaneous anthrax*:**

The clinical form in which spores enters the skin through abrasions or cuts and gets deposited in different areas like arms, hands, face, and neck. The infection arises within 1-7 days to maximum of 12 days and initially develops as painless small papule which then gets transforms into vesicle filled with dark bluish black fluid that contains numerous, large gram-positive bacilli and its get ruptures which reveals a black eschar, commonly referred as a malignant pustule. After one or two weeks the eschar dries and falls off. Regional lymphadenopathy may also be seen. Some patients will experience headache, malaise, and low-grade fever, usually asymptomatic.

ESCHAR LESION-CUTANEOUS FORM

***Inhalation anthrax*:**

The clinical form in which spores-bearing particles are inhaled and its gets deposited into alveolar spaces (Goossens et al.2009) which are then ingested by macrophages and transported via lymphatics to mediastinal lymph nodes. The disease follows rapidly after the germination of spores. The symptoms include fever, malaise, myalgia, cough, chest pain and abdominal pain. Within two to three days, patients enter into the second stage that starts abruptly with fever, acute dyspnoea, diaphoresis, cyanosis, and shock. Death occurs within a few to 36 hours.

***Gastrointestinal anthrax*:**

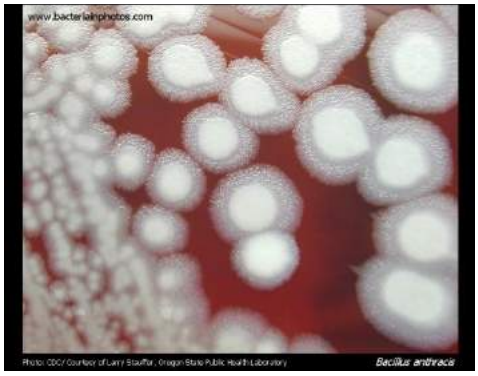
It occurs after ingestion of under-cooked meat contaminated with spores. Symptoms will appear after 2-5 days of ingestion which include nausea, vomiting, fever, and abdominal pain. Hematemesis, massive ascites and bloody diarrhoea may follow rapidly. A feature of intestinal anthrax is the presence of haemorrhagic mesenteric lymphadenitis (Burke, 2008).

LABORATORY DIAGNOSIS:

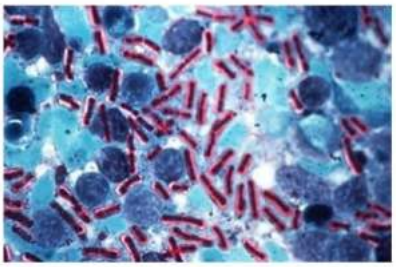
The organisms produce non-haemolytic typical colonies, 2-3 mm in diameter, with wavy margin and small projections (a "medusa head" appearance) on blood agar. *B. anthracis* produces a capsule in the host but not on the ordinary cultural media. The capsule is visible when the organism is stained with polychrome methylene blue by McFadyean's method (Swartz, 2001). On the hospital laboratory level, initial identification can be made by direct Gram's-stained smear of a skin lesion (vesicular fluid or eschar), cerebrospinal or pleural fluid and peripheral blood showing encapsulated, broad, gram-

positive bacilli. Initial identification also made by plating the above clinical specimens on blood agar and observing the characteristic cellular and colonial morphology.

"Medusa head" appearance of colonies on blood agar



B. anthracis
McFadyean reaction(polychrome MB stain)



TREATMENT

Penicillin, in large doses, was considered the drug of choice in treating human anthrax. Alternative antibiotics include erythromycin and tetracycline for patients allergic to penicillin. Other antibiotics can also be used include the aminoglycosides (gentamicin, tobramycin, amikacin) chloramphenicol, clindamycin, fluoroquinolones (ciprofloxacin, ofloxacin, levofloxacin), impinem, rifampin and Vancomycin). *B. anthracis* is resistant to cefuroxime, third generation cephalosporin's (cefotaxime, ceftazidime, etc.), aztreonam, trimethoprim and sulphamethoxazole. Cutaneous anthrax will respond excellently to antibiotic treatment with mortality rate reduced to less than 1%. Untreated inhalation anthrax is almost always fatal, however, even if antibiotic treatment started early in the course of the disease, high fatality rates will occur among the affected persons. However, early institution of antibiotics and aggressive supportive therapy is needed for successful management of inhalation anthrax.

PREVENTION AND CONTROL:

Control of anthrax in animals is a pre-requisite for its control in humans. A live spore vaccine derived from a non-capsulated strain of *B. anthracis* (Sterne strain) is available for use in livestock. The vaccine is administered as a single dose to animals with a yearly booster. The most widely used and studied in recent years is anthrax vaccine adsorbed (AVA). AVA consists of a non-infectious sterile filtrate from the culture of an attenuated strain, adsorbed to the adjuvant, aluminium hydroxide. The vaccine is administered subcutaneously at 0, 2, and 4 weeks and 6, 12, and 18 months with yearly boosters. AVA has been licensed by the Drug and Food Agency (FDA) in the US since 1970 and recommended for goat hair and woollen mill workers, veterinarians, laboratory workers, and livestock handlers who are at risk due to occupational exposure (Freidlander et al.1999).

Proper education and awareness among the public about the severity of disease and occupational hazards to be given in order to reduce the morbidity and mortality rates during outbreaks and epidemics. Public education campaign involving both

veterinary and local health personnel on the actual cause, prevention and control of anthrax could reduce outbreaks of the disease in human population. The important tools for the prevention of anthrax are vaccination, avoid opening of the carcass, proper carcass disposal, burning of the bush, appropriate treatment and annual revaccination is necessary for the outbreak area for at least three years.

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Genomic Selection for Dairy Cattle

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Abstract

With the advent of sequencing and genotyping technologies, a new selection scheme has been proposed for rapid and accurate animal selection, called genomic selection. Genomic selection, in principle, makes use of the information based on genome wide markers, i.e., SNPs (Single Nucleotide Polymorphism) to select animals, thus the breeding values obtained are called the GEBV (Genomic Estimated Breeding Values). Once the relationship between the marker and phenotypic record is established in a reference population, the GEBVs can be calculated and further selection in candidates can be achieved based on these GEBVs only, without phenotypic recording for the trait concerned. This article deals with the basic concept of genomic selection and its implementation in dairy cattle improvement specially in developing nations.

INTRODUCTION

Traditional animal breeding has relied on phenotypic recording of economically important traits without any knowledge of the genes affecting those traits. However, such methods have altered the genetic structure of population indirectly without actual manipulating the individual genes. Breeders have enhanced production traits in their herds by selecting superior individuals as parents for the next generations (Goddard and Hayes, 2007). The estimation of these "breeding values" on the basis of phenotypic records available has made a remarkable impact of improvement of dairy animals, for e.g. during years 1960 to 2005 feed conversion in pig production has been estimated to be decreased by 50%, also in major dairy breed like Holstein cattle milk production is still increasing by approximately 110 kg per animal per year. Although, the results are remarkable in terms of improvement in production quality and quantity problems still arises for traits that have low heritability, expensive to measure, difficult to measure like fertility, longevity, disease resistance, feed efficiency etc. Problems regarding these traits and their selection can be addressed by genomic selection (Eggen, 2012).

All the economically important traits in animals are governed by polygenes and hence are called quantitative traits. Some of these genes have small effect while some have larger effects on the phenotypic expression of the trait in consideration (Goddard and Hayes, 2007). Advancement in genomic technologies has provided ways to improve efficiency in livestock breeding by which long term improvements in overall animal production can be obtained. The genomic era has made it possible to look into the

genome of each animals and selection of that animal based on its DNA sequence. Genomic selection, in principle, makes use of the information based on genome wide markers, i.e., SNPs (Single Nucleotide Polymorphism) to select animals, thus the breeding values obtained are called the GEBV (Genomic Estimated Breeding Values). Once the relationship between the marker and phenotypic record is established in a reference population, the GEBVs can be calculated and further selection in candidates can be achieved based on these GEBVs only, without phenotypic recording for the trait concerned.

Principle of Genomic Selection

Genomic selection was described by Meuwissen et al. (2001), it is based on the fact that to study the inheritance of whole genome one can use markers that are distributed throughout the genome. With the advent of SNP chips one can track more than 40000 SNPs distributed throughout the genome, this approximately makes possible to study the whole genome of any individual. With large number of SNPs included in the analysis it is expected that some of them may be near or within the gene of interest for which selection has to be carried out or which is affecting the desired phenotypic trait. In broad terms such as association between an SNP marker and a causal mutation that is controlling the variation in particular trait is called linkage disequilibrium (disequilibrium is a misnomer) upon which the whole concept of genomic selection rests. The existing substantial linkage disequilibrium between one (or several) SNP and a causal mutation can be used to explain a significant fraction of the variation of the observed trait.

Genomic selection proceeds with access to a large group of animals, this random breeding group of animals will form the reference population which is used to estimate the GEBV. The population should have proper and accurate recording of phenotypic trait(s) that needs to be improved. This reference population is genotyped by SNP chip of required marker density (40K or more). The denser the markers on SNP chip the more better it is, as the denser chips will enable the tracking of more genetic variation. The optimum density of marker on SNP chips vary as per trait, population and resources. The animals are then genotyped using this chip as well as phenotypic recording is done for the traits of interest. Preferentially, more than one trait is recorded and used under this selection scheme and a prediction equation is developed using the genotypic and phenotypic data. The result of these equations is expressed as genomic estimated breeding values (GEBV) of each individual. This step is called the validation step, that is, in the reference population the genotype and its effect on the traits of interest is assessed and by using simultaneous equations GEBV are developed. After this step, the GEBV for other animals (other than the reference population) can be calculated based on their genotypes obtained from SNP chips without recording the phenotypic trait. Selection on basis of GEBV can be practiced on existing breeding programmes, in which the information on pedigree and phenotypic recording for trait(s) of interest are in routinely done because genomic breeding values provides a new level of accuracy for selection decisions in the existing programmes.

Accuracy of genomic selection

Accuracy of genomic selection depends upon the density of markers on chip, number of animals in reference population for genotyping and phenotyping, heritability of the trait and the number of independent loci or chromosomal segments in the population (Goddard 2008; Daetwyler *et al*. 2008). The accuracy of genomic breeding values has been reported to be better then parental averages in US, New Zealand and Australia, specially the reliability of genomic breeding values was increased when large number of bulls are used in reference population (Hayes et al., 2008). The accuracy of genomic selection further depends on two main factors viz., the level of linkage disequilibrium (LD) present between marker and the quantitative trait locus (QTL) and the distribution of QTL effects *i.e.*, the SNP being studied should be in sufficient LD with the QTL (or the gene of interest) so that the marker will be able to predict the effect of the QTL (whether good or bad, small or large, for a particular trait) across the population and generations. One more factor that affects the genomic selection is the number of phenotypic records used to estimate the QTL effects, obviously the more the number of records are available, the more number of observations can be obtained under a single SNP greater will be the accuracy of selection. Consequently, if the heritability of the traits is large then less number of records will be required as compared in lower heritabilities. Also, if there are many QTLs with smaller effects the requirement for phenotypic records will be more (Hayes *et al*., 2008).

Implementation and advantages of genomic selection

The major advantages of genomic selection are that it can be implemented very early in life, it is not sex limited, and can be extended to any traits that are recorded in a reference population, also it is useful for traits that are difficult to measure, sex limited or slaughter traits. It provides better accuracy of selection and reduces the generation interval thus increasing the selection intensity. Unlike marker assisted selection, it is not confined to families; neither it requires a pedigree population as the reference population can be a group of random breeding individuals without pedigree recording. As marker assisted selection is based on identification of markers in LD with causative mutation or the QTL affecting a trait, genomic selection conceptually follows the segregation of whole genome thus captures the genetic variance which is escaped in MAS scheme.

Simulation studies have shown that using genomic selection, the genetic gain per year could be doubled in dairy cattle and the cost of proven bulls can be reduced by more than 90%. Rather than cattle going through a long and expensive progeny test with the recording of phenotypic information on large numbers of daughters, accurate GEBV could be calculated through a cost-effective genotyping step that too early in life. In cattle, more than 15 countries are now using genomic breeding values on the national level and have successfully passed the international GEBV test organized by Interbull (http://www.interbull.org/). Genomic evaluations in dairy cattle have been a reality

since 2008. The structure and data recording schemes, as well as the biological characteristics of these species, have made the implementation of GS possible in Holstein breeding programs worldwide. The United States, Canada, New Zealand, France, The Netherlands and the Nordic countries, among others, have already incorporated it, and the list will include other countries soon. GS has been found useful in US in comparison to traditional methods for low heritability traits like mastitis, body condition score, fertility and lameness are traits for which GS may increase the genetic gain. New Zealand has reduced the number of progeny-tested bulls by using a higher selection intensity of candidates selected based on genomic. The implementation of GS for other dairy breeds, such as the brown Swiss, is planned, although some limitations exist due to smaller population sizes. Many progressive breeders are using genomic testing for the majority of their cows and heifers to identify those females that received the most favourable combination of genes from their parents. As cost-effective genomic tools continue to be developed for livestock, crop, and aquaculture species, the corresponding breeding industries will be able to make selection decisions sooner, improve traits that are difficult to address with traditional breeding methods, and provide consumers with higher quality, safer foods while reducing the impact of breeding on the environment and ensuring its long-term sustainability. Currently, a low-density (LD) chip with 6,909 SNP (Illumina, Inc.) and a medium-density (50K) chip with 54,609 SNP (Illumina, Inc.) are the products used most frequently by breeders, and GEBV for production, health, and conformation traits can be computed using genotypes from either chip. Genomic testing services are currently offered by breed associations, AI stud services, and some privately owned companies.

Opportunities for Developing Countries

In developed countries, phenotypes and pedigrees have been recorded for certain species, such as dairy cattle, for more than 100 years. Progeny testing has been implemented for nearly 50 years. Developing countries are often limited by the absence of programs that record phenotypes on pedigreed animals and the lack of evaluation or national testing programs to assess the genetic value of germplasms. However breeds that are undergoing national or regional selection programs can be used as reference population for genomic selection, In Indian perspective, breeds included in AICRP programs in cattle and buffalo can be utilized for estimation of genomic EBV and identification of superior sires. Centres already working in national programs tend to have nucleus herds and proper recording system which can adopt genomic criteria of selection. Also India is blessed with huge buffalo population and recent advances in buffalo genomics have paved way for GEBV estimation in buffaloes. In 2013, utilizing the Axiom® Buffalo Genotyping Array 90K it was found that about 75% markers were highly polymorphic on buffalo population of Brazil and Italy. It is also shown in simulation studies that that using genomic breeding values that the generation interval between male to ale selection in Nili ravi buffalo could be bought down to 3.3 years thus doubling the genetic gain as compared to the conventional progeny testing programms. In India, a few cattle breeds like Sahiwal, Fireswal are available in organised farms or

the breeds under field progeny testing schemes have long time pedigree and data recording therefore they can be used as reference population. However direct implementation of genomic selection may be difficult hence it is necessary to run a pilot scheme so that its efficiency, its cost effectiveness and its impact on local breed diversity and their niche market could be worked out in Indian context. Use of genomic tools hence may be a policy call for developing nations that may be only restricted to few breeds initially so that inbreeding could be maintained at minimal levels and our exceptional breed diversity may be maintained. Another point to consider is adaptation of genomics by local and regional dairy enterprises, private firms or dairy associations may themselves pool up there resources to produce bulls with high GEBV that may be used in public as well as private sector for breed improvement. This may make bull raising and semen supply a more profitable business as the program develops. Using genomic techniques in local breeds may also help in their preservation and further improvement of local breed population.

CONCLUSION

The advance in genomics, the transcriptome, the epigenome, and the metagenome of livestock species by rapid sequencing methods is opening a new world of possibilities for livestock improvement. Genomic selection provides a powerful and rapid tool for rapid livestock improvement. Utilizing genomic vales for animal improvement is certainly better asn well suited for organized farms or associations or setup where more number of bulls can be tested in a reference population. For developing countries like India the scenario remains a bit different as conservation of huge biodiversity and breed types is also important for future livelihood security. Therefore, genomic selection can be applied for breeds that are being reared under organized conditions like Frieswal cattle, also genomic approaches could be used in identification and preservation of critical populations for preservation and for conservation of locally well adopted breeds, however obtaining a minimum number of phenotypes in field conditions remains a challenging step for deployment of genomic values in developing nations.

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Medical termination of pregnancy in bitches

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Unwanted matings and pregnancy in breeding bitches is a major serious reproductive problem that occur frequently in dogs which is facing among the pet owners. As a result termination of pregnancy is one of the most common requests from pet owners in veterinary practice due to several reasons viz. possible difficulties encountered with a pregnant bitch, adoption of unwanted puppies, accidentally bred by an undesirable dog. Further, pet owners prefer pregnancy termination by drugs to avoid surgical sterilization and postoperative complications such as urinary incontinence, weight gain, and changes in coat condition or behavior. Most of the drugs used are not safe and have severe side effects .So, the drugs should be carefully chosen on the basis of its safety, efficacy, and costs as well as compliance of the owner. Before medication, the vet should confirm about pregnancy, the stage of gestation, and time elapsed since mating. The drugs used for termination of pregnancy in bitches are represented in the tabulated form(Table 1)

Table 1. Different drugs used for termination of pregnancy in bitches

Category	Ingredients	Dose rate	Role	Side effects
Estrogen	Estradiol benzoate	0.01mg/kg intramuscularly on day 3, 5 and 7 after mating	Prolongs the oviduct transport time and tightens the utero-tubal junction, resulting in implantation failure or embryonic death	Pyometra Metritis Ovarian cysts aplastic anemia, bone marrow suppression, alopecia
	Estradiol cypionate	44µg/kg intramuscularly once		
	Tamoxifen citrate	1mg/kg twice a day orally for 10 days starting either in proestrus, estrus, or days 2,15, or 30 of diestrus		
		0.1mg/kg twice a day subcutaneously		

Prostaglandins	Dinoprost	after 30-35 days of gestation	repeated dose causes luteolysis of corpus luteum resulting in decrease in progesterone concentration	vomiting, diarrhea, pupil dilation, hyperpnoea, salivation, urination, anxiety, ataxia, respiratory distress
	Cloprostenol	1- 2.5 µg/kg once a day subcutaneously for 4 to 5 days after 30 days of gestation		
Dopamine Agonists	Bromocriptine	25-50mcg/kg orally or subcutaneously thrice a day for 7 days after 35-40 days of pregnancy	Inhibits prolactin secretion, which is luteotrophic during the second half of pregnancy	Vomiting, anorexia, inappetance, depression
	Cabergoline	5 mcg/kg orally daily for 5 days from 30 days of pregnancy		
	Metergoline	400-500mcg/kg orally once a day for 5 days after 40 days of LH surge		
Progesterone receptor antagonists	Mifepristone	2.5 mg/kg subcutaneously twice daily for 5 days after 32 days of pregnancy	prevent binding of progesterone to its receptors	mammary gland development and lactation
	Aglepristone	10mg/kg subcutaneously once daily for 2 days after 30 days of pregnancy		
	Epostane	50 mg/kg/day orally for 7 days beginning at the onset of diestrus/ metestrus		
Corticosteroid	Dexamethasone	5mg/kg intramuscularly twice a day for 10 days after 30 days of pregnancy	may have luteolytic action	anorexia, polydypsia, polyuria, vaginal discharge, restlessness, anorexia or vomiting
GnRH Antagonists	Acycline	110-330mcg/kg orally for 7 days administered later in pregnancy	inhibiting Luteotropic hormone secretion from	Less side effects

			the pituitary gonadotroph cells	
Drugs in combination	Cabergoline /Cloprostenol	Cabergoline@ 5mcg/kg orally once a day for 7 days along with Cloprostenol @2.5mcg/kg subcutaneously three times on alternate days (Day 1, 3 and 5) after 25 days of LH surge.	Synergistic effect	Longer treatment schedule

**mcg-Microgram, LH-luteotropic hormone, mg-milligram ,kg-kilogram*

CONCLUSION

Majority of the bitches presented to vets for treating mismating are not pregnant. Different methods are available for pregnancy termination in the bitches. If drugs are to be used, their use must be discussed with the client regarding side effects, safety, efficacy, convenience, compliance in treatment, and cost. Thus, the permanent solution for pregnancy termination without using drugs is ovariohysterectomy.

Soil Quality - Managing soil for today and tomorrow

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Environmental sustainability will only be achieved by maintenance and improvement of soil quality. Soil quality is considered as the capacity of a soil to function. Its assessment focuses on dynamic aspects to evaluate the sustainability of soil management practices. The concept of soil quality (Doran & Jones, 1996; Karlen et al., 1997) is useful to assess the condition and sustainability of soil and to guide soil research, planning, and conservation policy. The importance of soil quality lies in achieving sustainable land use and management systems, to balance productivity and environmental protection. For assessing soil quality a complex integration of static and dynamic chemical, physical, and biological factors need to be defined in order to identify different management and environmental factors. Also, the consequences of any decline in soil quality may not be immediately experienced. The soil system does not necessarily change as a result of changing external conditions or use, because soil has the capacity of resistance (or resilience) to the effects of potentially damaging conditions or misuse or to filter out harmful materials added to it. In part, this capacity of the soil in buffering the consequences of inputs and changes in external conditions arises because the soil is an exceedingly complex and varied material with many diverse properties and interactions between soil properties. It is this complex dynamic nature which often makes it difficult to distinguish between changes as a result of natural development and changes due to nonnatural external influences. Soil-quality assessment, based on inherent soil factors and focusing on dynamic aspects of soil system, is an effective method for evaluating the environmental sustainability of land use and management activities (Nortcliff, 2002).for improving and ensuring soil quality, the main considerations should be identification and development of suitable methods to measure their quality. Then, the management-sensitive key indicators of soil quality should be identified and used for monitoring and predicting the changes periodically.

Soil Quality and Soil Health

The term soil quality and soil health are often used interchangeasbly in the scientific literature. Soil quality is the capacity of a specific kind of soil to function within ecosystem and land-use boundaries to sustain biological productivity, maintain environment quality, and sustain plant, animal and human health(Doran and Parkin,

1994). Soil health is defined as being a state of dynamic equilibrium between flora and fauna and their surrounding soil environment in which all the metabolic activities of the former proceed optimally without an hinderance, strees or impedance from the latter. Soil health is considered as the stae of a soil at a particular time, equivalent to the dynamic soil properties that change in short term, while soil quality may be considered as soil usefulness for a particular purpose over a long time scale, equalent to intrinsic or static soil quality (Goswami, 2006).

Assessment of soil quality

Soil quality can be determined from a variety of soil properties or processes (i.e., indicators), the selection of which may be partially dependent upon land use. Indicators of soil quality will reflect important soil functions (Magdoff and Weil, 2004), including:

- producing vigorous and healthy plants
- cycling and retaining globally important nutrients, e.g. (a) storing nitrogen in soil and releasing it to roots for efficient plant production and (b) storing carbon in soil and releasing it to the atmosphere in a dynamic balance that stabilizes atmospheric concentration of CO2
- supplying plants with water, nutrients, and plant-growth promoting compounds zprotecting water quality (both ground water and surface water) from nutrient and pathogenic contamination
- providing physical stability and support for vegetation, buildings, and roads
- enabling animal habitat and serving as a reservoir for biodiversity (microscopic and visible)
- buffering against toxic accumulation and transport of natural and synthetic compounds
- filtering elements to protect animals, plants, and the environment from undesirable exposure Soil quality assessments often use a small group of indicators (i.e., a minimum data set) to economically and efficiently characterize selected key soil functions. Land managers and scientists do not have unlimited time and and resources to study all of the potential functions served by soil in a region, nor can they predict future needs or demands on soil resources.

A minimum data set for soil quality assessment is designed to establish a reliable estimate of the capacity of soil to perform a defined set of functions and to assess changes in soil quality over time. A well-designed minimum data set should allow us to monitor changes in soil functions brought about as a result of a particular cropping pattern, tillage system, and overall management. Specifically, a minimum data set is proposed that should reliably detect changes in soil quality as farmland shifts from conventional to organic production.

Soil quality assessment distinguishes between static and dynamic soil properties.

Static soil properties reflect the inherent characteristics of a particular site, e.g. soil texture, mineralogy, and classification, all of which are influenced by geologic history and climatic conditions. In addition, topography, hydrology, and climate are factors that affect productivity and environmental quality of a site, somewhat independent of

management. Static soil properties have been adequately characterized in North America with regional sampling approaches by the USDA's Natural Resources Conservation Service through the periodic National Resources Inventory (Brejda et al., 2000). Similar efforts have been conducted by Agriculture and Agri-Food Canada (MacDonald et al., 1995). Static soil properties provide the contextual background for how soil management practices might eventually alter dynamic soil properties

Dynamic soil properties are those properties that can change value over relatively short time periods (e.g., months, years, and decades). Dynamic soil properties are at the leading edge of soil quality assessment, because they change quickly, and oftentimes dramatically, in response to management. Dynamic soil properties can indicate whether a farm uses agronomically and ecologically sustainable practices. Changes in soil properties with time are a key component of dynamic soil quality assessment. Sustainable cropping systems that improve soil quality indicators with time will lead to incrementally higher soil quality. Practices and strategies proven to enhance soil quality across a broad range of ecosystems include diverse crop rotations, minimal use of tillage for weed control and seedbed preparation, and addition of organic amendments like animal manures, crop residues, and compost. Management systems that cause a decline in soil quality indicators with time will lead to lower soil quality; often induced by cropping systems with low residue production, intensive tillage, and near monoculture cultivation.

Soil indicators

Indicators are measurable properties of soil or plants that provide clues about how well the soil can function. Indicators can be physical, chemical, and biological characteristics.

Useful indicators :

•are easy to measure
•measure changes in soil functions
•encompass chemical, biological, and physical properties
•are accessible to many users and applicable to field conditions
•are sensitive to variations in climate and management

Indicators can be assessed by qualitative or quantitative techniques. After measurements are collected, they can be evaluated by looking for patterns and comparing results to measurements taken at a different time or field

Physical Indicators

- Soil structure
- Depth of soil
- Infiltration and bulk density
- Water holding capacity

Relationship to Soil Health

- Retention and transport of water and nutrients
- Habitat for microbes
- Estimate of crop productivity potential
- Compaction, plow pan, water movement
- Porosity
- Workability

Chemical Indicators

- pH
- Electrical conductivity
- Extractable N-P-K

Relationship to Soil Health

- Biological and chemical activity thresholds
- Plant and microbial activity thresholds
- Plant available nutrients and potential for N and P loss

Biological indicators

- Microbial biomass C and N
- Potentially mineralizable N
- Soil respiration.

Relationship to Soil Health

- Microbial catalytic potential and repository for C and N
- Soil productivity and N supplying potential
- Microbial activity measure

MANAGING FOR SOIL QUALITY

1. **Add organic matter**: Regular additions of organic matter are linked to many aspects of soil quality. Organic matter may come from crop residues at the surface, roots of cover crops, animal manure, green manure, compost, and other sources. It can improve water holding capacity, nutrient availability, and can help protect against erosion.

2. Avoid excessive tillage : Tillage has positive effects, but it also triggers excessive organic matter degradation, disrupts soil structure, and can cause compaction.

3. **Carefully manage fertilizer and pesticide use**: Fertilizer can increase plant growth and the amount of organic matter returned to the soil They can harm non-target organisms and pollute water and air if they are mismanaged Manure and other organic matter also can become pollutants when misapplied or over applied .

4. **Increase ground cover** : Bare soil is susceptible to wind and water erosion, and to drying and crusting Ground cover protects soil, provides habitats for larger soil organisms, such as insects and earthworms, and can improve water availability. Cover crops, perennials, and surface residue increase the amount of time that the soil surface is covered each year .

5**. Increase plant diversity** : Each crop contributes a unique root structure and type of residue to the soil. A diversity of soil organisms can help control pest populations, and a diversity of cultural practices can reduce weed and disease pressures. Diversity across the landscape and over time can be increased by using buffer strips, small fields, contour strip cropping, crop rotations, and by varying tillage practices. Changing vegetation across the landscape or over time increases plant diversity, and the types of insects, microorganisms, and wildlife that live on your farm.

CONCLUSION

Maintenance and improvement of soil quality is one of the most important prerequisites to achieve the environmental sustainability. In spite of the huge controversy (Sojka & Upchurch, 1999), the modern concept of soil quality is a valid and important framework in interpreting scientific soil information and predicting sustainable soil use and management. Soil-quality indicators are valuable tools and are finding increasing application. However, dynamic soil indicators should be measured after estimation of inherent soil indicators. Sustainable soil management can maintain and even improve soil quality through the use of soil-specific practices, adapted to local soil, terrain, and climatic conditions, by using decision or planning support tools.

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Ashwagandha (*Indian Ginseng*): A boon to Indian Farmers

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Withania somnifera, commonly known as Ashwagandha, Indian ginseng is a plant of the Solanaceae or nightshade family. Its main use in Ayurvedic literature is as a "rasayana" or rejuvenating drug and traditionally known as Avarada which suggests the application for enhancing longevity. It grows in dried parts in subtropical regions. In India Ashwagandha is commercially cultivated as rainfed crop Rajasthan, Madhya Pradesh; Anantapur, Kurnool, Mahabubnagar, Warangal and Andhra Pradesh. Cultivation has been initiated at few locations in Karna-taka. Several other species in the genus somnifera species is a short, tender perennial shrub growing 35–75 cm (14–30 inches) tall. The branches are Tomentose shape radially extend from a central stem. Leaves are dull green, elliptic, usually up to 10–12 cm (4 - 5 inches) long. The flowers are small, green and bell-shaped. The ripe fruit is orange in colour. The extract is derived form the roots of *Withania somnifera* have medicinal values. It is known as one of the best known and most researched ayurvedic herbs and holds a place in the ayurvedic traditions similar to Ginseng in Chinese therapies. For that reason, *Withania somnifera* has been often referred to as the "Indian Ginseng". *Withania somnifera* is used in several indigenous drug preparations for maintaining health as well as treatment of several disease conditions. Its main use is as an immunomodulator and as an antistress. *Withania* contains number of phytoconstituents

and withanolides as the major constituent having medicinal value.

Plant Morphology

An erect branched under shrub up to 1.25 m in height, minutely stellate tomentose. Root fleshty, tapering, and whitish brown. Leaves are ovate and flowers are greenish in colour.

MEDICINAL USES OF ASHWAGANDHA

Leaves: The leaves of Ashwagandha are used as a cure for inflammation, to reduce the formation of pus in boils, ulcers, swellings and skin lesions. The leaves are curative in nature because of the presence of Withaferin A. Leaves are also given in fever. The ointment prepared from boiled leaves can be used to cure bedsores.

Roots: Extract from the roots can be used in the treatment of dropsy, disorders of female, hiccup, dropsy, rheumatism, and cough. It is used in weaknesses to gain strength**.** People suffering from joint pain and paralysis use the drug prepared from Ashwagandha. It is used as a sedative for the treatment of insanity, nervous disorder and for the treatment of high blood sugar, blood pressure, and cholesterol. Ashwagandha is used for increase of hemoglobin. It also reduces chronic stress and causes relaxation. It is used as antioxidant and it slows down the growth of lungs, breasts, and colon cancer cells and has anti- anxiety effect. Ashwagandha capsules can also be used to recover memory losses used as a tonic, it increases sexual potential. The powder mixed with oil reduces and cures skin infection.

Seeds and fruits: The seeds and fruits are diuretic in nature and promote passing of urine. The seeds are also used as rennet in cheese making.

SOIL AND CLIMATE

W. somnifera grows well in sandy loam or light red soil, having pH 7.5-8.0 with good drainage. It can be cultivated between 600-1200 ma latitude. The semi-tropical areas receiving 500-750 mm rainfall are suitable for cultivation of this rained crop. The crop requires dry season during its growing period. Temperature between 20 ^{0} C to 35 ^{0} C is

most suitable for cultivation. Late winter rains are conducive for the proper development of the plant roots.

CHEMICAL CONSTITUENTS

Different parts of the plant contain a number of chemical com-pounds. Some of them are listed below

Compound	Chemical constituents
Alkaloids	Ashwagandhine, anahygrine, anaferine, cuscohygrine, tropine, isopelletierine, pseudotropine, dlisopelletierine, hygrine, mesoanaferine, choline, somniferine, withanine, withananine, hentriacontane, visamine, withasomnine, tigloyloxtropine, tropyltigloate *etc.*
Steroidal compounds	Ergostane
Steroidal lactones	Withaferin (A-Y), withanolides A withasomniferin A withasomidienone withasomniferols A- C Withanone *etc*.
Saponins	Containing an additional acyl group: sitoindoside VII and VIII
Withanolides	A glucose at carbon 27: sitoindoside IX and X
Withanolide glycosides	Withanosides I, II, III,IV, V, VI and VII
Pyrazole derivatives	Pseudowithanine and ashwagandhine

CULTIVATION

LAND PREPARATION

Ashwagandha is usually grown in fields which are not well covered by the irrigation Systems. The fields on which food crops cannot be taken profitably are used for Ashwangandha cultivation. The soil of the field selected for Ashwagandha cultivation is well pulverized by ploughing, disking and/or harrowing the crop can be sown either by broad casting or in lines method. But line method is preferred as it increases root production and also helps in performing intercultural practices. The seeds are usually sown about 1-3 cm deep in June- July in nursery. A light shower after sowing ensures good germination. About 500-750 gm seeds are sufficient for 1 ha field. Seeds can be treated, with Thiram or Indofil or Dithane - 45 (@ (3 gm/kg seed), before sowing to protect seedlings from seed borne diseases. The seedling after 25-35 days after sowing can be transplanted in the field marinating 60 x 60 cm spacing between the plants & the rows. Since 'Asagnadh' is a rainy season Kharif crop, the time of sowing is decided by date of arrival of monsoon in particular area.

THINNING AND WEEDING

The seeds are sown by broadcasting or in the line furrows should be thinned out by hand at 25-30 days after sowing to maintain a plant population of about 30-60 Plants per square meter (about 3.5 to 6 lacs plants/hectare). The plant density to be used may depend on the nature and fertility of the soil. On the marginal land the seed population

will be kept high. The fertilizer (N: P: K: 20:20:20) is applied. Weeding at an early stage is sufficient to enable the Ashwagandha plants to take over the growth of weed which get suppressed by its smothering effect.

MANURES, FERTILISERS AND PESTICIDES

The medicinal plants have to be grown without chemical fertilizers and pesticides. Organic manures like, farm yard manure (FYM), vermi-compost, and green manure *etc.* may be used as per requirement of the species. Bio-pesticides (either single or mixture) from neem could be prepared to prevent diseases.

IRRIGATION

Light shower after transplantation ensures establishment of seedlings. There is no need of irrigation if rainfall is at regular intervals. Excessive rainfall/water is harmful to the crop. Life saving irrigations will be applied.

HARVESTING/ POST HARVESTING

The plant starts flowering and bearing fruits from December onwards. The crop is ready for harvest in January-March at 150 to 180 days after sowing. The maturity of crop is judged by drying out of leaves and yellow red berries. The entire plant is uprooted for roots which are separated from aerial parts by cutting the stem 1-2 cm above the crown. The roots are then either cut transversely into small pieces (7 to 10 cm) or dried as it is in the sun. About 650-800kg roots can be obtained from hectare on drying it comes to 350-435 kg. Berries are hard and plucked separately. They are dried and crushed to take out the seeds. The dried roots, entire or transversely cut into smaller pieces, have to be further cleaned, trimmed and graded. The roots are beaten with a club which removes adhering soil and breaks off the thin, brittle lateral rootlets. Lateral branches, root crown and stem remains on roots are carefully trimed with the help of knife.

Salicylic Acid (SA): Growth Booster of Onion

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Onion (*Allium cepa* L., from Latin *cepa* "onion"), also known as the bulb onion or common onion, is a vegetable and is the most widely cultivated species of the genus *Alliums*. India is the second largest producer of onion, the first being China. The total annual production in India is 18.73 million tonnes from an area of 0.88 million hectares and the productivity is 21.2 t/ha (Anon., 2015-16).

The major onion growing states of India are Maharashtra, Bihar, Karnataka, Gujarat, Andhra Pradesh, Uttar Pradesh, Orissa and Madhya Pradesh. It is an export oriented crop earning valuable foreign exchange to the country. In India, about 60 percent of onion is predominantly cultivated during winter followed by 20% each in kharif and late kharif seasons. The reason for lower productivity of onion in India is primarily due to cultivation of low yield potential varieties having susceptibility to both biotic and abiotic stresses. Onion is an important commercial crop exposing to wide array of damaging agents including biotic (pathogens and insects) and abiotic (drought, salinity, heat, cold and poor soil fertility) environmental aggressions. To cope up with these continuous challenges under field conditions, plants have evolved broad and efficient mechanism to obtain an adequate defense and one more such mechanism against pathogen attack is the synthesis of vast array of low molecular weight components with disparate functions in plant pathogen interactions (Dixon, 2001). *Stemphylium vesicarium* (Wall.) Simmons is the causal agent of leaf blight in onion (Shishkoff & Lorbeer 1984) in the main production areas of the world. In Egypt (Assiut Governorate) the first report of *Stemphylium* blight in onion caused by *S. vesicarium* was recently reported by Hassan *et al*. (2007)

Role of Salicylic Acid (SA)

One potential method to reduce the severity of disease caused by the pathogen is the induction of systemic acquired resistance (SAR). Certain chemicals, such as Salicylic Acid (SA), 2,6-dichloroisonicotinic acid (INA), potassium salts, amino butyric acid (BABA) and Bion, were reported to induce SAR in plants against plant pathogens (Oostendorp et al. 2001) .SA is recently included in the class of phytohormones for proper plant growth and development and induction of tolerance to both biotic as well as abiotic stresses. Salicylic acid (SA) or ortho-hydroxy benzoic acid is a common plant-

produced phenolic compound. It is an endogenous growth regulator, which contributes in the regulation of physiological, biochemical and molecular processes and there and therefore it affects the plant growth, development and productivity. Salicylic acid also reverses the closure of stomata caused by abscisic acid (Rai *et al*., 1986). Exogenous application of salicylic acid improves the yield in crops (Singh & Kaur, 1980). SA retards ethylene synthesis; stimulates photosynthetic machinery and increase the content of chlorophyll (Leslie & Romani, 1988). Recently, it has been recognized that salicylic acid is required in the signal transduction for inducing systemic acquired resistance against pathogenic infections (Metraux *et al*., 1990; Gaffney *et al*., 1993; Vernooij *et al*., 1994). The induced resistance can be defined as an increased expression of natural defence mechanisms of plants against different pathogens provoked by various type external factors. The term"**induced resistance**" (IR) is used synonymously to"**acquired resistance**" (AR). Depending on the mode of its expression, induced resistance can be systemic (SAR) or local (LAR). These studies clearly suggests the involvement of SA in realization of different anti stress functions in crop plants, but not much information was available on the efficacy of SA in one of the most important export oriented commercial vegetable crop of India, onion. Keeping this in view, a field experiment was conducted at Kalyani, Bidhan Chandra Krishi Viswavidyalaya, India, to study the effect of SA on growth and yield and disease reaction of onion and the observations on disease intensity were recorded using 0-5 scale. (Table 1)

SA treated plant | Untreated plant

Growth parameters of onion

The data given in table 2 indicated that, different treatments did not significantly influence plant height in onion. However foliar application of SA at 250 mg/L at 30 days after sowing + 30 and 45 days after transplanting treated plots recorded higher plant height, highest number of leaves per plant and highest collar thickness closely followed by application of SA at 30 DAS + second spray at 45 DAT and control with no SA treatment recorded the lowest value. These results indicated that foliar application of SA to onion improved crop growth and the extent of improvement was more in the

treatment with more number of foliar sprays. Exogenous application of SA increases photosynthetic activity which enhances the plant height and number of leaves per plant (Gharib, 2006)

Yield and disease pest reactions of onion

The results on yield attributing parameters of onion revealed that there was a significant variation in onion bulb diameter (polar and equatorial) and average bulb weight and total bulb yield due to spaying of SA at different times (Table 2). Significantly maximum polar diameter (PD) of 54.60mm and total bulb yield (31.43t/ha) was recorded in foliar application of SA at 250 mg/L at 30 days after sowing + 30 and 45 days after transplanting treated plots but, maximum equatorial diameter (ED) was recorded in SA at 30 DAS + second spray at 30 DAT + third spray at 60 DAT treated plots (50.59mm) as compared to control (46.18 mm). The results presented on disease severity rating and pest damage of onion revealed numerical variations among different treatments due to exogenous application of SA (Table 2). The results indicated that the plot treated with foliar application of SA at 250 mg/L at 30 days after sowing + 30 and 45 days after transplanting has lower disease severity rating (1.34) and also lowest pest (thrips) populations (1) as compared to control. Total yield also affected with the increase in disease severity.

Table 1: Scale adopted to indicate disease severity against leaf blight of onion

Grade	Percent Damage %	Disease severity
0	0	No disease
1	1-10	A few spots towards tip covering 10 percent leaf area.
2	11-20	Several purplish brown patches covering up to 20 percent of leaf area.
3	21-30	Several patches with paler outer zone covering up to 40 percent leaf area.
4	31-50	Leaf streaks covering up to 75 percent leaf area or breaking of the leaves from center
5	51-100	Complete drying of the leaves or breaking of leaves from center

Table.2 Effect of SA on growth, yield parameters and disease pest reaction of onion

Treatments	PH (cm)	NOL	CTh (mm)	Avg. wt. of bulb (g)	Bulb equatorial diameter (mm)	Bulb polar diameter (mm)	Total bulb yield (t/ha)	Cost Economics (B:C ratio)	Disease severity rating	Pest (Thrips) damage (1-5 scale)
Foliar spray SA at 30 DAS + second spray at 30 DAT	51.94	8.00	1.2	46.13	47.03	50.34	25.90	1 : 1.47	1.54	3
SA at 30 DAS + second spray at 45 DAT	54.21	9.33	1.12	52.51	50.03	53.37	28.01	1 : 1.52	2.87	2
SA at 30 DAS + second spray at 60 DAT	50.39	7.67	1.07	55.46	50.37	53.39	29.58	1 : 1.79	2.23	2
SA at 30 DAS + second spray at 30 DAT + third spray at 45 DAT	54.51	9.67	1.01	56.30	49.96	54.60	31.43	1 : 2.39	1.34	1
SA at 30 DAS + second spray at 30 DAT + third spray at 60 DAT	51.49	7.67	1.1	52.81	50.59	55.62	28.47	1 : 2.07	2.61	2
Control (Water spray only)	49.76	8.67	1.17	48.57	46.18	53.16	22.37	1 : 1.03	4.56	4
Mean	52.05	8.87	1.11	44.53	49.02	53.41	23.72	-	-	-
CD (5%)	3.17	1.29	0.27	6.66	6.31	7.37	15.61	-	-	-
CV(%)	3.35	8.05	13.68	8.41	7.08	7.58	3.70	-	-	-

**SA- Salicyclic Acid *DAS- Days after Sowing *DAT- Days after Transplanting*

CONCLUSION

From this study it could be concluded that foliar spray of SA is essential for onion crop. Foliar spray of SA at 30 days after sowing during nursery seedling stage, subsequently second spray at 30 days after transplanting and third spray at 45 or 60 days after transplanting during crop growth stage not only increased the vegetative growth but also the bulb yield of onion and found as best compared to other treatments for high B:C ratio (1 : 2.39).

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Agri-entrepreneurship – Generating Employment and Sustainable Livelihoods

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Abstract

There are currently nearly 31 million unemployed Indians looking for jobs. However, the number of job creation in 2018 is limited to an estimated 6,00,000. Employment programmes should be directed towards the objective of fostering a sustainable livelihood. Sustainable livelihood calls for achieving triple bottom line i.e., a balance between People, Planet and Profit. Agricultural sector provides numerous opportunities for creating such sustainable livelihoods and entrepreneurship is the key to success in sustainable agriculture. Thus agri-entrepreneurship has huge scope and is extremely important to create employment and sustainable livelihoods.

INTRODUCTION

The number of job-seeking people in India has always been on a high. As per information available on the official website of the Centre for Monitoring Indian Economy (CMIE) - a board that tracks business and economic data of the country, there are currently nearly 31 million unemployed Indians looking for jobs. It was noted that in the week ended on February 25, 2018, the unemployment rate increased to 6.1 per cent as compared to 5 per cent in January. As a new batch of students is set to graduate in May 2018, India will face a yet another jolt of unemployment. While there are about 31 million unemployed youth in India as of February, the number of job creation in 2018 is limited to an estimated 6,00,000.

Employment programmes should be directed towards the objective of fostering a sustainable livelihood. The experience of the US and other developed economies has shown that there is a strong link between entrepreneurship and jobs. We tend to associate entrepreneurial success and employment generation with large IT companies. However in the scenario of depleting natural resources, the agricultural sector can generate jobs in a sustainable way.

Agriculture sector has the major potential for providing the employment opportunities to this huge population of unemployed people in a sustainable way. Agriculture and allied sectors are considered to be the mainstay of the Indian economy. They not only provide food for the rural population but also contribute significantly to

the economy. They contribute around 17 per cent to the gross domestic product of India and about 50 per cent of the population is dependent on agriculture for their livelihood. Agriculture is extremely prominent in many rural regions and small villages of India as it allows the residents the opportunities to not only provide for themselves but also to create revenue from excess goods.

AGRI-ENTREPRENEURSHIP:

Any business in the agricultural industry which includes production agriculture, food, fiber, the environment and natural resources.

AGRICULTURAL ENTREPRENEURS:

The persons who undertake agricultural activities such as raising and marketing of crops, fertilizers and other inputs of agriculture.

CHARACTERISTICS OF AGRI ENTREPRENEURS:

- ***Focus on sustainable development:*** They strive to develop agrarian prosperity while also focusing on sustainable development. They stimulate exponential economic development within their communities and their industry while not undermining the natural resource base.
- ***Deal with living systems:*** Farm businesses feature a unique degree of permanence. Because they are living systems, farm businesses cannot be opened, closed, relocated and re-opened with the ease of many non-farm retail and service businesses.
- ***Desire to be connected with agriculture:*** Agricultural entrepreneurs are influenced by current agricultural conditions, off-farm employment opportunities. They are motivated to improve agriculture and have a desire to be connected with farming, living in a rural area, and preserving the family heritage.
- ***Desire to contribute to local development:*** They have a desire to contribute to local development. By taking up business activities in rural areas, they provide employment opportunities to the local people and help to improve their standard of living. This will also reduce the migration of rural people to urban areas.
- ***Exploit opportunities in areas related to agriculture:*** Exploit opportunities in areas of farming, agricultural processing and marketing.
- ***Mobilization of resources:*** Agricultural entrepreneurs have the ability to collect the necessary resources and combine them in a new business which is crucial to success. The factors determining the success of agricultural entrepreneurs would be accessibility of the resources necessary for their agricultural enterprises: capital, land, labor, and management expertise.
- ***Innovative:*** They are not satisfied with the conventional way of doing things. They constantly strive to put efforts in introducing new products, new method of production, opening new markets, and reorganizing the enterprise. Eg. Soy noodles of GUV food products-innovative idea of preparing noodles using soy flour instead of using maida.

- ***Interpersonal skills:*** Agricultural entrepreneurs are comfortable in dealing with people at all levels including those living in rural areas, as majority of agri enterprises are set up in rural areas. Several people in rural areas are illiterate. Agricultural entrepreneurs are able to effectively communicate in the local languages. They act in accordance with the values and beliefs of the existing social system and gain peoples' confidence and support.
- ***Ability to solve agricultural problems:*** They have the ability to solve problems related to any of the agriculture and allied sectors. They influence the outcome of their quest by believing in their ability to control fate and by putting in more efforts and then experiencing a sense of accomplishment.

CLASSIFICATION OF AGRICULTURAL ENTREPRENEURS BASED ON BUSINESS STRATEGY:

Management strategies are employed by agricultural businesses in response to the structural changes in agriculture. These strategies are specialization, diversification, and supplementation

1. SPECIALIZED AGRICULTURAL BUSINESSES:

These are typically commodity based businesses, concentrating in just one or two commodities, striving for perfection in quality and volume of production through adoption of proven technology or enterprise expansion. Specialization allows for efficiencies of size and scope as well as management and resource allocation. This sector of agriculture tends to have the highest capital investment, bear the greatest risk, and create the most jobs.

Eg. Mushroom farm

2. DIVERSIFIED AGRICULTURAL BUSINESSES:

These are those businesses that supplement the agriculturally-based income stream with other business ventures. These additional business ventures are agriculturally related, but are not necessarily based on agricultural production. Adoption of alternative production techniques is another characteristic of this group, with organic production being the most prevalent.

Eg. Vermicompost preparation

3. SUPPLEMENTAL AGRICULTURAL BUSINESSES:

These are operated by families that do not generate the majority of their gross income from the agricultural business. The off-farm household income may actually support the agricultural enterprise. These businesses help to pursue gainful off-farm employment that contributes cash and benefits.

Eg. Agri tourism

IMPORTANCE OF AGRI-ENTREPRENEURSHIP FOR SUSTAINABLE LIVELIHOODS

Livelihood thinking dates back to the work of Robert Chambers in the mid-1980s. Chambers developed the idea of "Sustainable Livelihoods" with the intention to enhance the efficiency of development cooperation.

*"A **livelihood is sustainable** when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base."* (Chambers and Conway, 1992)

CORE CONCEPTS OF SUSTAINABLE LIVELIHOOD:

- **People-centred:** People are the priority concern in the livelihoods approach, rather than the resources they use.
- **Holistic**: We must consider the social, economic, political, environmental, demographic, historical, and infrastructural information to understand the macro-level factors that influence the range of possibilities for livelihood systems.
- **Dynamic**: External support must recognize the dynamic nature of livelihood strategies, respond flexibly to changes in people's situation, and develop longer-term commitments.
- **Building on strengths**: A central issue of the approach is the recognition of everyone's inherent potential for his/her removal of constraints and realization of potentials. This will contribute to the stakeholders' ability to be strong and the ability to achieve their own objectives.
- **Macro-micro links:** Development activity tends to focus at *either* the macro *or* the micro level, whereas the sustainable livelihood approach tries to bridge this gap in stressing the links between the two levels because people are often affected from decisions at the macro policy level and vice-versa.
- **Sustainability**: A livelihood can be classified as sustainable, when it is resilient in the face of external shocks and stresses, when it is not dependent upon external support, when it is able to maintain the long-term productivity of natural resources and when it does not undermine the livelihood options of others. (Kollmair, M and St. Gamper, 2002)

LIVELIHOOD ASSETS

- The livelihoods approach is concerned first and foremost with people. So an accurate and realistic understanding of people's strengths ("assets" or "capital") is crucial to analyse how they try to convert their assets into positive livelihood outcomes. Five principal assets (or capitals) are suggested as important to livelihood and they are presented in the fig.1 (Scoones,1998).

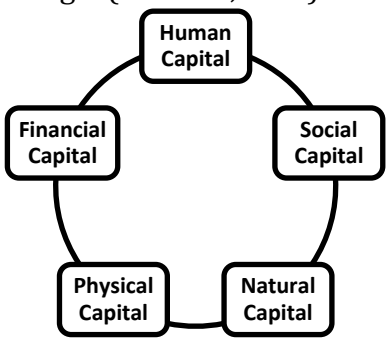

Figure 1. The five capitals of sustainable livelihood

- **Human Capital:** Human capital represents the skills, knowledge, ability to work and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives.
- **Social Capital:** Social resources upon which people draw in seeking for their livelihood outcomes, such as networks and connectedness, that increase people's trust and ability to cooperate or membership in more formalised group**s** and their systems of rules, norms and sanctions.
- **Natural Capital:** Natural capital is the term used for the natural resource stocks from which resource flows and services (such as land, water, forests, air quality, erosion protection, biodiversity degree and rate of change, etc.) useful for livelihoods are derived.
- **Physical Capital:** Physical capital comprises the basic infrastructure and producer goods needed to support livelihoods, such as affordable transport, secure shelter and buildings, adequate water supply and sanitation, clean, affordable energy and access to information.
- **Financial Capital: "**Financial capital" denotes the financial resources that people use to achieve their livelihood objectives and it comprises the important availability of cash or equivalent that enables people to adopt different livelihood strategies. Two main sources of financial capital can be identified:
  - **Available stocks** comprising cash, bank deposits or liquid assets such as livestock and jewellery.
  - **Regular inflows of money** comprising labour income, pensions, or other transfers from the state, and remittances, which are mostly dependent on others and need to be reliable.

LIVELIHOOD OUTCOMES:

These are the achievements of livelihood strategies

- More income (e.g. Cash),
- Increased well-being (e.g. Non material goods, like self-esteem, health status, access to services, sense of inclusion),
- Reduced vulnerability (e.g. Better resilience through increase in asset status),
- Improved food security (e.g. Increase in financial capital in order to buy food)
- More sustainable use of natural resources (e.g. Appropriate property rights).

AREAS OF AGRI-ENTREPRENEURSHIP PROVIDING SUSTAINABLE LIVELIHOODS:

- Organic farming
- Setting up of apiaries ; honey and bee products processing units
- Setting up of poultry farms
- Feed processing and testing units
- Compost and mushroom production units
- Cultivation of medicinal and aromatic plants
- Setting up of vermiculture units
- Production of bio-fertilizers, bio-pesticides and bio-control agents
- Polyhouse cultivation of vegetables and ornamental crops

- Setting up of dairy units
- Sheep rearing
- Goat raising

Sustainable livelihood approach is beneficial both to the company as well as to the poor as given in Table 1.

Table 1. Benefits of sustainable livelihood approach:

To the company:	For the poor:
Develop new market opportunities for high volume sales	Access to adequate and affordable products and services to fulfill basic needs
Grow customer base and brand loyalty in new markets	Raising awareness of problems and learning about market-based solutions
Reduce operating costs through use of local resources	Income generation through employment
Improve image and enhance brand value	Opportunities to participate in local economy
Ability to deal with government and gain preferential access to contracts	Access to financial services (credits, savings, business skills development)
Develop cheaper and environmentally friendly technologies that can be transferred back to developed markets.	Skill and technology transfer for micro-entrepreneurs
Improve capital efficiency through new product development	Improved business environment and investment climate

CONCLUSION

It can be summarized that sustainable livelihood calls for achieving triple bottom line i.e., a balance between People, Planet and Profit**.** (John Elkington, 1994) as shown in fig.2.

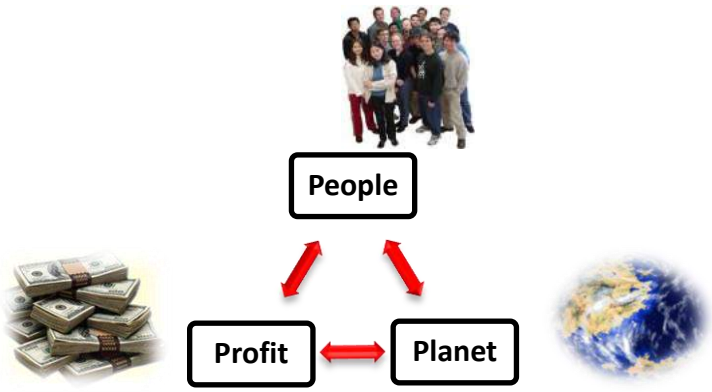

Figure 2: Triple bottom line

Agricultural sector provides numerous opportunities for creating such sustainable livelihoods and entrepreneurship is the key to success in sustainable agriculture. Thus

agri-entrepreneurship has huge scope and is extremely important to create employment and sustainable livelihoods

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Animal Cruelty

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Abstract

Animal Cruelity cases make headlines around the world every day, whether it's the person who kills the neighbour's cat, the hoarder of sick and dying animals or the family whose freezing, starving dog is tied up outside in the middle of winter. Animal Cruelty has several types which may be one of Simple Neglect, Gross Neglect, Intentional Abuse, Animal Hoarding, Organized Abuse or Animal Sexual Assault. Theses cases of cruelty cannot be overlooked as it has proven to have severe implications ranging from the fact that is linked to other crimes, to the factual truth that these practices inflict great pain on these animals that have nobody to speak for them.

INTRODUCTION

Animal Cruelty – the legal definition

The California penal code defines animal cruelty as the malicious or intentional maiming, mutilation, torture or wounding of a living animal, and states that any person who overworks, tortures, torments, deprives of necessary food, drink or shelter, cruelly beats, mutilates or cruelly kills an animal is guilty of a misdemeanor or felony. Any person, who owns, possesses keeps or trains a dog with the intent to engage the animal in exhibition fighting, as well as any person who is knowingly present as a spectator at an exhibition of fighting of dogs, is guilty of a misdemeanor. In addition, any person who willfully abandons any animal is guilty of a misdemeanor[1,2].

TYPES OF ANIMAL CRUELTY

1. **Simple neglect:** this involves failure to provide adequate food, shelter, water, or veterinary care to one or few animals, usually due to ignorance. This form of animal cruelty is the most common around the world today[3]. The most common example of simple neglect found everywhere today is the case of dog owners chaining their dogs around the neck without a dog belt and most times the dog is kept stagnant at the backyard for hours if not days without proper shelter.
2. **Gross neglect:** it can also be called willful, malicious or cruel neglect. It is important to make a distinction between simply failing to take adequate care of animals and intentionally or knowingly withholding food or water needed to prevent dehydration or starvation. Gross neglect is therefore the intentional act of withholding food or water from an animal or group of animals. A typical example of this type of cruelty is the case

of people throwing away their sick dogs callously, some leaving their dogs out in the cold or rain.

3. **Intentional abuse:** cases of intentional cruelty are the ones of greatest concern to the general public and the ones more likely to involve juvenile offenders. There is legitimate fear that the individuals involved in violent acts against animals present a danger to the public. Intentional animal abuse is often seen in association with other serious crimes including drug offenses, gang activity, weapons violations, sexual assault and domestic violence and can be one of the most visible parts of an entire history of aggressive or antisocial behavior. Such cases are often easier to prosecute than neglect or hoarding cases since the effects of the crime on the victim may be easier to document and the intentionality of the offense is more clearly recognized.

4. **Animal Hoarding:** this is the accumulation of a large number of animals and failing to provide minimal standards of nutrition, sanitation and veterinary care; to act on the deteriorating condition of the animals; and to recognize or correct the negative impact on the health and well-being of the people in the household[4]. Examples of animal hoarding cases are: the transportation of large number of animals in an in-humane way, the keeping of birds and other animals is a very poor and un-conducive environment, pigs and other animals kept to starve to death at livestock farms etc.

5. **Organized Abuse: Dog fighting and Cock fighting**

Blood sports such as dog fighting and cock fighting have been singled out for special attention in the anticruelty laws of the United States and the United Kingdom since their inception in the 19th century. This act involves the setting of two or more dogs, cocks or any other animal in a fight circle and allowing them to brutally kill each other for the sole purpose of entertaining the spectators.

6. **Ritualistic Abuse:** the phrase 'occult and ritualistic animal abuse' immediately evokes many disturbing images: a cat nailed to a crucifex and burned, the head of a dog left on the steps of a building with a piece of paper bearing a curse stuck in the animal's mouth, a goat's throat slit as part of a ritual sacrifice. Few other crimes against animals create such intense concern within a community. Most crimes in which animals are killed or mutilated and left where they will be discovered immediately raise fears of satanic or cult activity and concern about what other crimes the perpetrators of such acts may have committed.

Benefits of Animal Cruelty Study

1. Reveals tendency for other crimes.
2. Exposes family violence.
3. Exposes a dysfunctional youth.
4. Animal cruelty links with extreme violence.

There are three common offences against animals in India

A. Mischief.
B. Cruelty against Animals.
C. Bestiality**.**

A. Mischief: This includes killing, poisoning or maiming an animal. Poisoning is the most

commonest method of mischievous killing of an animal. *Abrus precatorius,* arsenic, aconite root, snake venom, datura leaves and seeds of yellow oleander are common poisons used in the mischievous killing of the animals. Accidental poisoning may occur in animals by linseed or jowar poisoning. Mischief is punishable under Section 428 and 429 I.P.C. Maiming means making an animal useless by the use of violence. This type of offence is also common and its aim is to harm the owner when an animal damages the crop or other property. The common forms of hurting animals and rendering them useless are:

a) Fracture of bone.
b) Cutting tendons of legs and neck.
c) Injury to udder in milch animals.
d) Tearing of the vagina or rectum by introducing sharp or blunt object.
e) Punctured wounds etc.

B. Cruelty against Animals: This offence includes beating, overloading, using a diseased animal for work, starvation, *Phuka* method etc. these acts are punishable under the Prevention of Cruelty to Animals Act, 1960.

C. Bestiality: Bestiality means carnal intercourse with man, women or animal against the order of nature. This type of crime is more frequently found in India due to the following reasons:

a) The common belief among illiterate people that intercourse with a she-donkey is a remedy for gonorrhea.
b) Excessive sexual desire with less opportunity for natural intercourse.
c) Young villagers who go out to graze cattle in fields far away from human eye, are incited, owing to loneliness and the proximity of the animals, to commit this crime.
d) People having some mental abnormalities.

In bestiality the human male is generally the active agent and the passive agent is a she-goat, donkey, mare, cow or even hen. No cases of the human female being involved in similar manner are publically known.

EXAMINATION OF ANIMAL FOR BESTIALITY

a) The offenders are usually caught red-handed.
b) The vagina of animal should be examined for evidence of injury and that accused
c) examined for marks of injuries caused by the kicks, teeth or claws of the animal.
d) The surrounding hairs of the animal should be examined for the presence of human spermatozoa (this is very important to note that the spermatozoa found are of the same animal or not, for this purpose the presence or absence of heat in the female animal is also a guide).
e) The presence of organisms of gonorrhea in the vagina of the animal is a sure sign of bestiality.
f) The clothes of the accused will give off a smell of urine or faeces of the animals as after a sexual act animals have a habit of urinating.
g) Bestiality is punishable under Section 377 I.P.C.

EXAMINATION OF SEMINAL STAINS

In the case of bestiality, it is essential to determine presence of human seminal fluid in or around the parts of the animal. Detection of human spermatozoa in a smear from the vagina of the animal and that from the discharge adhering to the surrounding hairs is a positive proof of the offence.

The examination of seminal stains may be carried out by the following methods: Physical, Chemical, Microscopic and Serological.

a) **Physical Examination:** The physical characteristics of fresh semen of different animals and men are given in Table 1.

Table-1: The physical characteristics of fresh semen of different animals and men

Species	Average volume of ejaculate (ml)	Average concentration (million per ml)	pH	Colour	Consistency
Bull	3-4	600-1200	6.5-7.5	Resembles whole milk	Slight viscid and opaque
Stallion	75-125	50-200	7.0-7.8	Whitish	Thinner than bull's semen
Ram	0.8	800-4000	6.2-6.8	Creamy	Creamy
Boar	200	270	6.8-7.2	Whitish	Gelatinous
Dog	7	125	5.8-6.9	Grayish to milky white	Watery
Cock	0.6	0.5-60	7.3-7.8	White	Dense opaque to watery
Man	3.5	150-200	7.2-8.9	Opalescent white or pale yellow	Thick viscid

Seminal stains, when dry, present a grayish-white colour and become stiff. The dried seminal stains show an irregular map-like contour. The invisible stains may be made distinctly visible by its bluish fluorescence under ultra violet rays.

b) Chemical Examination

There are two preliminary chemical tests for seminal stains; Florence's Test and Barberio's Test.

Florence's Test:

1) Prepare a thick smear of seminal fluid and place a cover slip.
2) One or two drops of the Florence's solution is allowed to run-in under the cover slip.
3) Large brown haemin-like needle-shaped crystals of choline periodide will shortly be formed in the presence of semen.

c) Barberio's Test:

1) Prepare a thick smear of seminal fluid and place a cover slip.
2) One or two drops of concentrated picric acid solution is allowed to run-in under the cover slip.

3) Yellowish needle-shaped crystals of spermin picrate will be formed in the presence of semen.

d) Microscopic Examination

Take a drop of mucus from the vagina of the animal on a glass slide and one drop of a normal saline solution. Place a cover slip and examine under the high power of the microscope for the presence of spermatozoa.

Prepare a thin smear of mucus taken from the vagina of the animal and stain by the haemalum and eosin staining method.

Procedure:

1) Prepare a thin smear.
2) Fix with methyl alcohol.
3) Refix with 95% and then 70% ethyl alcohol for five minutes.
4) Rinse quickly with water.
5) Stain with haemalum solution for 20 minutes.
6) Steep in running water for 30 minutes.
7) Restrain with haemalum for five minutes.
8) Rinse in water for 10 minutes.
9) Counter-stain with eosin solution for 3 minutes.
10) Differentiate in sequence of 70%, 90%, and absolute alcohol.
11) Clear in xylol.
12) Mount in Canada balsum and apply cover slip.
13) Examine under the high power of the microscope.

MORPHOLOGY OF SPERMATOZOA

The spermatozoa consists of a head and a tail. The head is flattened ovoid, made up of a nucleus covered anteriorly by the acrosome or galeacapitis and posteriorly by the post-nuclear cap. The long thin tail is differentiated into three parts: mid-piece, main-piece and end-piece. The anterior end of the mid-piece connecting with the head is known as the implantation region. The mid-piece (10 to 15 microns) is the thickened region of the tail between the head and the main-piece. Here the sperm is surrounded by a helix or spiral of mitochondria. The main-piece (about 30 microns) is the longest part of the tail. The axial filament in this region is surrounded by a tail sheath. In the end-piece (3 microns), the filament is not surrounded by a sheath.

Table- 2: The morphological differences of spermatozoa of animals, man and cock

Species	Length of sperm (in micron)	Shape of head	Size of head (in micron)	Length of the tail (in micron)
Animal	50-60	Flattened ovoid	8.0	40-50
Man	50-55	Flattened ovoid or pear shaped	4.5	50
Cock	100	Long cylindrical	15.0	80

e) Sereological examination (Precipitation Test)

By this method the seminal fluid of man is differentiated from that of animals. An immune serum is prepared by injecting a rabbits with human seminal fluid or the seminal fluid of a particular animal, in the same manner as for the production of anti-blood serum. The serum precipitates must be removed by mixing it with an equal part of 1 in 20 dilution of human serum or animal serum. Leave the mixture at room temperature for an hour and centrifuge. This removes all precipitum from human serum or from the serum of particular group of animals. In this way immune serum of different animals are prepared.

Procedure:

1) Take 1 ml of seminal fluid extract to be tested in a test tube.
2) Add 0.1 ml of antiserum.
3) A white ring will be formed at the junction of two fluids within two to five minutes in positive cases.

EXAMINATION FOR GONORRHOEA ORGANISMS

Presence of organisms of gonorrhea in the vagina of the animal is sure sign of bestiality because only human beings are susceptible to gonorrhea.

Method

The vaginal secretion should be taken by introducing a swab. The material obtained on the swab is transferred to a microscopic slide and thin film is prepared. The film is fixed by gentle heat and stained by Gram's method. Bean-shaped, Gram negative diplococcic are seen in positive cases[5].

CONCLUSION

Combating this menance of Animal Cruelty is a journey that must be undertaken and everybody including the Government, NGOs and even Culture has a major role to play in this.

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Animal Welfare

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Abstract

Animal Welfare means how an animal is copying with the conditions in which it lives. An animal is in a good state of welfare (as indicated by scientific evidence), it is healthy, comfortable, well nourished, safe, able to express innate behavior, and if it is not suffering from unpleasant states such as pain, fear, and distress. Good animal welfare requires disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling and humane slaughter/killing (OIE).

INTRODUCTION

Animal Welfare

Animal welfare is also defined as "its state (physical, biological and mental) as regards its (the animal) attempt to cope with its environment. This state includes how much it had to do to cope, the extent to which it is succeeding in or failing to cope and its associated feelings."

Animal welfare is the well-being of animals. The standards of 'good' animal welfare vary considerably between different contexts. These standards are under constant review and are debated, created and revised by animal welfare groups, legislators and academics worldwide[1-2]. Animal welfare science uses various measures, such as longevity, disease, immunosuppression, behavior, physiology, and reproduction[3]. Concern for animal welfare is often based on the belief that non-human animals are sentient and that consideration should be given to their well-being or suffering, especially when they are under the care of humans. These concerns can include how animals are slaughtered for food, how they are used in scientific research, how they are kept (as pets, in zoos, farms, circuses, etc.) and how human activities affect the welfare and survival of wild species.

WELFARE PRINCIPLES

The Farm Animal Welfare Council in 1979 recommended that animals require the freedom to "turn around, to groom themselves, to get up, to lie down and to stretch their limbs". These have since been elaborated to become known as five Freedoms of animal welfare.

The five freedoms are:

1. Freedom from thirst, hunger and malnutrition.
2. Freedom from discomfort due to environment.
3. Freedom from pain, injury and disease.
4. Freedom to express normal behavior for the species.
5. Freedom from fear and distress.

ANIMAL WELFARE BOARD OF INDIA

The Animal Welfare Board of India was set up in 1962, in accordance with section 4 of the prevention of Cruelity ro Animal Act, 1960 (No. LIX of 1960). In this Act, establishment of Animal Welfare Board, construction of the board and functions of the Board are included. Committee for control and supervision of experiments on animals duties of committee and power of the committee are also included in this Act.

ANIMAL BIRTH CONTROL

To maintain the ecological balance and to ensure sustainable animal welfare birth control is essential. Spread of zoonotic diseases, causing road accidents and creating public nuisance routinely encountered due to homeless animals schemes to control overpopulation of animals have been launched by NGOs, municipal corporations and government. Some Animal Welfare Organizations emphasize on adoption of these animals by individuals or adoption by resident societies. Animals birth control by reducing the reproductive capacity of homeless dogs. Spaying and castration has proved to be effective in India and is internationally accepted. The hormonal imbalance following operation, create emotional and physiological disturbances amongst animals leading to poor welfare. It is advised not to remove both ovaries in bitches and both testicles in male dog.

As per Animal Birth Control (Dogs) (Rule 2001), following guidelines are issued by government.

1. Classifications of dogs and their sterilization:

a. All dogs shall be classified in one of the following categories: Pet dogs or Street dogs.
b. The owner of the pet dogs shall be responsible for controlled breeding, immunization, sterilization and licensing in accordance with these rules and the law for the time being in force within a specified area.
c. The street dogs shall be sterilized and immunized by participation of Animal Welfare Organization, private individuals and the local authority.

2. Capturing/sterilization/immunization/release:

1. Capturing of dogs shall be based on:

a) Specific complaints (for which the local authority in consultation with the Monitoring Committee shall set up a dog control cell to receive complaints about dog nuisance, dog bites and information about rabid dogs) .

b) General:

i. On receipt of specific complaint about nuisance or dog bite the same shall be attended on priority basis, irrespective of the area from which the complaint comes. On receipt of such complaint the details such as name of the complaint, his complete

address, date and time of complaint, nature of complaint etc. shall be accorded in a registrar to be maintained for permanent record.

ii. Capturing for general purpose will be on such dates and time to be specified by the Committee.

2. The dog capturing squad shall consist of

i. The driver of the dog van.

ii. Two or more trained employees of the local authority who are trained in capturing of dogs.

iii. One representative of any of the Animal Welfare Organization.

Each member of the dog squad shall carry, a valid identity card issued by the local authority. The dog capturing squad will be accompanied by a representative of an Animal Welfare Organization nominated for the purpose.

3. On receipt of specific complaint or for capturing dogs in normal course the dog squad will visit the concerned area, capture the dogs identified by the complainant in case of complaint oriented capturing and other dogs in case of general capturing. All the dogs brought will be tagged for identification purpose and to ensure that the dogs are released in the same area after sterilization and vaccination.

4. The dogs shall be captured by using humane methods such as lassoing or soft-loop animal catchers such as those prescribed under the provisions of Prevention of Cruelty (Capture of Animals) Rules, 1979.

5. While the dogs are being captured in any locality the representative of the local authority or of the Animal Welfare Organization accompanying the dog squad, will make announcements on a public addresss system that dogs are being captured from the area for the purpose of sterilization and immunization and will be released in the same area after sterilization and immunization.

6. The captured dogs shall be brought to the dog kennels/dog pounds managed by the Animal Welfare Organizations (AWOs). On reaching the dog pounds, all the dogs shall be examined by the veterinarians and healthy and sick dogs should be segregated. Sick dogs should be given proper treatment in the hospitals run by and only after they are treated they should be sterilized and vaccinated.

7. At a time only one lot of dogs shall be brought for sterilization, immunization at one dog kennel or dog pound and these dogs shall be from one locality. Two lots from different areas or localities shall not be mixed at the same dog pound or dog kennel.

8. The dog kennel must have sufficient space for proper housing and free movement of dogs. The place should have proper ventilation and natural lightning and must be kept clean. Adults and puppies must be housed separately and amongst the adults the males and females also should be housed separately. Adequate arrangement for drinking water and food shall be made for dogs while in captivity.

9. Female dogs found to be pregnant shall not undergo abortion (irrespective of stage of pregnancy) and sterilization and should be released till they have litter.

3. Identification and Recoding: Sterilized dogs shall be vaccinated before release and the ears of these dogs should either be clipped or tattooed for being identified as sterilized or immunized dogs. In addition, the dogs may be given token or nylon collars

for identification and detailed records of such dogs shall be maintained. Branding of dogs would not be permitted.

4. Euthanasia of Street Dogs: Incurably ill and mortally wounded dogs as diagnosed by a qualified veterinarian appointed by the Committee shall be euthanized during specified hours in a humane manner by administering sodium pentathol for adult dogs and Thiopental intraperitoneal for puppies by a qualified veterinarians or euthanized in any other humane manner approved by Animal Welfare Board of India. No dog shall be euthanized in the presence of another dog. The person responsible for euthanizing shall make sure that the animal is dead, before disposal.

5. Furious or dumb rabid dogs:

1) On the receipt of complaints from the public to the Dog Control Cell of the Local Authority or on its own, the dog squad of the Local Authority would catch such dogs, suspected to be rabid.
2) The caught dog would then be taken to the pound where it would be isolated in an isolation ward.
3) The suspected rabid dog would then the subjected to inspection by a panel of two persons i.e.
   a. a veterinary surgeon appointed by the Local Authority and
   b. a representative from an Animal Welfare Organization.
4) If the dog is found to have a high probability of having rabies it would be isolated till it dies a natural death. Death normally occurs within 10 days of contracting rabies. Premature killing of suspected rabid dogs, therefore, prevents the true incidence of rabies from being known and appropriate action being taken.
5) If the dog is found not to have rabies but some other disease it would be handed over to the AWOs who will take the necessary action to cure and rehabilitate the dog.

6. Disposal of Carcasses: The carcasses of such euthanized dogs shall be disposed off in an incinerator to be provided by the local authority.

Animal Welfare during Disaster

A disaster is the impact of a natural or man-made event that negatively affects life, property, livelihood or industry often resulting in permanent changes to human societies, ecosystem and environment. Their possibility of occurrence, time, place and severity of the strike can be reasonably and in some cases accurately predicted by technological and scientific methods. Animals are silent victims of disaster. We can to some extent reduce the impact of damage.

Disaster Management Plan for Animals

Planning (short term and long terms) may have to be followed up by monitoring, impact assessment and evaluation. Control rooms, temporary veterinary hospitals, equipments and other infrastructure are important along with stockpile of equipments and drugs.

Disaster preparedness

The objectives should be to

1) Minimize suffering, losses and damages,
2) Prevent any communicable disease,
3) Reduce losses due to delay with prompt communication, improving and optimizing existing facilities, equipping support system and
4) Assisting rehabilitation.

Animal Welfare Organizations

1) International NGOs
2) People for the Ethical Treatment of Animals (PETA)
3) Royal Society for the Prevention of Cruelty to Animals (RSPCA)
4) International Fund for Animal Welfare (IFAW)
5) World Wildlife Fund (WWF)
6) 6000 NGOs registered with Animal Welfare Board of India.
7) Society for the Prevention of Cruelty to Animals (SPCA)
8) 600 SPCAs registered with AWBI
9) Blue cross of India

CONCLUSION

NAIW (National Institute of Animal Welfare) is premier training institute of the Government of India under Ministry of Environment and Forests, at Ballabhgarh, Fardidabad, Haryana, in the NCT of Delhi with an objective to create enabling environment for fulfillment of the statuary requirements as laid down in the Prevention of Cruelty to Animal Act, 1960.

It is imparting training and education on diversified subjects in Animal Welfare including animals management, behaviour and ethics with the purpose to foster knowledge to personnel's working with animals in the state Veterinary departments, municipal corporations, forensic labs, forestry departments, laboratories dealing with animal experimentation, sanctuaries, animal houses/shelters, pharmaceuticals, diagnostic labs, members/nominees of Animal Welfare Board of India (AWBI), CPCSEA, SPCA, Institutional Animal Ethics Committees (IAEC), Animal Welfare Organisations (AWO), NGOs registered with Animal Welfare Board of India, students graduating in Veterinary and Animal Sciences, fisheries sciences, wild life sciences, biological sciences etc[4].

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Breeding for Heat Stress Tolerance in Crop Plants

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Abiotic stress are often related to each other either singly or in combination as they cause morphological, biochemical, physiological and molecular changes that affect plant growth and productivity. High temperature, drought, salinity, cold and water logging are major abiotic stresses that cause severe cellular damage in crop plants. The increasing threat of climate change is already having substantial impact on agricultural production worldwide as heat waves cause significant yield losses with great risks for future global food security. Heat stress is defined as the rise in temperature above the optimum level for period of time sufficient to cause irreversible damage to plant growth and development. It is a complex function of intensity, duration of exposure and rate of increase in temperature (Wahid *et al.*, 2007). Heat stress is a serious threat to crop production worldwide. At very high temperature, severe cellular injury and even cell death may occur within minutes (Schoffl *et al.*, 1999). It includes protein denaturation, aggregation and increased fluidity of membrane lipids. At moderately high temperature, injury may occur only after long-term exposure. It includes inactivation of enzymes in chloroplast and mitochondria and loss of membrane integrity. These injuries eventually lead to starvation, inhibition of growth, reduced ion flux, production of toxic compounds and reactive oxygen species (ROS) (Howarth, 2005). At molecular level, heat stress causes alterations in expression of genes involved in direct protection from high temperature stress. These include genes responsible for the expression of osmoprotectants, detoxifying enzymes, transporters and regulatory proteins (Krasenskyand Jonak, 2012). Heat stress during reproductive stage is more harmful than during the vegetative stage (Cossani & Reynolds, 2012).

Presently, the Indian lowlands are the source of approximately 15% of global wheat production but it is anticipated that climate change will transform these into a heat stressed production environments. A temperature increase of 3-4 C cause crop yields to fall by 15-35% in African and Asian countries (Oritz *et al.*, 2008). Based on mathematical modeling, cereal production in Southeast Asia and Southern Africa is most likely to be affected by climate change if new strategies for amelioration are not found (Fischer and Edmeades, 2010). However, it is suggested that world food production will have to increase 70% to meet the demand of an expected population of 9 billion in 2050 (Bita and Gerats, 2013). The increasing food demand and heavy crop losses due to heat stress, development of heat stress tolerant genotypes is a major challenge for plant breeders.

1. Plant responses to heat stress

1.1 Morphological response

i) Scorching of leaves and twigs,
ii) Sunburns on leaves, branches and stems,
iii) Leaf senescence and abscission,
iv) Shoot and root growth inhibition,
v) Fruit discoloration and damage
vi) Reduced yield (Vollenweider and Gunthardt, 2005)

1.2 Anatomical response

i) Reduced cell size,
ii) Closure of stomata and curtailed water loss,
iii) Increased permeability of plasma membrane
iv) Larger xylem vessels
v) Loss of grana stackings or its swelling
vi) The cumulative effects of all these changes under high temperature stress may result in poor plant growth and productivity (Srivastava, *et al.*, 2012).

1.3 Physiological response

i) Cell membrane thermostability

Membranes are mosaic of proteins and lipids. As the temperature rise, a lipid movement accelerates movement of molecules across the membrane, thereby loosening the chemical bonds within molecules of biological membrane. This makes the lipid bilayer more fluid either by increasing in unsaturated fatty acids or by denaturation of proteins. Such alterations enhance the permeability of the membranes leads to the solute leakage and decrease in cell membrane stability (Savchenko *et al.*, 2002).

ii) Photosynthesis

Upon perception of heat stress, disruption of the manganese cluster takes place which lead to the release of manganese ions from oxygen evolving complex and damage the photosystem-II. Once the OEC is damaged the supply of electrons form OEC toward the acceptor side of PSII in the direction of PSI reaction center is imbalanced (De Ronde *et al.*, 2004). Since $P680^+$ is strong oxidant it damage the reaction center by oxidizing surrounding amino acids residues of proteins particularly D1 protein (De Las Rivas and Barber, 1997). Alternatively, the light-induced impairment of the oxygen-evolving complex might allow the access of oxygen molecule to P680, yielding $^1O_2$ or other ROS that can also damage the reaction center oxdatively.

iii) Oxidative stress

A direct result of heat stress induced cellular changes is overproduction of reactive oxygen species (ROS) in plants. ROS are highly reactive and toxic affecting various cellular functions in plant cells through damage to nucleic acids, protein oxidation and lipid peroxidation eventually leads to cell death (Bhattacharjee, 2005). ROS system

consists of both free radicals including superoxide radical (O^{-}_{2}), hydroxyl radicals (OH^{-}), alkoxy radicals and non-radicals like hydrogen peroxide (H_2O_2) and singlet oxygen ($^1O_2$). These species are always formed by the leakage of electrons from the electron transport activities of chloroplasts, mitochondria and plasma membrane. ROS toxicity due to heat stress is considered to be one of the major causes of low crop productivity worldwide.

2. Mechanism of heat stress tolerance

2.1 Heat escape

Heat escape means an alternative mechanism through which plant completes its life cycle before the onset of heat stress. This property has been exploited in developing early maturing genotypes in durum wheat such as Waha-1, Omrabi-5 and Massara-1 (Al-Karaki, 2011).

2.2 Heat avoidance

i) Leaf orientation
ii) Reflective properties
iii) Leaf rolling

2.3 Heat tolerance

Heat tolerance is defined as the ability of the plant to grow and produce economic yield under high temperature. Major heat tolerance mechanisms include membrane stability, osmotic adjustment, antioxidant defense, heat shock proteins and stem reserve mobilization.

i) Membrane stability

Membrane lipid saturation is considered as an important element in high temperature tolerance. A high share of saturated fatty acids in membrane lipid increases the lipid melting temperature and prevents a heat-induced increase in membrane fluidity. Thus, increasing the saturation level of fatty acids appears to be critical for maintaining membrane stability and enhancing heat tolerance (Larkindale and Huang, 2004).

ii) Osmo-protectants

The accumulation of low molecular weight water-soluble compounds known as “compatible solutes” or “osmolytes” is the common strategy adopted by plants to combat the heat stress as primary metabolites participate directly in osmotic adjustment. The most common compatible solutes are betaines, sugars (mannitol, sorbitol and trehalose), polyols, polyamines and amino acid (proline). For instance accumulation of proline, glycine betaine, soluble sugars is necessary to regulate osmotic activities and protect cellular structures from increased temperatures by maintaining the cell water balance and membrane stability (Farooq *et al.*, 2008). Glycine betaine production in chloroplasts maintains the activation of rubisco by sequestering rubisco activase near the thylakoids and preventing its thermal inactivation (Allakhverdiev *et al.*, 2008).

iii) Antioxidants

The exposure of plants to high temperature leads to the production of ROS. Over production of ROS above a constitutive level potentially harmful to all cellular compound as it negatively influences cell metabolism. To counteract the injurious effect of ROS plants have evolved a complex antioxidative defense system. An efficient antioxidative system comprise of both enzymatic antioxidants *viz.*, Superoxide (SOD), catalase (CAT), glutathione peroxidase (GPX), ascorbate peroxidase (APX), monodehydroascorbate reductase (MDHAR), dehydroascorbate reductase (DHAR), glutathione reductase (GR) and non-enzymatic antioxidants *viz.*, ascorbate (AsA), glutathione (GSH), carotenoids and tocopherols (Gill and Tuteza, 2010). The enzyme SOD converts O^{-}_{2} to H_2O_2, which further break down into H_2O and O_2 by catalase. GPX requires a phenolic compound guaiacol as an electron donor to decompose H_2O_2, while APX uses a reduced form of ascorbate to protect cell agaianst damaging effects of H_2O_2 (Tripathy and Oelmuller, 2012).

iv) Stem reserve mobilization

During heat stress, photosynthesis is reduced as a result of low CO_2 uptake due to stomatal closure. Assimilation rates in photosynthetic leaves decreased due to reduced photosynthetic metabolites, enzymatic activity and damage to photosynthetic apparatus due to production of ROS. When this situation arises at reproductive stage there is huge loss in grain yield. To overcome this problem, the reserve of stems which accumulated at vegetative stage prior to anthesis are utilized by the plants for grain formation. These stem reserves are in the form of carbohydrates. Sucrose is the principal end product of photosynthesis which translocates from source to sink organs through the phloem.

v) Heat-shock proteins

Heat stress lead to protein denaturation, resulting in the exposure of hydrophobic amino acid residues normally buried within the interior of proteins. A denatured protein may misfold or aggregate due to the interaction of the surface exposed by the hydrophobic region within such region of itself or other denatured proteins. Under such conditions up-regulation of several heat inducible genes, commonly referred to as heat shock genes (HSGs) which encode HSPs are very much necessary for plants survival under heat stress. HSPs function as molecular chaperons that bind to the exposed hydrophobic surface of proteins to prevent its misfolding or aggregation and subsequently facilitate refolding of native conformation and assembly into a protein complex.

The protective mechanism of pathways leading to the expression of genes to synthesize HSPs is composed of sensing temperature that is connected to the signal transfer to HSFs where the activation of gene expression occurs by binding to the heat shock elements (HSE) in DNA (Larkindale *et al.*, 2005). In the absence of stressing factors, HSFs are present in the cytoplasm as single and free. Upon heat stress perceived by the plant cell, monomeric heat shock factors enter into the nucleus from cytoplasm.

In the nucleus, HSF monomer form active trimer that will bind to specific sequence element in DNA (HSE) of the respective heat shock gene.

Once bound to the HSE, the trimeric HSF is phosphorylated and promotes the transcription of HSP mRNA, which lead to production of functional HSP to protect the plant cell and responsible for heat stress tolerance (Hasanuzzaman *et al.*, 2013).

3. Physiological traits as selection criteria for heat stress tolerance

i) Cell membrane stability

a) Electrolyte leakage

Cell membrane thermostability assay measures electrolyte leakage from the leaf tissues. Less electrolyte leakage from leaf tissues indicates higher membrane stability.

b) Tetrazolium test

The tetrazolium viability test is a simple assay that may be used to determine the physiological viability of a large number of plant samples at a particular point of time. Heat tolerant plants are better able to reduce 2,3,5-triphenyltetrazolium salts to an insoluble red formazan compound by accepting electrons from the electron transport chain via the dehydrogenase pathway, this reduction can be correlated to the level of enzyme viability. Heat tolerant genotypes showed more dehydrogenase activity.

ii) Canopy temperature depression

Canopy temperature depression (CTD) is the difference between air temperature and canopy temperature as criteria to avoid evapotranspiration under heat stress is one of the parameter to measure tolerance. CTD shows high genetic correlation with yield. High CTD value mean cooler canopy is the indicator of heat tolerant genotypes.

iii) Chlorophyll flurescence

Chlorophyll flurescence is an indicator of electron flow through PS II. Heat stress cause functional separation of LHC from PS II and block electron flow, which cause (Fo) increase and Fm decrease. Fv (expressed as Fm - F0) decreases constantly with the increase of temperature.

4. Breeding strategies for heat stress tolerance

4. 1. Conventional breeding

i) Screening of germplasm: Screening of germplasm for selection of heat tolerant genotypes under controlled environments in glasshouse, where heat stress allows exposure of the nurseries to heat stress throughout the life cycle, thus making the selection in glass house more reliable.

ii) Use of heat tolerant genotype in hybridization programme: Some heat tolerant genotypes developed using conventional breeding approaches have been released. Use of those heat tolerant genotypes in hybridization programme followed by selection of segregants for high yield associated with heat stress tolerance helps in improving heat tolerance.

iii) Use of wild relatives: In the event of non-availability of desirable heritable variation for heat tolerance in the primary gene pool, wild relative may serve as rich resource for useful genetic variation.

Heat tolerant varieties

Recently promising genotypes WH1021 and WH 730 showing enhanced yield under heat stress were discovered in wheat (Dhanda and Munjal, 2012). Similarly, three synthetic wheat lines, SYN11, SYN 36, SYN 44 were identified highly heat tolerant based on cluster analysis of morphological attributes and ISSR markers (Sharma *et al.*, 2014).

4. 2. Marker-Assisted Breeding

The quantitative nature of heat tolerance and unpredictability of heat stress in the field makes it particularly difficult for breeders to effectively select for the trait. Due to difficulty of managing of heat tolerance through conventional phenotypic selection and the presence of several QTLs for a single target trait with complex inheritance, the selection of target trait can be achieved indirectly using molecular markers that are closely linked to underlying genes.

4. 3. Transgenic approach

Conventional breeding for heat stress tolerance has not been much successful due to several reasons like lacking of suitable source of genes in sexually compatible gene pools, complex nature of the HS trait, lack of understanding on the genetic mechanisms of the heat tolerance response etc. Advent of recombinant DNA (rDNA) technology has opened the way for tackling the issues relating to complex genetic traits. It has been suggested that plants for heat tolerance can be genetically-engineered by altering Hsps levels, osmolytes level, components of the cell detoxification mechanisms and components that regulate membrane fluidity (Burke and Chen, 2006). A betaine aldehyde dehydrogenase gene (BADH) from spinach was introduced into tomato (*Lycopersicon esculentum* cv. 'Moneymaker') via Agrobacterium-mediated transformation. Transgenic tomato lines expressing BADH exhibited higher capabilities for glycine betaine accumulation. Chlorophyll fluorescence analysis of wild type (WT) and transgenic plants exposed to heat treatment (42 °C) showed that transgenic plants exhibited higher photosynthetic capacities than WT plants (Li *et al.*, 2014).

CONCLUSION

Heat stress is a major abiotic stress that affects the crop production worldwide. Due to complex nature of heat stress tolerance, improvement or introgression of a gene or QTL by conventional breeding is usually not sufficient to develop heat tolerant genotypes. In addition, an understanding the nature of signaling cascades as well as specific genes expressed in response to heat stress will be valuable for developing stress tolerant plants. In conclusion, a combination of plant breeding, plant physiology, molecular biology and genetic engineering is required for developing genotypes tolerant to heat stress.

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System of Rice Intensification (SRI) an effective approach to increase production and productivity of rice in drought affected areas

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Rice is the staple food for more than half of the world's population and plays a major role in food security of many countries; more than 90% of the global production and consumption of rice is in Asia. As for India rice is not only a food commodity but also a source of foreign exchange earning about 11,000 cores annually. To assure the food security in the rice-consuming countries of the world, those countries will have to produce 50% more rice with improved quality to meet consumers demand by 2025. This additional rice will have to be produced on less land with less water, less labor, and fewer chemicals. The projected trends indicate that the country has to add 1.7 mt of additional rice every year under declining area, increasing cost of cultivation and shrinking natural resources like water. Among the constraints, water scarcity appears to be major challenge affecting rice production across globe. Therefore, further rice production depends on how we improve the water use efficiency of rice crop. Production of "more rice crop from every drop of water" will have to be the guiding principle for the future.

HISTORY OF SRI METHOD

System of rice intensification (SRI) developed in Madagascar in 1980's based on the cropping principles of significantly reducing plant population. It was developed in 1983 by the Father Henri de Laulanie in Madagascar. Adopting this SRI technique of rice cultivation to study a response of rice grain yield at different organic and NPK level under SRI and traditional planting. The finding shows that growing of rice under SRI 100% NPK recorded significantly higher mean grain yield of 76.56 q/ha then traditional planting in which grain of 64.76 q/ha resulting in yield increase of 11% and the SRI method was evaluated across the country at 25 location the result clearly indicate that SRI is 50% more superior over (ST) standard transplanting and SRI is 50% more superior over (ICM) integrated crop management and also water requirement of rice in SRI method about 1110 (mm) and in Traditional method 1745 (mm) an hence water saving about 36.3% in SRI method.

What is SRI?

System of rice intensification (SRI) is a method aimed to increasing the yield of rice produced in farming. It is a low water, low labor intensive, organic method that uses younger seedlings singly spaced and typically hand weeded with special tools.

Objectives of SRI

- Early, quick, healthy plant establishment & reduced plant density.
- Improved soil conditions through enrichment with organic matter.
- Reduced and controlled water application.

PRINCIPLES AND METHODS OF SRI

Principles

- Young seedlings between 8-12 days old (2-3 leaf stage) are transplanted.
- Spacing at 25 cm x 25 cm & use cono-weeder/rotary hoe/power weeder to aerate the soil

Methods

- The (SRI) is just altering the management practices to make more productive.
- Artificial environment is created for growth and development.
- Genetic potential, land and water resources can utilize efficiently.

Raising Nursery for SRI

Selection of site: The nursery bed should be preferably prepared in the corner of the plot for quick transplanting.
Size of bed: For 1 ha^{-1} transplanting, the nursery bed can be raised in (100 sq meters). A bed with a width of 125 cm or 4 feet is ideal for nursery.
Bed preparation: Nursery bed is prepared with application of (FYM) in layers. All these layers should be mixed well as it will helps in easy penetration of roots.
Seed rate: 2-3 kg of seeds is required to transplant in 1 ha^{-1} of land. Seed should be thinly spread to avoid crowding of seedlings.

Preparation of main field

- Land selected for SRI should be well levelled; it should not have water logging condition.
- When the plot is irrigated the water should spread uniformly across the field.
- The main field is prepared and levelled with little standing water a day before transplanting for grid marking to obtain optimum spacing.
- Provision should be made for 30 cm wide channels at 2 meters interval.
- Perfect levelling is the pre-requisite for proper water management and good crop stand.

Method of Transplanting

- The field should be well puddled and levelled. After levelling the field, a marker can be used to lay out the plot into wider spacing, about 25 cm x 25 cm row to row and plant to plant.
- Young rice seedlings of 8 to 12 days old about (2-3) leaf stage seedling are ideal.

- Care should be taken to prevent any harm to seedlings while pulling them from nursery or at the time of transplanting.
- A metal sheet is inserted 4-5 inches below the seedbed and seedlings scooped along with soil without any disturbance to their roots. Transplanting of tender seedlings need care to minimize root damage.

Nutrient Management

- Application of organic manures FYM (10-12 t/ha) before ploughing and incorporated in soil.
- Though complete organic manuring is recommended for SRI method, but inorganic fertilizers supplements are adopted to obtain higher yields.
- Fertilizers (NPK) through inorganic i.e., 100:50:50kg/ha. & 25kg/ha Zinc sulphate is applied.
- 50%Nitrogen & entire P&K is applied as basal dose at the time of transplanting and (25% N) at tillering, (25% N) at panicle initiation stage gives maximum yield.

Irrigation management

- SRI method does not require continuous flooding.
- Irrigation is given to maintain soil moisture near saturation initially.
- Soils having low water holding capacity require frequent irrigation to obtain higher yield.
- As the soil is not flooded, the roots of the paddy plants grow healthy leads to higher yield.
- Alternate wetting and drying is followed to minimize the water wastage & to increase the water use efficiency.

Weed management

- Most commonly found weeds are: Echinochloa colonum, Echinochloa crusgalli, Cyperus spp, Cynodon dactylon, chenopodium album etc.
- One or two hand weeding is done to remove the weeds during critical period (15-45 DAT).
- Application of Pre-emergent herbicides; Butachlor @ 1.5 Kg ai/ha, Anilofos @ 0.4 Kg ai/ha is applied within 5 days of transplanting.
- Application of Post-emergent herbicides; 2,4-D @ 0.75 Kg ai/ha, Propanil @ 0.75-1.0 Kg ai/ha is applied within 5 days of transplanting.

Advantages

- Yield is most evident advantage due to increased number of tillers & more panicles per plant.
- Reduce water, seed, labour and other inputs which lead to cost reduction and increased profitability with Lower capital requirements.

- Resistance to weed, pests and diseases, farmers can reduce use of agrochemical sprays.
- Resistance to climatic effects & greater tolerance to drought, cold, storm and salinity, lodging resistance.
- Higher grain quality higher milling quality & better eating qualities,
- Water saving can be possible about 25-50% & seed reduction should be 80-90%.
- Labour saving is possible & all these savings reduce cost per kg of rice produced.

Table.1 Water Requirement of Rice As Influenced By SRI and Traditional Transplanting

Methods	Water requirements (mm)			% Saving of water (mm)
	2014	2015	Mean	
Traditional	1840	1650	1745	
SRI	1180	1040	1110	36.3

Table.2 Grain Yield & Yield Parameters, WUE & Root Growth of SRI & Traditional Method

Planting method	Grain yield(q/ha)			Yield parameters			Others parameters		
	2006	2007	Mean	Panicles per m^2	Grains Per panicle	Grain weight per hill (g)	WUE kg per (ha^{-1} mm)	Root volume (cc)	Root dry weight (g)
SRI Organics	30.90	24.98	28.00	251	97	15.6	2.52	74.7	8.2
SRI 50% NPK	48.34	67.08	57.71	349	113	31.4	5.20	84.0	9.2
SRI 100% NPK	64.82	88.30	76.56	436	113	42.0	6.90	114.7	11.7
Traditional	59.20	70.33	64.76	396	116	22.6	3.71	29.4	3.2
CD (p=0.005)	3.74	5.07	3.07	15.0	202	2.41	0.28	10.8	1.58

INFERENCE

Total area under SRI method has been increased from (87,978 ha^{-1}) to (86,630 ha^{-1}) which covers (44.57%) of total paddy area in all the seasons. Growing of Rice under (SRI 100%) NPK Treatment was recorded significantly higher grain yield then traditional method. The Treatment recorded mean grain yield of 76.56 q ha^{-1} as against 64.76 q ha^{-1} in case of Traditional method resulting 15% higher grain yield. Response of

SRI method on grain yield across the locations: The results of multi-location trial indicated that the performance of SRI recorded 50% higher yield over Standard transplanting (ST) method in 19 locations and also SRI is 50% superior over integrated crop management (ICM) method in 17 locations. Growing rice under SRI method required a mean quantity of 1110 mm/crop/season as against traditional transplanting which required 1745 mm/crops/season resulting in saving of 36.3 % in water. However, more information about these procedures is needed and this topic needs more study and investigation. On the basis of the information described in the present article, some points are represented as conclusion.

Bio-digesters: an effective approach of recycling animal wastes

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Biodigester produce biogas, an alternative fuel source: Biodigesters convert organic wastes into a nutrient rich liquid fertilizer and biogas, a renewable source of electrical and heat energy. Their use is widespread in developing countries, particularly India, Nepal, China and Vietnam. Biodigesters help families by providing a cheap source of fuel, preventing environmental pollution from runoff from animal pens, and reducing diseases caused by the use of untreated manure as fertilizer. As organic wastes break down, whether in the ground, a compost heap or landfill, they release methane (a potent greenhouse gas that traps heat at 23 times the rate of carbon dioxide). A biodigester or biogas system is a waste-management solution that traps methane as it is produced, making it available for heating or cooking or even electricity generation. By preventing methane from venting freely into the atmosphere, these systems can help reduce emissions that contribute to climate change. Biogas is a sustainable substitute for the propane, kerosene, and firewood that many rural families in developing countries use for their domestic energy needs. For those families that buy their fuel, a biodigester can save those hundreds of U.S. dollars every year.

Biodigesters also create high quality fertilizer: In a biodigester, animal waste is coverted into biogas and fertilizer. In addition to providing fuel, these systems offer an environmentally friendly way of treating waste. As waste is processed in a biodigester, it is sterilized by methane-producing bacteria and the high-methane environment; over 90% of protozoa, cysts and disease-causing bacteria, such as *E. coli*, are killed. The effluent that remains after gas production is a high quality organic fertilizer that can be safely used on food crops. Some studies have shown that this liquid fertilizer has a higher nutritional value than the feedstock initially put in.

Biomass encompasses materials derived from plants, animals, humans as well as their wastes. In addition, food processing, agro-industrial and industrial wastes are other sources of biomass wastes, so also is the microbial population metabolically active and cultivable plus metabolically active but non-cultivable cells existing within these wastes. Depending on the characteristics of these wastes, they can be converted into energy/and or fuel by combustion, gasification, co-firing with other fuels and ultimately by anaerobic digestion.

What is Biodigester?

A biodigester is a tank that processes the organic material that produces biogas. A biodigester can come in different shapes and sizes, depending on the needs of the people using it and the local possibilities in building materials.

Environmental and Public Health Implications of Animal Manure

Wastes from agricultural animals (poultry and livestock) often contain high concentrations of human pathogens, spilled feed, bedding material, fur, process-generated wastewater, undigested feed residues, feces and urine therefore must be effectively managed to minimize environmental and public health risks. However, the type and pathogenic microbial load depend on the type of the waste and its composition. The following contaminants including pathogens (bacteria, viruses and protozoa), nutrients (phosphorus, nitrogen and sulphur), heavy metals (zinc and copper), veterinary pharmaceuticals (antibiotics) and naturally excreted hormones are present in animal manure. Taking into consideration the concentration of contaminants in animal wastes, it does have the potential to pollute land, water and air if containment and treatment do not adequately manage it. From the environmental point of view, excessive nutrients (especially phosphorus and nitrogen) in conjunction with elevated levels of biological oxygen demand (BOD) and chemical oxygen demand (COD) in these water bodies can contribute to algal blooms and cyanobacterial growth thus presenting serious socioeconomic hazards.

Sources of Contaminants in Animal Manure

The intestinal tract of human and animals have been found to be the major sources of *Salmonella* and *Escherichia coli* in nature, which could be shed in feces. These pathogens may persist for days to weeks to months depending on the type of pathogen, the medium and the environmental conditions. Approximately 1% to 3% of all domestic animals are infected with Salmonellae. Furthermore, other non bacterial pathogens that may be present with fecal material include protozoa (*Cyptosporidium*and *Giardia*) and viruses (Swine Hepatitis E- virus).

Anaerobic Digestion of Animal Waste in Bio-Digesters

Growth and intensification of livestock operations often result to great quantities of manure that have to be properly managed. Even when stored, manure generates and releases methane (a greenhouse gas) into the atmosphere. Moreover, anaerobic degradation has usually taken place in the lower digestive tract of animals and then continues in the manure piles resulting in malodorous compounds. These malodorous compounds originate from the incomplete breakdown of organic matter in manure by anaerobic microbes under uncontrolled environmental conditions.

Types of Bio-Digesters for Treating Animal Manure

A biogas digester consists of one or more airtight reservoirs (chambers) into which animal manure or a mixture of manure and co-substrate is placed, either in batches or

by continuous feed. These biogas generating systems could be categorized on the basis of the number of reactors used into single (one) stage or multi (two) stage and on the mode of feeding into continuous and batch feeding systems. In single stage processes, the three stages of anaerobic process occur in one reactor; however, the growth rate of fermentative bacteria is faster than that of acetogenic and methanogenic bacteria. Consequently, acids accumulate; the pH falls and the growth of methanogenic bacteria is inhibited due to increase organic loading rate and inappropriate other process parameters. Whereas multi-stage processes make use of two or more reactors that separate the acetogenesis and methanogenesis stages in space and allow the establishment of operational conditions that reduce the start time and micro biota specialization in each reactor, thereby allowing the most desirable products at each stage to be obtained.

Microbial Communities Involved in Anaerobic Digestion of Animal Manure

Acidogens: It has been documented that the bacterial species active in the polymer hydrolysis phase are also active during the acidogenic phase. Hence, the hydrolytic and acidogenic bacteria are sometimes referred to as fermentative bacteria. They can be either facultative anaerobic bacteria (*i.e.*, can survive under both aerobic and anaerobic conditions) or strict anaerobes. The family *Enterobacteriaceae* or enteric bacteria (a group of bacteria that inhabit the intestine of humans and other animals) are active fermenters and are among the organisms responsible for the first step in the bioconversion of carbohydrates to CH_4.

Methanogens (Archaea): Methanogens are found in a wide range of anaerobic habitats including freshwater and marine habitat, sewage digesters, the digestive tracts of herbivores, mammals and wood and humus feeding insects *etc*. They belong to the domain *Archaea* and they occupy a key position in the anaerobic digestion process because it is in this last step of the process where the valuable methane is produced. During an unstable anaerobic digestion process in a poorly performing anaerobic digester, the methanogenic populations are especially sensitive to acidity (pH), concentrations of volatile fatty acids, and free ammonia and ammonium ions in the digesting substrate.

FACTORS INFLUENCING ANAEROBIC DIGESTION OF ANIMAL MANURE

Temperature

Based on temperature, anaerobic microorganisms can be categorized into psychrophiles (<20°C), mesophiles (25–37 °C) and thermophiles (55–65 °C). Some methanogenic species exhibit a preference of extreme heat (90–100 °C) thus, are classified as hyperthermophilic Methanogens. Examples are *Methanocaldococcus jannaschii* and *Methanococcus vulcanius*. Temperature can be considered as the most important environmental factor influencing the growth of microbes.

PH and Alkalinity

In regards to anaerobic digestion, it is more appropriate to discuss pH alongside alkalinity since the latter can be used to control pH thus buffering the acidity of the system derived from acetogenesis phase. Therefore, the amount of alkalinity present in an anaerobic digester represents the buffering capacity. Livestock wastes (rich in ammonia and nitrogen compounds) such as cow, swine and poultry manure have high buffering capacity as they produce alkalinity when degraded upon by microorganisms. However, anaerobic digestion of these wastes is often maintained at higher pH values of 7.6.

Ammonia Concentration

Anaerobic digestion of urea- and protein-rich wastes such as animal wastes is often faced with the challenge of high levels of free ammonia due to their high organic nitrogen concentration which upon biological degradation results in high concentration of total ammonium ion plus free ammonia. In aqueous solution, inorganic ammonia nitrogen exists in two principal forms; ammonium ion (NH_4^+) and unionized ammonia or free ammonia (NH_3) in a pH dependent equilibrium state. Ammonia toxicity is influenced by the operating pH and temperature.

ADVANTAGES OF BIODIGESTER

- Reduce greenhouse gas emissions. The combustion of biogas produces lower greenhouse gas emissions than typical methane emissions from a waste lagoon or septic system.
- Reduce contamination of surface water, groundwater and other resources.
- Reduce odors and pathogens. Biodigesting sewage can reduce the parasitic and pathogenic bacteria counts by over 90%.
- Convert waste into high quality organic fertilizer. Families can obtain improved crop yields and save money.

- Can accommodate a wide variety of organic wastes including animal manure, night soil, crop stalks, straw, slaughterhouse wastes, biodegradable garbage and wastewater.

DISADVANTAGES OF BIODIGESTER

Biodigesters function poorly in colder climates unless an external heat source is applied. The methanogenic bacteria responsible for generating biogas require temperatures well above freezing (optimal temperature ranges - mesophilic: 30-40°C; thermophilic: 50-60°C.

CONCLUSIONS

Anaerobic digestion of animal manure is looked upon as a strong option in safely reusing wastes or transforming them into valuable materials and energy. This decomposition process that occurs within a confinement contributes to pollution control as it presents with the following benefits; it reduces biological oxygen demand (BOD) and chemical oxygen demand (COD) of wastes; it destroys pathogenic microbes reducing the microbial load to a level which could be safely handled by humans with limited health risks and it destroys volatile fatty acids and many malodorous compounds present in the feedstock and reduces the emission of greenhouse gases. Ultimately, it generates biogas and high quality nutrient-rich fertilizer from animal manure thus upholds the concept of waste to wealth in enhancing sustainability of development.

Shelter belt and its significance role in crop production

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Shelterbelts are linear plantings combining trees, shrubs and plants designed to alter the flow of wind or snow, thereby altering the microclimate in an immediate area to make it more habitable for crops, wildlife, livestock and dwellings. Shelterbelts are also called windbreaks, hedgerows, timber belts, living fences or conservation buffers. They provide shade and shelter for livestock and opportunities for supplemental farm income from the sale of berries, firewood, and pulpwood. Shelterbelts also generate a variety of social benefits such as enhancing wildlife habitat, maintaining the regional groundwater balance, protecting watersheds.

What is Shelter belt?

It is defined as a belt of trees or shrubs maintained for the purpose of shelter from wind. The Shelter belt is a wide range of trees, shrubs and grasses planted in rows which go right across the land at right angles to the direction or the prevailing to defect in movement to reduce wind velocity and to give general protection to cultivated area.

What are Wind Breaks?

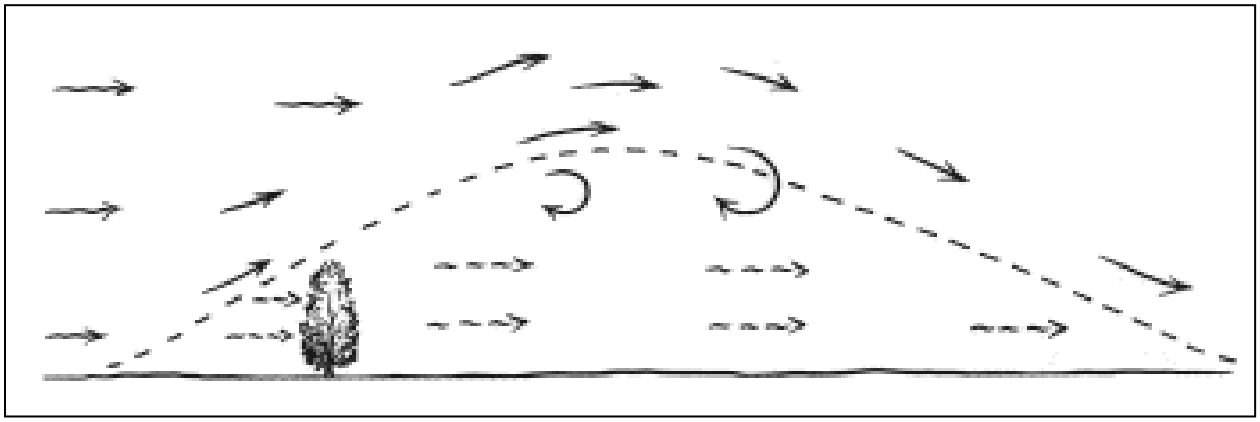
Wind-breaks are strips of trees and or shrubs planted to protect fields, homes cannels or other areas from wind and blowing soil or sand. The purpose of Raising Wind Breaks:

- To protect field crops / livestock from cold / hot wind.
- To prevent soil erosion & to reduce evaporation from farmlands.
- To improve the microclimate, for fencing and boundary demarcation. & for fuel, fodder, etc.

Main Features of Wind Break:

- **Permeability:** The primary purpose of raising windbreaks is to filter and break up the force of the wind. Permeable windbreaks, which allow some wind to pass through, are the most suitable. The desired permeability can be obtained by carefully selecting trees and shrub species. Species such as Eucalyptus and Casuarina will form dense mind break but most native species are more permeable.
- **Orientation:** For best results, wind-breaks should be-raised at right angles to the direction of wind. N - S direction is good compromise.

Effect of shelter in wind speed



The characteristics of a tree suitable as wind break are:

- It should be fast growing & easily established.
- It should be able to acclimatize to the environment
- Should have dense canopy & resistant to pests and diseases
- It should be frost resistant & drought resistant
- It can be propagated by various methods
- Planting material should be easily available and cheap
- It should have multipurpose uses like fuel wood, fodder etc.

Benefits of Shelter Belt

1. Reduced soil erosion by wind:

A field shelterbelt modifies the microclimate, mostly in its downwind vicinity. This modified microclimate includes reduced wind speed and, therefore, reduced soil erosion.

2. Reduced wind damage to crops:

Crops benefit from the reduced wind speeds in the protected zone. The plants are less likely to be twisted by the wind or sandblasted by eroding particles.

3. Increased moisture for crop growth:

Shelterbelts reduce evaporation and provide more moisture for crop growth.

Field shelterbelts use moisture and nutrients from a greater depth than most annual crops. However, additional moisture accumulated in the sheltered zone more than compensates for moisture used by the shelterbelt.

4. Potential for increased crop yields:

Most of the research conducted around the world reports yield increases due to field shelterbelts. In drought-prone prairie regions that receive snow in winter, about half the yield increase is attributed to extra moisture from snow trapping by shelterbelts.

What are Natural shelterbelts?

Natural (or native) shelterbelts can be left when clearing land. Strips 10 to 15 m wide of existing mixed stands make excellent shelterbelts. When strips of natural shelterbelt are left, extra time will be required for measuring, marking and clearing, but the result is a

fully grown, instant shelterbelt. Savings include establishment costs and time needed to grow a shelterbelt.

Components of shelter belts

Shape and Composition of shelter belt: A typical shelter belt has a triangular cross section. This can be done by planting tall trees in the center, flanked on both sides, successfully on other trees, tall shrubs and then low spreading shrubs and grasses. There should be a systematic mixture of trees, shrubs and grasses keeping their height, shape, crown form, longitivity, & resistance to insect and diseases.

Density of Width: The central arid zone research institute, Jodhpur has advised data in arid zone, wind velocity not exceeds 20 km/ hr. A typical belt may consist of 3-5 rows and in the same cases 7 rows may be planted as a distance of 4 m.

Orientation: The orientation of shelter belt depends upon the wind direction and velocity, particularly during the vulnerable season and shelter belt should be should oriented as early as possible at right angles to the prevailing winds that are more damaging to the preveling time of the year. In case where winds blow from different direction shelter belt should be raised.

Height and Spacing: Height of shelter belt is more important because it affects the distance to which protection will be given on the leeward side. Higher the trees forming shelter belt, the greater is the beneficial effect on leeward side. Shelter belt protect the area up to 15 to 20 times the height or belt. In Rajasthan, taking the height of shelter belt to about 7.5m spacing recommended is two times the height i.e. 75 cm.

Basic Principles of shelter belts

Porosity: Ideally 50%, to slow the wind, not stop it altogether.

Height: Preferably as tall as the situation allows. Deciduous trees can provide excellent shade.

Species: A mix of deciduous trees and native evergreens has benefit of the ideal 50% porosity.

Spacing: Single row shelter 1.2 to 1.5m apart. Multiple rows and timber belts 1.8 to 2.5m.

Choice of Species: The choice of species to be raised in shelter belt is by the climate, soil and topography of the area. It is better to grow local species which may serve the object in view, as they can be easily established. The selected species should be fast growing & drought resistant.

Table1: Species Recommended for shelter belt:

Shrubs	Small Trees	Trees
Jatropha	Choke Cherry	Neem, Popular, Casuarina
Caragana	Amla, Singapore cherry	Teak wood, Red sanders
Desert hop bush	Silver Buffalo berry	Erythrina indica, Cassia‘s
Siberian pea tree	Acute willow	Silver oak, Jamun, Mango

Advantages of Shelter Belts

Moderating effect on temperature & it can increase or decrease the temperature.
It retards the evaporation & increases the soil moisture.
It reduces the wind velocity and wind erosion of soil.
It increases the fruit production by minimizing wind damage.

Plant/Tree Species Recommended For Shelter Belts

JATROPHA

ACACIA ARABICA

Dalbergia Sisso (Rose Wood)

Desert Hop Bush (Dedonae Visosa)

INFERENCE

On the basis of the information described in the present article, some points are represented as conclusion as the shelterbelts reduce soil erosion by wind, conserve soil moisture and reduce wind damage to crops. They complement good crop management and other water conservation practices to protect the soil from erosion. It also promotes organic farming & sustainable agriculture. However, more information about these procedures is needed and this topic needs more study and research. On the basis of the information described in the present article, some points are represented as conclusion.

Integrated Approach towards Natural Organic Farming and LEISA Techniques

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What is Natural farming?

Natural farming emphasizes on efficient use of on-farm biological resources and enrichment of soil with the use of Vermiwash, Jivamruta, Bijamruta, Panchayagavya, & Plant growth botanicals to ensure high soil biological activity & increase the production without affecting the ecosystem.

What is LEISA?

Low External Input Sustainable Agriculture (LEISA). The term low external input sustainable agriculture has been defined as a production activity that uses synthetic fertilizers or pesticides below rates commonly recommended by the agriculture extension service. It does not mean elimination of these greater materials & yields are maintained through greater emphasis on cultural practices like INM, IPM, IDM and IWM.

Objectives of LEISA

- Recycling of farm wastes; crop residues, cattle waste, poultry waste, fish waste etc.
- Reduce external input to increase the production & productivity per unit area.
- Maximum utilization of available resources & stabilizing the yield sustainability.
- The LEISA concept seeks to optimize the use of locally available resources by maximizing the complementary & synergistic effects of different components of the farming systems.
- Poultry litter can replace nitrogen fertilizers in the production of vegetables.
- Preparation of various organic liquid by utilizing the on-farm resources to increase crop production by reducing the external inputs.
- Integrated pest management, disease management, nutrient management & weed management

Criteria's under LEISA

1. **Ecological criteria:** Balanced use of nutrients and organic matter, efficient use of water resources and diversity of genetic resources, minimum negative environmental effects.
2. **Economic Criteria:** Sustained farmer livelihood systems, competiveness, efficient use of production factors, and low relative value of external inputs.

3. **Social Criteria** Wide spread & equitable adoption potential, especially among farmers, reduced dependency on external institutions, enhanced food security at the family & national level, respecting & building on indigenous knowledge & value systems, contribution to employment generation.

Preparation of Organic Liquids & Plant Botanicals by Utilizing Available Farm Resources under LEISA Techniques

1. Panchgavya

Panchgavya, an organic product has the potential to play the role of promoting growth and providing immunity in plant system. Panchgavya consists of five products viz. cow dung, cow urine, milk, curd & ghee. With addition we can mix ripe banana, Tender coconut and jaggery.

Ratio of Materials used: (5:4:3:2:1) cow dung 5 kg: cow urine 4 lit: milk 3 lit: curd 2 lit: ghee 1 lit + 10 ripe banana + 2 lit coconut water + 2 kg jaggery.

Preparation: All the above items are taken in a mud pot or plastic container. The container should be kept open under shade & all the material is mixed properly & it is stirred twice a day both in morning and evening. Allow the product for fermentation upto 30 days. The Panchgavya stock solution will be ready after 30 days. Cover the container with a wire mesh or net to prevent houseflies from laying eggs and the formation of maggots in the solution.

Recommended dosage:

a. Spray system: 3-6% solution (3-6 lit of Panchgavya is mixed in 100 litres of water is ideal for all crops. This concentration was found to be most effective.

b. Irrigation system: The solution of Panchgavya can be mixed with irrigation water at 50 litres per hectare either through drip irrigation or flow irrigation.

c. Seed/seedling treatment: 3-6 % solution of Panchagavya can be used to treat the seeds or dip the seedlings before planting. Soaking for 30 minutes is sufficient. Rhizomes of Turmeric, Ginger and sets of Sugarcane can be soaked for 1hr before planting.

Table.1 Physico chemical properties of Panchagavya

Sr. No.	Chemical composition	Concentration	Other Components Present
1	pH	5.45	Fatty Acids: Oleic acids, Palmitic acid
2	EC dSm2	10.22	Myristic acid, Deconore acid, Deconomic acid
3	Total NPK (ppm)	229, 209, 232	Alkanes: Decane, Octane, Heptane,
4	IAA (ppm) & GA (ppm)	8.5 & 3.5	Alcohols: Heptanol, Tetracosanol, Propanol and Methanol.

2. Bijamruta

Bijamruta, an organic product has the potential to play the role of promoting growth and providing immunity in plant system through seed treatment. Bijamruta is used as seed/ planting material treatment. Bijamruta consists of four products viz. cow dung, cow urine, milk, lime. With addition we can mix jaggery solution as stabilizer.

Ratio of Materials used: (5:5:5:0.2) cow dung 5 kg: cow urine 5 lit: milk 5 lit: Lime 0.2 kg + 0.5 kg jaggery.

Preparation: All the above items are taken in a mud pot or plastic container. The container should be kept open under shade & all the material is mixed properly. Allow the mixture for fermentation upto 1 day. The Bijamruta solution will be ready in 1 day for treating seeds.

Recommended dosage of Seed treatment: 5-6 % solution of Bijamruta can be used to treat the seeds or dip the seedlings before planting. Soaking for 30 minutes is sufficient. Rhizomes of Turmeric, Ginger and sets of Sugarcane can be soaked for 1hr before planting.

3. Jivamruta

Jivamruta an organic product has the potential to play the role of promoting growth and providing immunity in plant system. Jivamruta consists of four products viz. cow dung, cow urine, Jaggery, Pulse flour.

Ratio of Materials used: (10:10:2:2) cow dung 10 kg: cow urine 10 lit: Jaggery 2 kg: Pulse Flour 2 kg.

Preparation: All the above items are taken in a mud pot or plastic container. The container should be kept open under shade & all the material is mixed properly. Allow the mixture for fermentation upto 10-15 day. The Jivamruta solution will be ready in 15 day for application.

Recommended dosage:

a. Spray system: 6-10% solution (6-10 lit of Jivamruta is mixed in 100 litres of water is ideal for all crops. Higher concentration was found to be most effective in field & horticulture crops.

b. Soil application with Irrigation system: The solution of Jivamruta can be mixed with irrigation water at 400-500 litres per hectare either through drip irrigation or flow irrigation.

c. Seed treatment: 10 % solution of Jivamruta can be used to treat the seeds or dip the seedlings before planting. Soaking for 15-20 minutes is sufficient for effective germination.

d. Advantages: Jivamruta has been found to be rich in various beneficial microorganisms, as per the studies conducted by Bio Centre Bangalore the Jivamruta contains following microorganisms: Azospirillum 2 x 106, PSM 2 x 106, Pseudomonas 2 x 102, Trichoderma 2 x 106, Yeasts and moulds 2 x 107.

4. Plant Growth Botanicals Liquid Extract

Liquid Extract is an organic product which is extracted from various cultivated & wild species of plant. These extract play important the role in increasing growth hormones, pigments, enzymes, protein, vitamins and providing immunity against biotic & abiotic stress in plant system.

Plant Species used for preparation of liquid extracts: It consists of various species of cultivated & wild plants viz. Neem (*Azadirachta indica*), Banyan (*Ficus benghalensis*), Mango (*Mangifera indica*), Peepal (*Ficus religiosa*), Morinda (*Morinda citrifolia*), Pongamia (Pongamia pinnata), Datura (*Datura* stramonium), Castor (*Ricinus communis*), Lantana (Lantana camera) and Jatropha (Jatropha curcas).

Ratio of Materials used: 10 kg of leaves are taken from each of the plant species + 5kg cow dung + 5 lit cow urine.

Preparation: All the leaves from individual plant are taken and chopped into small pieces & taken in a big plastic container containing 100 lit of water. The container should be kept open under shade & all the material is mixed properly & it is stirred twice a day both in morning and evening to avoid sedimentation. Allow the product for fermentation upto 25-30 days. The liquid extract solution will be ready after 30 for application.

Recommended dosage:

a. Spray system: 3-6% solution (3-6 lit of liquid extract is mixed in 100 litres of water which is ideal for all the crops. Higher concentrate will be most effective in horticulture crops.

b. Advantages: Liquid extract has been found to be rich in growth hormones, pigments, enzymes, anti bacterial, & anti fungal properties which Increases growth, yield and quality of the crops, controls pests like aphids, thrips, mites and other sucking pests & also controls diseases like leaf spot, leaf blight, powdery mildew etc.

Beneficial Effects of Organic Liquids & Plant Botanicals on Commercial Crops

- Induces dense flowering and increases more female flowers in mango.
- Enhances keeping quality by 12 days in room temperature in fruit crops.
- Flavour and aroma are maintained in mango.
- Fruits are plumy with strong aroma in citrus crops.
- Higher TSS is obtained in guava.
- The bunch size becomes uniform in banana crop.
- Enhances the yield by 22% in turmeric & zinger.
- Extra long fingers in turmeric & zinger and enriches the curcumin content in turmeric.
- Yield enhancement by 18% and in few cases like Cucurbits & Cole crops.
- The yield is doubled in Wholesome vegetables with shiny and fresh appearance of skin

Beneficial Effects of Panchagavya on Animal Health

Panchagavya is a living elixir of many micro organisms, bacteria, fungi, proteins, carbohydrates, fats, amino acids, vitamins, enzymes, known and unknown growth promoting factors micronutrients trace elements antioxidant and immunity enhancing factors. When it is taken orally by animals and human beings, the living micro organisms in the Panchagavya stimulate the immune system and produce lot of antibodies against the ingested microorganisms. It acts like vaccine. This response of

the body increases the immunity of animals and humans and thus helps to prevent illness and cures disease.

In Cows: Panchagavya with animal feed and water at the rate of 100 ml per cow per day, cows become healthier with increased milk yield, fat content and SNF. The rate of conception increased. The retained placenta, mastitis and foot and mouth disease can be controlled.

In Poultry: Panchagavya mixed with the feed or drinking water at the rate of 1 ml per bird per day, the birds became disease-free and healthy. They lay eggs for longer periods and in broiler chickens the weight gain was impressive and the feed-to-weight conversion ratio improved.

In Humans: Studies says that it is showing significant results over various diseases in humans; Psoriasis, Neurological disorders, Parkinsonism, Diabetes mellitus & Pulmonary Tuberculosis.

INFERENCE

On the basis of the information described in the present article, some points are represented as conclusion as the response of crop towards organic liquids & plant botanicals as foliar spray @ 10-15 days interval will be beneficial to increase yield attributes & quality of crops by minimizing the biotic & abiotic stress. However, more information about these procedures is needed and this topic needs more study and research.

Indigenous and local knowledge and practices (ILKP) for pasture and forest management

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Indigenous knowledge and local practices (ILKP) are increasingly recognized and used as a valuable resource for planning climate change adaptation. Vulnerable communities use indigenous practices to plan adaptation and disaster risk reduction activities at the local level. ILKP are also specific to agriculture and animal husbandry, natural resource management, rural transport, human dwellings, traditional medicine and biodiversity conservation

Indigenous and local knowledge system (ILKs) encompasses dynamic and culture specific knowledge, practice and belief. The system evolves through adaptive processes based on the location specific learning by doing behavior and intergenerational transmission. The concept of ILKs can be understood through a number of cultural and linguistic attributions: indigenous and traditional knowledge (ITK), traditional ecological or environmental knowledge (TEK), ethno-science, indigenous science, folk science and farmers' and pastoralists' knowledge. ILKs are generally more predominant in mechanical and ethnic/tribal societies than in developed and organic societies. ILKs is also closely interlinked with governance and institutions, since the indigenous knowledge holders are the custodians of the knowledge and the institutions play critical roles in production and integration of knowledge in adaptation and change. ILKs lose relevance when removed from the control of the culture and society where it has evolved and is practiced. Coexistence and coproduction of ILKs and contemporary knowledge systems foster generations of integrated and synthesized knowledge to meet the new challenges emerging from climate change and natural and manmade disasters.

Pasture and forest management:

- ✓ Indigenous and local forest and pasture management practices have evolved from cultural norms, traditional values, contextual demand, collective behavior, community based institutions and a good understanding of local ecosystems. Government agencies should, therefore, recognize and promote them as climate adaptive and resilient practices in climate change adaptation.

- ✓ Indigenous forestry practices have thrived in locations where access to resources is guaranteed and tenure security is in place under the principle of care and share. The govt. should specify property rights to forest users and allow equitable sharing of benefits among local users to promote better adaptation of forest resources to climate change.
- ✓ Government agencies should also promote integration between contemporary and traditional community based forest and pasture management practices by providing economic and policy incentives.
- ✓ Social and gender inclusion and equity are key to successful indigenous forest management practices. Integrating these elements into the system is often possible with local innovations that combine conservation and commercial uses of resources. Conservation of forest species together with commercial use of under story vegetation, such as non timber forest products and pasture resources can promote resilience building through community based forestry.

Indigenous local adaptation practices

S.N.	Community assets and infrastructure	Climatic and non-climatic stress	ILKP used in adaptation and resilience building responses
1.	forest and pasture resources	forest encroachment and overgrazing	social fencing and inclusion of landless and squatter families in the user groups;
		Habitat destruction and fragmentation	community protection and enforcement of conservation rules; rotation grazing, and stall feeding of animals;
		Productivity decline	Planting non-timber and medicinal plants and grasses; regulated extraction of forest resources;
		forest fire	Preventive measures through awareness building; Community based fire fighting and management
		Invasive species	early detection of invasive species; annual cleaning and timber stand improvement;
		Landslides and soil erosion	Integration of biological and cultural measures together with mechanical and structural measures for landslide and erosion control

Limitations of indigenous practices

There are several limitations to the application of ILKP. Since most ILKP evolve in a limited geographical region and within the confines of a particular culture, community or society, they are applicable to that area only and may not work in other areas. ILKP cannot solve all the problems and challenges that climate change causes. ILK reflects the cultural values and knowledge of the local people in a specific geographical space. It is site specific which means that no practice can be easily scaled up and replicated without being tested for replication and tailored to different locations. ILKP are also more effective as preventive measures than as tools to repair extreme damage.

Climate change and its impacts on agriculture and livestock

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Abstract

This paper provides an overview of climate change and its influence on crop production to a greater extent in countries like India where agriculture depends largely on natural circumstances. Plausible scenarios of climate change like higher temperatures and change in rainfall will directly affect crop yield. This topic covers both agronomic and economic aspects of the impact of climate change on major crop production as well as a critique of the methodologies used to estimate them. The paper ends with some extended bibliography provides a compendium of the likely impact of climate change on the yield and productivity of several major crops in India; on water-related parameters such as evaporation, water runoff and soil moisture; and on soil productivity, pests and crop diseases. Such an analysis also helps in targeting adaptation investments, specific to vulnerable regions.

Key words: Climate, Vulnerability, Temperature, Rainfall, Food-crops.

INTRODUCTION

Climate change is threatening food production systems and therefore the livelihoods and Food security of billions of people who depend on agriculture in the Asia and Pacific region (Here after, Asia and the Pacific). In India agriculture is the sector most vulnerable to climate change due to its high dependence on climate and weather and because people involved in agriculture tend to be poorer compared with urban residents. Consistent warming trends and more frequent and intense extreme weather events have been observed across Asia and the Pacific in recent decades. At the same time, agricultural activities release significant amounts of greenhouse gases (GHG) into the atmosphere. Asia and the Pacific accounts for 37% of the world's total emissions from agricultural production, and the People's Republic of China (PRC) alone accounts for more than 18% of the total Asian Development Bank (2009). The Earth has a carbon cycle, arising from the partial absorption by oceans and other water bodies and by vegetation on land, of the CO2 in the atmosphere. Jayaraman *et al* (2010). Thus, apart from fossil fuel emissions, some of the CO2 absorbed by water on the Earth's surface is re-emitted into the atmosphere, while the decay of vegetation also releases carbon in the form of methane. Further, there is slow circulation of CO2 from the upper parts of oceans to their lower depths. Water vapour is also a significant greenhouse gas but the

main contribution of water vapour comes from natural water bodies, particularly the oceans, and human activity contributes relatively little water vapour directly. The combination of these characteristics of agriculture its importance as an economic sector, its vulnerability to climate change, and its contribution to emissions make building resilience to climate change in Asia and the Pacific an enormous challenge**.**

GLOBAL WARMING

The rise in temperature due to emission of greenhouse gases into the atmosphere has a profound effect on the Earth's climate system as a whole, and this in turn has important consequences for the geosphere and biosphere. The mean temperature in India is projected to increase by 0.1–0.3◦C in kharif and 0.3–0.7◦C during Rabi by 2010 and by 0.4–2.0◦C during kharif and to 1.1–4.5◦C in Rabi by 2070. Similarly, mean rainfall is projected not to change by 2010, but to increase by up to 10% during kharif and Rabi by 2070. At the same time, there is an increased possibility of climate extremes, such as the timing of onset of monsoon, intensities and frequencies of drought and floods. Indian agriculture in particular is not contributing significantly to global climatic change, as GHG emissions from agriculture indicate. India's total contribution to global methane emission from all sources is only 18.5Tg per year. Agriculture (largely rice paddies and ruminant animal production) is a major source of CH4 emission and contributes 68% to it. Based on this estimate, an international opinion was made that Asia and in particular, India and China are contributing significantly to global warming and they should do something to prevent this phenomenon.

Effect of Climate Change on Indian Agriculture: Scenario and Impacts

Scenario: The food grain production in India has increased spectacularly due to the Green Revolution from 50 Mt in 1951 to 212 Mt in 2002 and the mean cereal productivity has increased from 500 kg per ha to almost 1800 kg per ha. The share of agricultural products in exports is also substantial with 15% of export earnings. Agricultural growth also has a direct impact on poverty eradication and is an important factor in employment generation. The wheat accounts for one-third of the total food grain production, while rice forms 43% of the total and is cultivated in 43 mha (million hectares), which is about 30% of the net cultivated area (Fig: 1) Planning Commission (1997-2002).

Impact: Agriculture is extremely vulnerable to climate change. Indian agriculture faces the dual challenge of feeding a billion people in a changing climatic and economic scenario. Even it is the main source of livelihood for almost 60% of the country's total population. The impacts of climate change on agriculture will be severely felt in India. It has been projected that under the scenario of a 2.5°C to 4.9°C temperature rise, rice yields will drop by 32%-40% and wheat yields by 41%-52%. This would cause GDP to fall by 1.8%-3.4% GOI (2011). Agricultural productivity is sensitive in two broad classes of climate-induced effects (a) direct effects from changes in temperature, precipitation, or carbon dioxide concentrations and (b) indirect effects through changes in soil

moisture and the distribution and frequency of infestation by pests and diseases. The impact assessment can be assessed with the three major factors i.e. Environmental, Biophysical and Socio-economic factors (Fig: 2).

Impact of Climate Change on Ecosystems

The ability of ecosystems to naturally adapt to changes in climate is likely to be severely reduced over the next century. This is due to unprecedented combinations in climatic events such as severe flooding and drought, ocean acidification, and the emergence of new pests. This also includes land-use change and the over-exploitation of natural resources due to human activities Impact assessment:

1) **Environmental factor**

- Availability of irrigation water.
- Pest incidence and virulence.
- Soil fertility.
- Sea level rise.
- Duration and frequency of drought and floods.

2) **Biophysical factor**

- Crop growth.
- Crop development.

3) **Socio-economic factor**

- Policy
- Farmer response
- Future Food demand and Land use changes

Table 1. Climate Change and its Impacts on Agriculture

Climate Phenomena	Impacts on Agriculture	Probability
In most terrestrial areas, days and nights will be warmer, less frequently cold and more frequently very warm	Better harvest in cold environments; worse in warm environments; insect pests more frequent	Almost certain
More frequent heat waves and warm periods	Impoverishment of the crops in warmer regions due to heat stress; increased risk of uncontrolled wildfires.	Very likely
More frequent intense precipitation events in most regions	Damage to crops, soil erosion, inability to cultivate the land due to water logging	Very likely
Increase in areas affected by Drought	Lower yields, crop damage and even crop failure; major losses of livestock; increased risk of uncontrolled wildfires	Likely
Increased intensity of tropical Cyclones	Damage to crops, uprooting of trees, damage to coral reefs	Likely

Table: 2 Agriculture sector: Key Indicators (per cent at 2004-05 prices)

Sr. No	Item	2009-10	2010-11	2011-12	2012-13	2013-14
1	Growth in Agriculture GDP	0.8	8.6	5.0	1.4	4.7
	Share in total GDP	14.6	14.6	14.4	13.9	13.9
	Of which agriculture	12.3	12.4	12.3	11.8	NA
2	Share in total GCF	7.3	6.3	7.0	7.1	NA
	Of which, Agriculture	6.7	5.8	6.5	6.5	NA
3	GCF as percent of Agri GDP	20.1	18.5	20.8	21.2	NA
	Of which, private sector	16.7	15.7	18.0	18.1	NA
4	Agri exports (Marine products) as per cent of total exports	8.2	8.0	10.1	11.8	11.9

Impact of Climate Change on Food Security

Together with local overpopulation and poor land and water management, climate change is responsible for causing hunger and malnutrition for some 45 million people worldwide as a result of reduced yields of cereals, fruits, vegetables, livestock and dairy, and cash crops like cotton and fish for poor people, especially children, the elderly and the ill, suffer from hunger and malnutrition when agricultural yields, livestock and fish supplies decline. Climate change is affecting the ability of subsistence farmers to produce sufficient food by creating less favourable growth conditions. Many do not have enough crop production to feed their families and the shortfall may force them to buy food when prices are high GHF (2009).

Impact of Climate Change on water sources

Growing evidence suggests that changes in the hydrological cycles can bring longer droughts and more intense rains making wet regions even wetter and arid areas drier. Changes in rainfall and the disappearance of glaciers will result in a considerable reduction of water quantity and quality for human consumption and farming. This in turn will affect agricultural production and food security. Rising sea levels cause saltwater intrusion into ground water and fresh water streams and warmer water temperatures also accelerate water pollution.

Impact of Climate Change on Freshwater Resources

Increased water scarcity in the semi-arid basins of Indian rivers due to decreasing rainfall and increasing evapo-transpiration (ET). Further Gosain *et al,* (2011) projected

the impact of climate change on 17 most important river basins in India up to mid-century and towards the end of the century, estimating a decline in rainfall in 14 out of the 17 river basins towards the 2030s (mid-century) and the 2080s (end century) including the relevant ASSAR sub regions.

Impact of Climate Change on Livestock

India's large cattle population is an integral part of prevalent mixed farming practices. Climate change poses quite a few challenges for the development of this sector in India. Among the environmental constraints affecting farm animals, one of the severest threats is heat stress, challenging animal production and performance across several geographies round the world have attempted to quantify range and stress levels attributed to the rise in temperature, using Temperature Humidity Index (THI) and its influence on livestock production (Upadhaya et al., 2008). A nationwide study conducted by Chauhan and Ghosh (2014) estimated an annual loss of about 1.8 million tonnes of milk (equivalent of 2661.62 Crore INR) accounting for a 2 per cent decline in national milk production.

Impact of Climate Change on Human Health

Climatic variations and extreme events have adverse impacts on human health concludes that 'Climate change is the biggest global health threat of the 21st century'. It further elaborates that 'Effects of climate change on health will affect most populations in the next decades and put the lives and wellbeing of billions of people at increased risk'. Health is impacted by excessive heat and floods, and through various water-borne and vector-borne systems (Majra and Gur, 2009).

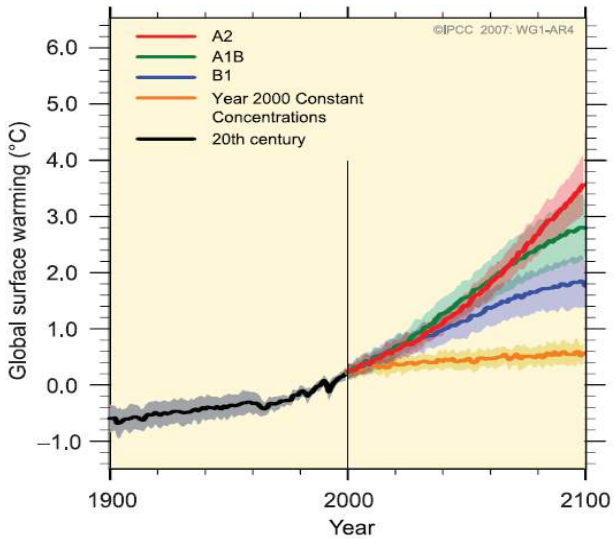

Fig 1: Projected scenario of Climate change IPCC (2007).

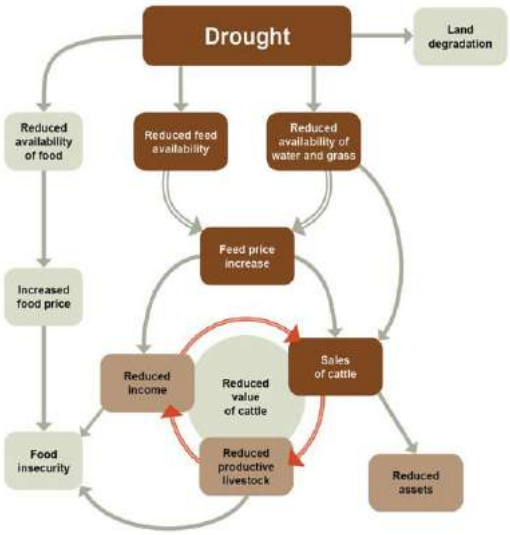

Fig 2: Impacts of a drought on grazing systems

Climate Change Adaptation

Climate change adaptation: an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Adaptation can prevent future risks, it can reduce present adverse effects and it can refer to individual or collective action. Adaptive capacity is defined as "the ability of a system [human or natural] to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Vulnerability, Adaptation to climate vulnerability

The term vulnerability in early work on risks/hazards focused on the biophysical threat (e.g. floods, hurricanes) as the point of departure and a particular exposure unit (e.g. place or sector) is assessed for vulnerability to a specific hazard. However, this understanding has evolved with later work on political economy, which critiqued this approach and made explicit the issues of resource allocation, social privilege and political disempowerment in shaping vulnerability. Finally, resilience thinking has emerged in the 1980s and seeks understanding vulnerability and resilience (the ability to resist, cope with or recover from shocks and stresses) at a system level in a more dynamic sense, 'Why and how do systems change? 'What is the capacity to respond to change?' And 'What are the underlying processes that control the ability to adapt.

Vulnerability is commonly broken down into three key elements

- **Exposure to specific climate risks:** This refers to the geographical nature of climate risks, but social exclusion also operates on spatial terms with the poorest of the poor often forced to live on the steepest, fragile slopes and to cultivate in areas with poor quality soils etc.
- **Climate-sensitivity:** Poor people's livelihoods and poorer countries are disproportionately reliant on climate-sensitive activities, including farming, fishing and collecting wild produce and wood fuel. Women are disproportionately affected because of their traditional gender roles (e.g. responsibility for the collection of water, edible wild plant and medicinal plant collection, crop cultivation etc) all of which may be negatively affected by climate change.

Towards Climate Resilient Agriculture through Adaptation and Mitigation Strategies

This aims to enhance resilience of Indian agriculture to climate change and climate variability through strategic research and technology demonstration. Strategic research on adaptation to progressive climate change covers crops, livestock, fisheries and natural resource management (2012).

Village level interventions towards climate resilient agriculture

- **Building resilience in soil:** Soil health is the key property that determines the resilience of crop production under changing climate. A number of interventions are

made to build soil carbon, control soil loss due to erosion and enhance water holding capacity of soils, all of which build resilience in soil.

- **Adapted cultivars and cropping systems:** Farmers in the villages traditionally grow local varieties of different crops resulting in poor crop productivity due to heat, droughts or floods. Hence, improved, early duration drought, heat and flood tolerant varieties are introduced for achieving optimum yields despite climatic stresses.
- **Rainwater harvesting and recycling:** Rainwater harvesting and recycling through farm ponds, restoration of old rainwater harvesting structures in dry land/rainfed areas, percolation ponds for recharging of open wells, bore wells and injection wells for recharging ground water are taken up for enhancing farm level water storage.
- **Water saving technologies:** Since climate variability manifests in terms of deficit or excess water, major emphasis was laid on introduction of water saving technologies like direct seeded rice, zero village and other resource conservation practices, which also reduce GHG emissions besides saving of water.
- **Farm machinery (custom hiring) centres:** Community managed custom hiring centres are setup in each village to access farm machinery for namely Sowing/planning. This is an important intervention to deal with variable climate like delay in monsoon, inadequate rains needing replanting of crops.
- **Crop contingency plans:** To cope with climate variability, ICAR/CRIDA has developed district level contingency plans for more than 400 rural districts in country. Operationalization of these plans during aberrant monsoon years through the district/block level extension staff helps farmers cope with climate variability.
- **Weather based agro advisories:** Automatic weather stations at KVK experimental farms and mini-weather observatories in project villages are established to record real time weather parameters such as rainfall, temperature and wind speed etc.
- **Institutional intervention:** Institutional interventions either by strengthening the existing ones or initiating new ones relating to seed bank, fodder bank, commodity groups, custom hiring centre, collective marketing, introduction of weather index based insurance and climate literacy through a village level weather station are introduced to ensure effective adoption of all other interventions and promote community ownership of the entire programme**.**
- **Village Climate Risk Management Committee (VCRMC):** A village committee representing all categories of farmers including women and the land less is formed with the approval of Gram Sabah to take all decisions regarding interventions promote farmers participation and convergence with ongoing Government schemes relevant to climate change adaptation.

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The story of a novel insecticidal chemistry class: Diamides and their Role in Integrated pest management

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Abstract

So many efforts have been made to reduce the risk to human exposure to pesticides from past four decades. A number of novel insecticides with unique modes of action were registered during the late 1990s and early 2000s for insect control in agriculture. These new insecticides have several advantages over older classes of insecticides. Among them, Diamide group insectcides (IRAC group 28) became so popular due to low mammalian toxicity and greater selectivity and minimal harm to natural enemies and pollinators make them attractive replacement broad spectrum insecticides and efficient component of IPM.

Key words : Diamide, Coragen, Flubendiamide, Novel insecticides

INTRODUCTION

Diamides are belongs to novel group of insecticides. One of the most interesting features of the diamides is their exceptional activity against insects and their very low mammalian toxicity. They play an important role in the Integrated Pest Management of cropping system due to their high selectivity, better efficacy, and higher LD50 values make them attractive alternative option when compared with other broad spectrum insecticides. Introduction of these insecticides resulted in reduction OP, carbamate and other broad spectrum insecticide use in world. These are also known as "reduced risk" insecticides by U.S. Environmental Protection Agency.

MODE OF ACTION:

The plant alkaloid ryanodine, from which the receptor derives its name, has been investigated extensively as a potential pest control agent. Recently two classes of synthetic chemicals have emerged resulting in commercial insecticides that target insect RyRs. Ryanodine receptors (RyRs) are a distinct class of ligand-gated calcium channels controlling the release of calcium from intracellular stores. Activation of ryanodine receptors which leads to uncontrolled calcium release in muscle that leads to insect death. Because of structural differences between insect and mammalian ryanodine receptors, they exhibit remarkable selectivity and safety for mammals (Cordova et al., 2006).

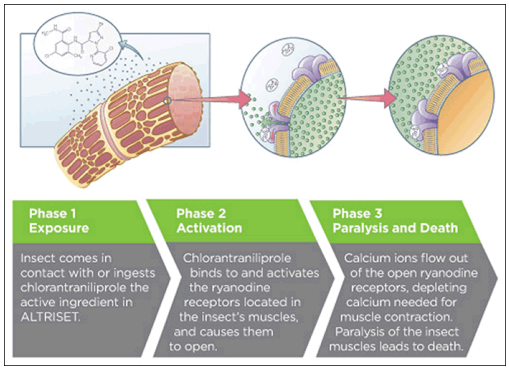

Fig 1. Mode of action of Diamide insecticides

DISCOVERY OF DIAMIDES:

flubendiamide was first commercialized synthetic ryanodine receptor insecticide This belongs to phthalic acid diamide class. Shortly after the discovery of the phthalic diamides, the anthranilic diamides were discovered. This class has produced the insecticides Rynaxypyr(R) and Cyazypyr(TM).

Phthalic diamides

1. **Flubendiamide**

Flubendiamide, a phthalic acid diamide shows exceptional activity across a broad range of economically important lepidopterus pests i.e., Helicoverpa spp., Spodoptera spp., Plutella spp., Trichoplusia including including spp. and Agrotis spp. resistant strains. This insecticide cause cessation of feeding immediately and thus avoids crop damage by acting at insect muscle receptor. This unique mode of action makes the compound well suited as a tool in insect resistance management programmes.

Anthranilic diamides

1. **Chlorantraniliprole (Coragen, Rynaxypyr)**

Chlorantraniliprole shows broader insecticidal activity in comparison to flubendiamide, giving good control not only of Lepidoptera but also Coleoptera (beetles), Diptera (flies) and Isoptera (termites) species. it also exhibits mating disruption at sub-lethal doses. Successful commercialization of chlorantraniliprole leads to the control of Lepidoptera and other insect pests at very low application rates.

It can be a useful tool in the IPM of different insect pests of cauliflower Coragen is discovered and commercialized by Dupont crop protection, Field efficacy tests conducted around the world indicate that in addition to its outstanding efficacy on lepidopterian pests (Bassi et al., 2007). Coragen Protects vegetables, tobacco, sweet corn, potatoes, strawberries, mint, hops and other crops from a broad spectrum of Lepidopteran pests, including silverleaf whitefly nymphs (suppression), leafminer larvae, Colorado potato beetles and others. It provides fast Protection (Lepidopteran pests stop feeding within minutes after exposure) and minimal impact on bees and

other pollinators makes it ideal for IPM programs. This can be a valuable tool for the management of key whitefly species, providing inhibition of virus transmission and overall crop protection.

2.Cyantraniliprole

Cyantraniliprole is a cyano-substituted anthranilic diamides. This insecticide activity is much broader, affecting both chewing and sucking pests. It has improved plant systemic properties and control the pests from the wide range of orders like Coleoptera, Lepidoptera and Hemiptera.

Table 1. Diamides recommended for insect pest management in India.

Flubendiamide 39.35% M/M SC	Pigeonpea, Black gram : Pod borer complex
Chlorantraniliprole 18.5% SC	Soybean: Green Semilooper, stem fly, girdle beetle Pigeonpea, Black gram, Chick pea: Pod borer comple

CONCLUSION

Among different novel insecticides, Diamide insecticides have emerged as one of the most promising new classes of insecticide chemistry due to their excellent insecticidal efficacy and high margins of mammalian safety. However, if they allow secondary pests to gain primary pest status that lack effective natural enemies due to their high level of selectivity leads the need for other insecticides. Being a "reduced risk" pesticide, diamides are recommended as an alternative to pyrethroids for vegetables.

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Nutritional security and income generation through an integrated livestock farming system

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The livestock-based integrated system is one of the growing agricultural systems for the north-east region. This practice has been maintained in this region with conventional way since time immemorial. The basic ideology of this system is the productive recycling of agricultural waste. Different subsystems work together in an integrated operating system, resulting in higher total productivity than the total of their individual output. Fish farming and animal husbandry are the main concern of the Livestock based integrated farming system.

Fish - livestock farming systems

Fish farming facilities is extremely safe technology in which the predetermined amount of livestock manure obtained by raising cattle is applied to a pond to raise the fish farm without additional nutrient input. The main potential links between animal husbandry and fish production are the use of nutrients, in livestock manure for fish production. Primarily elements such as nitrogen (N) and phosphorus (P), which act as fertilizers to stimulate natural food webs rather than the nutritional use of livestock as food components. The direct use of animal waste is the largest and most widely recognized type of integrated agriculture. Production waste includes manure, urine and spilled food these are used as fresh inputs or treated in one way or another before use.Depending on the type of livestock used for integration, there are many combinations in livestock-fish systems. Some of the combinations are listed and explained below.

Cattle-Fish Culture

Watering a fish pond with cow dung is one of the common practices around the world. A healthy cow excretes more than 4,000 to 5,000 kg of manure, 3,500 to 4,000 liters of urine per year. Instead of raw cow dung, biogas sludge could be used with equally good production. Twenty to thirty thousand kilograms of biogas slurry are recycled in a 1 ha

water zone to obtain more than 4,000 kg of fish without feed or fertilizer application.Cow dung, is a rich source of natural food body and bacteria in the pond. A unit of 5-6 cows can provide enough fertilizer for 1 ha of pond,and provide about 9,000 kg of milk, along with 3,000 to 4,000 kg of fish / ha / year can be harvested.
The barn should be built near the pond to facilitate the handling of cow manure.

Pig-Fish system

Exotic breeds such as White Yorkshire, Landrace and Hampshire are reared in the pigsty near the fishpond The waste produced by 30-40 pigs equals 1 ton of ammonium sulfate.. However, pig sty can also be built at a nearby site, where pork rings and manure first enter the oxidation tanks (digestion chambers) of biogas plants for domestic methane production. The manure (mud) is then thrown into the fish ponds through small ditches that cross the pond gangs. Alternatively, pig manure can be piled up in localized ponds or applied to fish ponds by dissolving in water.
Pork manure contains over 70% digestible food for fish. Undigested solids in pig dung also serve as a direct food source for tilapia and carp. The optimum amount of pig manure per hectare was estimated at five tonnes for a one-year growing season. Fish such as grass carp, silver carp and carp (1: 2: 1) are suitable for integration with pigs.
Pigs reach the slaughter maturity size (60-70 kg) within 6 months and give 6-12 piglets in each litter. Her age at first maturity varies from 6-8 months. The fish reach a marketable size in one year. The last harvest is done after 12 months of breeding.

Poultry-Fish Culture

Poultry farming for meat (broiler) or eggs (layers) can be integrated into fish culture to reduce the cost of fertilizer and feed in fish culture and to maximize benefits. Poultry can be raised above or beside the ponds and the poultry excrement can be recycled to fertilize the fish ponds. Poultry houses, if built above the water level with bamboo poles, would directly fertilize fish ponds. In the integration of fish fowl, birds kept in intensive systems are considered to be the best. Birds are kept captive without access to the outside. Deep litter is well suited for this type of farming. An approximately 6-8 cm thick layer of chopped straw, dry leaves, sawdust or peanut shells are sufficient.
Poultry manure in the form of fully built-up dip-litter contains: 3% nitrogen, 2% phosphate and 2% potash, therefore it acts as a good fertilizer and used as fish food. This reduces the cost of fish production by 60%. In one year 25-30 birds can produce 1 ton of dip-litter and based on that it is estimated that 500-600 birds are enough to fertilize 1 ha of water-spreading area for good fish production. Every day at a rate of 50 kg / ha of water catchment area, poultry manure is applied to the fish pond. If phytoplankton blooms are seen above the surface water of the fishpond, the application of poultry manure to the pond should be stopped immediately. The integration of poultry and fish also maximizes the use of space, saves work.

Duck-Fish Culture

A fish pond, which is a semi-enclosed biological system with several aquatic animals and plants, provides an excellent disease-free environment for ducks. In return, ducks

eat frogs, tadpoles and dragonflies, creating a safe environment for fish. Duck dropping goes directly into pond, which in turn provides vital nutrients to stimulate the growth of natural foods. This has two advantages, there is no energy loss and fertilization is homogeneous. This integrated agriculture was followed in West Bengal, Assam, Kerala, Tamil Nadu, Andhra Pradesh, Bihar, Orissa, Tripura and Karnataka. The most common breed for this system in India is the "Indian runners".

It is very profitable as it greatly increases animal protein production in terms of fish and duck per unit area. Ducks are known as live fertilizers. Duck dropping contains 25 percent organic and 20 percent inorganic matter with a range of elements such as carbon, phosphorus, potassium, nitrogen, calcium, etc. Therefore, it forms a very good source of fertilizer in fish ponds for fish food organisms. In addition to fertilizing, ducks eliminate the unwanted insects, snails and their larvae, which can be the vectors of fish pathogens and water borne pathogens that infect humans. In addition, ducks also help in the release of nutrients from the bottom of ponds, especially when they move the banks of the pond.

In duck-fish cultures, the ducks can move freely on a regular basis or be placed in shielded resting places above the water. Floating pens or scales made of bamboo slats can also be hung in the pond for even fertilization. The ducks can be stored in these sheds in an amount of 15 to 20 / m^2. It is better if the ducks only stay in ponds until they reach a marketable size. Depending on the growth rate of ducks, they can be replaced once in two to three months. Ducks about 15-20 days old are generally selected. The number of ducks can range between 100 and 3,000 / ha, depending on the duration of the fish culture and the requirements of the manure.

In order to breed fish with ducks, it is advisable to release more than 10 cm large fish, as the ducks can otherwise feed on the young fish. The stocking density of juvenile fish also depends on the size of the pond and the number of ducks released. Because nitrogen-rich duck dung promotes both phytoplankton and zooplankton production, phytoplankton-feeding silver carp and zooplankton-feeding cats and carp are ideal for duck fish culture. Fish farming usually lasts one year, and at a stocking density of 20,000 / ha, fish production of 3,000-4,000 kg / ha / year was achieved in duck fish culture. Eggs and duck meat are also produced in good quantities every year.

Livestock-crop production system

An "integrated farm animal system" is a form of mixed production that uses crops and livestock to complement each other through space and time. The backbone of an integrated system is the herd of ruminants (animals such as sheep, goats or cattle)

grazing a pasture to build the soil. Eventually enough organic soil builds up to the point where the plants can be supported. Animal can also be used for farms and transports. While crop residues provide feed for livestock and crops provides additional feed for productive animals.

Animals play a key and multiple roles in the functioning of the farm, not only because they provide animal products (meat, milk, eggs, wool and skins) or can be turned into quick cash in emergencies. Animals also supply manure and other types of animal waste. Animal excretions have two crucial roles in the overall sustainability of the system:

• Improving the nutrient cycle: excretion contains several nutrients (including nitrogen, phosphorus and potassium) and organic matter essential for maintaining soil structure and fertility.

Provision of energy: Excretes are the basis for the production of biogas and energy for domestic use (eg cooking, lighting) or for the rural industry (eg mills and water pumps). Fuel in the form of biogas or dung cake can replace charcoal and wood.

A major benefit of livestock farming systems is that livestock can be fed with crop residues and other products that would otherwise be a major disposal problem. Adding slurry to the soil not only fertilizes but also improves the structure and water retention.

Over all Advantages of Integrated Farming System

1. **Productivity:** IFS offers the opportunity to increase the economic yield per unit of area per unit of time through the intensification of growers and related businesses, especially for smallholders and border farmers.

2. **Profitability:** Feed costs for livestock account for approximately 65-75% of total production costs; however, the use of waste material and its by-product reduces production costs, and vice versa, it is the same for crop production as fertilizer demand for harvested animal waste is provided. No additional fertilizer is needed to buy outside the farm as a result of the cost of ownership increases ratio and purchasing power of farmers thereby improves.

3. **Sustainability:** In the IFS, the subsystem of one waste or by-product serves as input to the other subsystem, and its by-product or by-products are organic in nature, providing the opportunity to sustain the opportunities of the production base much longer than monoculture ,

4**. Balanced nutrition:** All nutrient needs of humans are not found exclusively in individual foods. To meet these requirements, different foods must be consumed by the farmers. Such a requirement can be met by introducing IFS at the farmer level, allowing for different sources of nutrition.

5. **Environmental safety:** IFS effectively recycles waste by combining suitable components, minimizing environmental pollution.

6. **Recycling:** Effective recycling of products, by-products and wastes in IFS is the cornerstone of the sustainability of the agricultural system under resource-constrained conditions in rural areas.

7. **Income rounds the year:** Due to the interaction of companies with grains, eggs, meats and milk, cash flow offers year round farming community.
8. **Save energy:** Cattle are used as a means of transport in rural areas, more than cow manure is used as a burning material for cooking or biogas production, reducing dependence on gasoline / diesel or fossil fuels available source within the agricultural system to save energy.
9. **Meeting feed crisis:** By-products and crop waste materials are used effectively as feed for livestock (ruminants) and products such as cereals, maize is used as feed for monogastric animals (pigs and poultry).
10. **Job creation:** The combination of crops with livestock farms would significantly increase the need for work and help to substantially reduce the problems of underemployed workers.

CONCLUSION

It has been accepted by all around the world that sustainable development is the only way to promote the rational use of resources and environmental protection without hampering economic growth. Developing countries around the world promote sustainable development through sustainable agricultural practices that help them tackle socio-economic and environmental issues at the same time. Within the broad concept of sustainable agriculture, "Integrated Farming Systems" have a special position, because nothing is wasted in this system but becomes the by-product of one system as input to others. Integrated agriculture is an integrated approach to agriculture compared to existing monocultures. In addition, the system helps poor peasants, who have very small areas for the production of crops and a few ranchers, to diversify agricultural production, increase cash income, improve the quality and quantity of food produced, and use untapped resources.

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Oat- potential food and feed crop

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Cereal grains feed a large population around the world. They constitute a significant part of daily diet of the consumers. These contribute to over 60% of the world food production providing about 50% of protein and energy necessary for human diet. Oat is said to be unique among cereals, oat provide more protein, fibre, iron and zinc than other whole grains. The oat (*Avena sativa*) was domesticated around 2000 B.C. The hexaploid oats originated in the Hindu Kush region. However some considers the western part of the Mediterranean region (Morocco, Spain) as the primary centre of origin of oats. Oat (*Avena sativa* L.) is an important winter cereal crop in the world used as food, feed and fodder. It belongs to the family Poaceae & ranks sixth in the world cereal production following wheat, maize, rice, barley and sorghum. The bulk of the oats produced in the world are used extensively as feed for livestock and only 17% of the world production (grain) is used as human food. The multifunctional uses of oat include forage, fodder, hay, silage chaff, human food. They are usually winter sown, grazed prior to stem elongation and taken to maturity for use as feed and/or milling grains. Multiple cuts are usually taken, after which part or all of the crop may be saved for seed. The oat is now being preferred as food for good health as it is rich source of fibre and also has antioxidants properties. It is consumed primarily as a breakfast cereal. Oat is cultivated in European Union, Russia, Canada, Australia, United States, Ukraine, Belarus, China, Chile, and Argentina. . The total area, production and productivity of oat during 2016-17 were about 9.53 million hectares, 22.85 million metric tons and 2.50 metric tons per hectare, respectively in the world (USDA, 2018). European Union is the largest producer of oat followed by Canada and USA (USDA, 2018). In India, oat is grown on 100,000 hectares of area with productivity of 35-40 tonnes of green fodder per hectare. In India, oat is grown on 100,000 hectares of area with productivity of 35-40 tonnes of green fodder per hectare. It is grown in India from Himalayan region in north to Deccan plateau in south i.e. Punjab, Haryana, Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Rajasthan, Maharashtra and West Bengal. In these areas, Berseem is a popular crop but mainly for irrigated conditions. India supports nearly 20% of the world livestock and 16.8% human population on a land area of only 2.3%. Livestock population has increased substantially in Gujarat (15.36%), Uttar Pradesh (14.01%), Assam (10.77%), Punjab (9.57%), Bihar

(8.56%), Sikkim (7.96%), Meghalaya (7.41%) and Chhattisgarh (4.34%). There is tremendous pressure of livestock on the available total feed and fodder, as land available for fodder production has been decreasing. Most of the fodder crops are grown under irrigated situations except in areas, which receive adequate winter rains. Under such situation where water supply is limited and the farmers are not in position to grow the crops having high water requirement such as lucerne and berseem, oat can grow successfully. The livestock grain feed is still the primary use of oat crops. It can be fed as green forage or silage to the animals covering the scarcity period of the year.

NUTRITIONAL SIGNIFICANCE OF OAT

Oat has a well-balanced nutritional composition (Table 1). It contains much higher levels of lipids than other cereals which are excellent sources of energy and unsaturated fatty acids (Table 2). The fat content of oat ranges from 5.0 to 9.0 % of the total lipid content. The high lipid content of oat provides an advantage when used for animal feed as it provides high energy along with good fatty acid composition.

Oats contains a globulin (legume-like protein) avenalin, as the major (80%) storage protein and only a small proportion of water soluble albumins and alcohol soluble prolamin. Phenol compounds present in oats and its by-products have a considerable antioxidant potential. Oats comprises a very balanced profile of both soluble and insoluble dietary fibres. Soluble fibre, β-glucan, has been proven to help lower cholesterol. A high intake of dietary fibre in oat has beneficial effects including reduced blood sugar level, decreased level of plasma cholesterol, increased faecal bulk and improved large bowl function. Oat protein is nearly equivalent in quality to soya protein, which World Health Organization research has shown to be equal to meat, milk, and egg protein. The protein content of the hull-less oat kernel (groat) ranges from 12 to 24%, the highest among cereals. The fat, ash, calcium and iron content in oat are also much higher than corresponding values present in other cereals (Table 3). Fodder of oat has been rated as one of the best among the cereals.

Table 1 Nutritional composition of oat

NUTRIENTS	WHOLE GRAIN OAT
Energy	1.628kJ (389Kcal)
Carbohydrates	66.3g
Protein	16.9g
Total dietary fibre	10.6g
β - glucan (soluble fibre)	4g
Tryptophan	0.365g
Leucine	2.003g
Lysine	1.094g
Methionine	0.487g
Phenylalanine	1.396g
Arginine	1.860g

Alanine	1.374g
Glutamic acid	5.791g
Glycine	1.312g
Proline	1.457g

Table 3 Mineral content in 1 cup oat (156 gm) (USDA, 2005)

Ash	~3.5%
Calcium	84 mg
Iron	7.36 mg
Magnesium	276mg
Potassium	669 mg
Zinc	6.19 mg
Manganese	7.669 mg

Table 2 Lipid composition of oats (USDA, 2005)

Lipids 1 cup oat (156 gm)	
Fatty acids, total saturated	1.889g
12:0	0.037g
14:0	0.023g
16:0	1.613g
18:0	0.101g
Fatty acids, total monounsaturated	3.398g
Fatty acids, total polyunsaturated	3.955g
18:2 undifferentiated	3.781g
18:3 undifferentiated	0.173g
Cholesterol	0 mg

Table 4: Nutritional value at 50 % flowering stage

Crude protein	Neutral detergent fibre	Acid detergent fibre	Cellulose	Hemicellulose
10-12%	55-63%	30-32%	22-23.5%	17-20%

USES OF OATS

Animal feed

Livestock feeding is the main use of oat forage. Oat contains 10-12 % crude protein, 22-23.5% cellulose (Table 4). Oat is an important winter fodder, mostly fed as green but surplus is converted into silage or hay to use during fodder deficit period. It is a preferred feed of all animals and its straw is soft and superior to wheat and barely. The nutritive value of oat forage is high and dry matter digestibility is in excess of 75 per cent when fed to dairy cattle. The cereal straws have almost similar chemical composition but oat straws have more digestible organic matter and metabolizable

energy. It has excellent growth habit, quick recovery after cutting and provides good quality herbage.

Human Food

The use of oats for human consumption has increased progressively, owing to emerging use and interest in oats as human health food. Oat is considered to be a nutritious source of protein, carbohydrate, fibre, vitamins, and minerals as well as of compounds with beneficial effects on health. Health effects of oat rely mainly on the total dietary fibre and *β*-glucan content. Daily intake of 3 g of soluble oat β-glucan can lower the risk of coronary heart disease, reduce blood pressure and reduce blood cholesterol level. Oatmeal is chiefly eaten as porridge; Porridge is good source of manganese, which is essential in allowing the body to produce energy as well as helping to build bones and connective tissue. It also contains zinc, which is needed for normal growth, sexual development and reproduction and a healthy immune system. Oat bran i.e. outer casing of the oat, consumption is believed to lower LDL cholesterol, and possibly to reduce the risk of heart disease. Oat can also be used to make variety of baked goods, such as oatcakes, oatmeal cookies, and oat bread. Oat grass has been used traditionally for medicinal purposes; including helping balance the menstrual cycle, treat dysmenorrhoea, and urinary tract infections.

PRODUCTION TECHNOLOGY OF OAT

Oats are well adapted to cooler environment. Its optimum growth is attained in sites with 15-25º C temperature in winter with moist conditions. Although, it can tolerate frost up to some extent but its fodder yield and quality is reduced due to hot and dry conditions.

Soil and land Preparation:

Oat is successively cultivated in different soils. Although oats are widely adapted to loam to clay loam soil with adequate drainage. They produce satisfactory yields on heavy or light soils with proper moisture. It can be grown under moderate acidic or saline conditions also. Two to three operations by harrow or cultivator followed by planking are sufficient to destroy weeds and create the desired tilth.

Sowing Time:

Normally oat sowing should be started in early October to end of November in North-West to East zone of the country. For regular supply of fodder from December to March, scattered sowing is advocated.

Seed Rate and Sowing Method:

A seed rate of 70-80 kg/ha is recommended for uniform stand in oats however bold seeded variety like kent require 100-125 kg seed/ ha. Low tillering varieties should be sown with 20-25 cm row spacing while higher tillering type should be sown 30 cm apart. Sowing of seed should be preferably be done in line with seed drill or pora/ kera behind the plough.

Manure and fertilizer

The crop may be manured with 15 tonnes of FYM 10-15 days before sowing. In addition to this application of 80 kg N. 40 kg P_2O_5/ha to single cut and a dose of 120 kg N, treatment with Thiram@3gm/kg of seed reduces the infestation of these diseases. In double and multicut varieties, top- dressing of 40 kg N/ha after first cut and to equal split doses of 40 kg N/ha after first and second cut should be done respectively.

Irrigation:

Oats require 4-5 irrigations including the pre-sowing irrigation. If soil is dry, first irrigation is given before preparing the seedbed. Next irrigation may be given at 20-25 DAS. Timely irrigation improves the tillering remarkably, which contributes to higher forage yield. In total 3-4 irrigation for single and 7-8 irrigation for multicut varieties are needed.

Weed Control:

Oat is infested with winter season grassy and broad-leaved weedy mostly found as in wheat. Effective control of weeds in oats can be obtained with weeder cum mulcher at 4 week crop stage followed by application of 2,4-D@ 0.37kg a.i./ha at 6 weeks crop stage.

Pest and Diseases

Root rot and leaf blotch are major disease in oat. Root rot characterized by yellow and stunted growth of young shoot, in severity embryo or the young seedling may be killed. In leaf blotch long brick red blotches appear on young plants in third & fourth leaf stage seed treatment with Thiram@3gm/kg of seed reduces the infestation of these diseases. In addition of diseases aphid also cause damage to crop by sucking cell sap resulting mottling and distortion of leaf may occur. Application of Dimethonate 30 EC@0.03% prevent aphid attack care should be taken that do not feed the fodder to animal at least 10 days after spray.

Harvesting:

Proper stage of harvesting determines the herbage yield and quality of Oat. The harvesting of single cut oat varieties is done at 50% flowering. In double cut varieties, first cut should be taken at 60 days followed by second cut at 50% flowering stage.

Yield:

The average green fodder yield from single, double and multi- cut varieties of oat ranges from 30-45, 40-55 and 45-60 tonnes/ha respectively. If crop is left for seed, 25 tonnes/ha green fodder from first cut and 2.0-2.5 tonnes/ha seed and 2.5-3.0 tonnes/ha straw is obtained.

OAT BASED CROPPING SYSTEMS

Sorghum-oat- maize
Maize – oat- maize
Cowpea –oat + mustard –maize + cowpea
Sorghum + cowpea –oat + Lucerne

IMPROVED VARITIES OF OAT

Oat is traditionally being cultivated under low input condition by small and marginal farmers. To boost the production and productivity in oat 23 high yielding varieties have been developed and released for different agro-climatic condition regions of the country by various institute / universities. Varieties Bundel Jai- 822, Bundel Jai- 851, Bundel Jai 992 (JHO 99-2), Bundel Jai 2004 (JHO 2000-4), Bundel Jai 991 (JHO 99-1), Bundel Jai 2001-3 (JHO 2001-3) were developed by IGFRI, Jhansi. Similarly HJ-8 for dual cut, OS-6, OS -7 both single cut for temperate and sub- tropical region was developed by CCS HAU, Hissar. OL-9 for north, north-west and south hills, OL-125 for north-west and central zone of country, suitable for single/multi cut. Sabzaar (SKO -7) for temperate region of Kashmir & high altitude region of Jammu by SKUA&T, Srinagar. UPO-212 under multi cut system, UPO -94 by GBPUA&T, Pantnagar for north & central India.

SUMMARY

Oat has the potential of the nutritious crop to boost livelihoods and improve health and nutrition of the poor farmers. Oat creates a high amount of nutritionally valuable biomass, which can be fed to domestic animals as forage or fodder. Micro-entrepreneurs are essential to the process of adding value. Wide ranged public awareness activities are required for sensitizing consumers of urban and rural areas about the health benefits of oat. With development and popularization of improved varieties the yield potential of crop have increased many fold and rekindle the interest of farmers in cultivation of crop. Keeping in view the challenges of climate change crop like oat needed to be promoted through government by providing favourable policies for such crops.

CONCLUSION

Nutritionally oats are superior to the cereals. Compared with other cereals oats contain a high percentage of protein and balanced composition of amino acids. Oat is primarily grown for feed and forage, fodder of oat has been rated as one of the best among the cereals. Health effects of oat rely mainly on the total dietary fibre and β-glucan content.

Plastic-ware: A long-term effect on the environment and human health issues

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Abstract

A worldwide used compound named as plastics are available in a various forum (Polyethylene Terephthalate, High-Density Polyethylene, Polyvinyl Chloride, Low-Density Polyethylene, Polypropylene, and Polystyrene) and have huge applications in Textile fibers, Packaging, Electronics, Automotive, Infrastructure and Agriculture etc. Globally, the rate of production is 335 million tonnes in 2016 and further the production it will gradually increasing due to the rise of demand for plastics items day by day. With the massive consumption and improper disposal, the waste can go directly to the environment which remains as such in many years without decomposing which will further effect on the land and water quality as well as human health significance. Micro-plastics can store as a residue in the body of aquatic animals which may cause a Bio-magnification, Bioaccumulation, and Bio-concentration. A boycott of plastic product is not a way to eradicate this problem because we may, directly and indirectly, depend upon it. To reduce the consumption of plastics and use of brown bag instead of polythene and proper disposal activities and reuse of plastics may reduce the effect of plastics to some extent. This may only possible to combined the efforts of Public, Government bodies, NGOs and other agencies have mutual understanding and making effective strategies/policies and new technologies like plasma pyrolysis which enhancing towards the green environment, adoption of biodegradable plastics. To get the effective result regularly monitoring are required whether its implemented properly or not.

INTRODUCTION

Globally, a material named plastic is widely used around the world and play a crucial role in shaping our day need products. In the ancient period (1600 BC), the Mesoamericans were first processed natural rubber into ball and bands (Hosler *et al.,* 1999). In 1839, the American chemist Charles Goodyear who developed vulcanized rubber which pliable, waterproof moldable rubber with the help of chemical process and accidentally discovery of polystyrene from storax (the resin of the Sweetgum tree) by Eduard Simon in 1839 (Scheirs *et al.,* 2003). Over the nineteenth century, modern thermoplastic began and demand was surprisingly high due to inexpensive, lightweight, corrosion resistant, durable, elastic and high thermal properties. In 1907, the Belgian-American chemist Leo Baekeland was made first plastic named as Bakelite from synthetic components. According to the report of PlasticsEurope 2017, the annual global production of plastic material in the 2015 and 2016 was 322 and 335 million tonnes respectively. With the FICCI statistics (2017), the current per capita

consumption rate was highest in the USA 109 kg/person followed by Europe 65kg, China 38 kg, Brazil 32kg and India 11 kg respectively.

Types of plastics and its uses

Plastic has become the crucial resource for humanity, often provide functionality, economically viable and hard to replace by other material. The plastic industry supplies different kinds of daily usable items and fulfills our need such as clothing, housing, construction, furniture, automobiles, household items, agriculture, horticulture, irrigation, packaging, medical appliances, electronics and electrical items in entire life. To identify different types of plastic by consumers and recyclers, the Society of the Plastics Industry (SPI) established a classification system in 1988 with an SPI code or number, on each plastic product, usually on the bottom. Classification of plastics and their uses are given in Table 1.

Impact on the environment

One of the widely used materials, Plastic has a major effect on the environment due to their excessive consumption and non-biodegradable nature. Untreated Dumping of Byproducts coming from the Plastic industries can lead to serious damage to air, land and water pollution due to their heavy load of toxic chemicals and metals ions which can enter into the soil, atmosphere and aquatic environment. With the time passes, they substance remain as such in toxic form and cannot decompose which further affect the food chain in human as well as in animals. The consumption of plastic in India is increasing gradually and its waste which already explores the natural environment. Due to its non-biodegradable property, there is no such safe way to dispose of the plastics. Some of the material such as Low-density polyethylene, High-density polyethylene, Polyvinyl chloride, Polyethylene terephthalate, Polypropylene and Polystyrene have major conflicts like stuck in the sewage pipes, release toxic chemicals, non-biodegradable, disrupt the habitat of plants and animals, destroy the breeding ground of many fishes, create pollution in the inland as well as marine ecosystem, make a residue in the body of consumer, accidentally ingest by birds and animals such as, fish can confuse between plastic pellets and plankton, many birds may eat pieces of plastic for small fish and cuttlefish (Derraik J.G.B, 2002 and Gregory M.R, 2009), degrade soil quality and pollute the drinking water.

Impact on the human health

Many of the plastics such as bisphenol A and phthalates have a health impact like particular effect to the endocrine system, to create a tumor, lung infection during inhaling, choking, digestion problem, inflammation, irritability and hormonal derangements on human and animals after the ingestion. The chemical could accumulate in the body through most likely pathway ingestion in the food chain and make it into larger form in the top by the bio-magnification process (Science for Environment Policy 2011). A packaging of hot edible items by plastics bags that contain styrene which is carcinogenic can react with food and migration of the harmful chemical (Sung G.B, 2010).

Table: 1 Types of Plastics, properties and their uses.

Sr. No.	Plastic type	Year	Discovered By	General properties	Common household uses
1.	**Polyethylene Terepthalate (PETE)**	1941	John Rex Whinfield and James Tennant Dickson	High heat resistant, Hard and Solvent resistant	Mineral water, fizzy drink and beer bottles, Fiber for clothing and carpets, Packaging shampoo and mouth wash bottles etc.
2.	**High Density Polyethylene (HDPE)**	1953	Karl Ziegler and Erhard Holzkamp	Moisture barrier properties, Chemical resistance, Soft waxy surface Permeable to gas and HDPE films crinkle to the touch	Detergent, bleach and fabric conditioner bottles, Snack food box and cereal box liners Toys, buckets, rigid pipes, crates, plant pots, Compost containers and garden furniture etc.
3.	**Polyvinyl Chloride (V)**	1872	Eugen Baumann	Excellent transparency, Hard, good chemical resistance, long term stability, stable electrical properties and low gas permeability	Credit cards, carpet backing and floor covering, window and door frames guttering, pipes and fittings, wire and cable sheathing and synthetic leather products.
4.	**Low Density Polyethylene (LDPE)**	1933	E. W. Fawcett and R. O. Gibson	Tough and flexible, waxy surface, good transparency, low melting point and stable electrical properties.	Films, fertilizer bags, refuse sacks, packaging films, bubble wrap, flexible bottles, shopping bags, wire and cable etc.
5.	**Polypropylene (PP)**	1954	Giulio Natta	Excellent chemical resistance High melting point, waxy surface and translucent	Most bottle tops, ketchup and syrup bottles, yogurt and some margarine containers, potato chips bags, biscuit wrappers, crates, plant pot, drinking straws, hinged lunch boxes, refrigerated containers, fabric/ carpet fibers, heavy duty bag.
6.	**Polystyrene (PS)**	1839	Eduard Simon	Clear to opaque, glassy surface, rigid, hard, brittle, high clarity and affected by fats and solvent	Yogurt containers, egg boxes, fast food trays, video cases, vending cups, disposable cutlery, seed trays and coat hangers etc.

Disposal activities

Plastics have a major ecological impact if it disposes of an unintended way like landfills. However, disposal of plastics by landfilling are considered to be irrelevant as it requires a large amount of space and the chemical constituents which react with the soil and degrade its quality. For instance, the energy contained in plastic is lost in this disposal route. A precaution must be taken during the landfills, make sure the areas are far away from the city as well as agricultural crop. Another method of disposal is incineration, plastics waste provide a high stored energy than any other waste. In fact, one pound of plastic can produce as much energy as Wyoming coal and almost as much energy as fuel oil. However, the incineration method tends to have a negative impact on the environment and human health due to a release of obnoxious gases and toxic compound such as carbon monoxide, chlorine, Hydrochloric Acid, Dioxin, Furans, Amines, Nitrides, Styrene, Benzene, 1, 3-butadiene, CCl4, and Acetaldehyde, nitrogen dioxide, sulfur dioxide, and phosgene are etc. These gases may degrade the air quality and cause air pollution. One of the best methods to deal with the plastics is to be reused; the method is not fully utilized due to difficulties with the collection and sorting of plastics waste. The amount of recycled the plastics is highly depended upon the public awareness, economic viability, and availability of the infrastructure where recycle the plastics waste and facilities to the public like recycle bins and waste collecting trucks. To overcome this problem, biodegradable plastics are used such as polyhydroxyalkanoate (PHA) instead of toxic chemical-based plastics. These plastics can decompose by the action of the living organism and to solve the numbers of problems related the waste management, especially for disposable packaging that hard to be separated from organic waste. The biodegradable plastics are the progressive approach to a green environment, healthier and to overcome the plastics problems but due to a high cost of production, the techniques are not being widely used on the mass level.

Case study

In CPCB 2007, management of plastics waste management particular related with manufacture, use, and recycle the product is come under the “Recycled Plastics Manufacture and Usage Rules”, 1999 and as amended in 2003. This has now been replaced by Plastic Waste Management and Handling Rules, 2016. In 2012, Tamil Nadu pollution control board, and Panchayat of Madukkarai village (Tamil Nadu) considered to improve the waste management and move towards the zero landfills concept. The segregation of households waste and making compost from the organic matter and use of non-recyclable plastics, rubber, leather and soiled cloth in roads construction and remaining non-recyclable material called as non-recyclable Segregated Combustible Fraction (SCF) is sent across to the ACC limited plant for making a cemented kilins (CPCB plastic waste report, 2017).

CONCLUSION

Nowadays, plastic waste is one of the major problems in the community like lack of decomposition capabilities in India as well as worldwide which have negative impacts on ecosystem and rise human health issues. To reduce the effect of plastic, numbers of government agencies like central Pollution Control Board, Bureau of Indian Standards, State Control Pollution Board and NGOs are working together with their new policies and amendments with the effective and sustainability way such as to avoid the use of plastic bottles, canned foods and drinks, polythene bag, plastics water bottles, cling wraps and plastics containers and to keep the environment green and safe from the plastic hazards. Adoption of new technology like plasma pyrolysis technology can reduce the plastic waste and converted the gaseous form which further used as energy for Thermal work. For instance, there is need to be established the effective policies and acts/ guidelines regarding plastic waste management are to be implemented properly. Through, this way can enhance the quality of lithosphere, atmosphere and hydrosphere resources (free from contamination) and be making new strategies for further with respect to rectify the plastics waste issues.

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Pulse revolution: a need of hour

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ABSTRACT

India has attained self-sufficiency in food production as a result of impressive growth in Indian agriculture sector, but failed to ensure household food and nutritional security due to its imbalanced growth. Though India has achieved a considerable growth in production of pulses from 8.41 MT in 1950-51 to 17.3 MT in 2014-15, it is very meager when compared with the growth in food grain production, which was only 50.82 MT in 1950-51 which has sky rocketed to 251.12 MT in 2014-15. Hence, growth in total pulses production is not on par with the population growth of India over the years. Pulses are the major and cheap sources of protein in Indian diet. Besides, pulses are environmental friendly and resource conserving, as it requires very less water compared to all other crops. Therefore, increasing the production of pulses with other food crops and cash crops production would act as a solution for problems like nutritional security and water scarcity. This paper focuses on the significance of pulses in food consumption and nutritional security in India. Pulses are gradually shifting away from the dietary pattern of the population, which is occupied by fruits, vegetables, processed food and food items of animal origin. This negative growth in the consumption of pulses leads to a decline in protein intake which would increase malnutrition, particularly among the children and the women. So, a revolution to increase pulse production and measures to increase the availability of pulses by adopting various innovative measures like institutional and policy support, development and wider adoption of HYV and low cost technologies, proper extension services for production and marketing of pulses, development of value chain would support in ensuring the nutritional security of the growing population.

Key words: Pulses, Nutritional Security, Dietary pattern, Malnutrition

INTRODUCTION

Food and nutritional security is said to be achieved when adequate food (quality, quantity, safety, socio-economic acceptability) is available and accessible for and satisfactorily used and utilized by all individuals at all time to live a healthy and active life (UNICEF, 2008). The impressive growth of Indian agriculture in no doubt has helped the country to achieve self-sufficiency with respect to availability of food grains at national level. The estimates suggest that India is likely to be the most populous country on the planet by 2020 with a population of 1.39 billion. India is a house for 445 million poor i.e. 35 percent of Indian are living on less than $1.25 a day. Half of the pregnant women are anemic in India, while in the case of children under the age of five years, 74

percent are reported to be anemic and 43 percent underweight (World Bank, 2012). Hence, ensuring household food and nutritional security is still a challenge for the country, particularly when a huge proportion of 1.2 billion people are poor and malnourished.

The growth of agriculture in India may help immensely in improving food and nutritional security as agriculture plays a key role in increasing the food availability and higher realization of income, support livelihoods of major proportion of population and contribute to the overall growth of the economy (World Bank, 2008). However, imbalanced growth of agriculture may also lead to continued malnutrition. The Green Revolution of mid 1960s, regarded for revolutionizing Indian agriculture, has been biased towards wheat and rice.

Pulses are the major and cheap sources of protein in Indian diet. Besides, pulses are environmental friendly and resource conserving, as it requires very less water compared to all other crops. Therefore, accelerating the pulses production with other food crops and cash crops production would act as a solution for problems like nutritional security and water scarcity. Though the proportion of pulses have shown some sign of recovery during the last decade owing to various government policies, still much progress could not be made in terms of availability of pulses. Inefficient marketing and relatively higher prices of pulses further aggravates the problem of poor availability of pulses leading to malnutrition. This paper focuses on the significance of pulses in food consumption and nutritional security in India. Pulses are gradually shifting away from the dietary pattern of the population, which is occupied by fruits, vegetables, processed food and food items of animal origin. Hence, a revolution to increase pulse production and measures to increase the availability of pulses by adopting various innovative measures like institutional and policy support, development and wider adoption of HYV and low cost technologies, proper extension services for production and marketing of pulses, development of value chain would support in ensuring the nutritional security of the growing population.

This paper focuses on

1. The trend in production, productivity and per capita availability of pulses in India.
2. The consumption pattern of small, medium and large income households based on nutrients
3. The nutrient composition in various commodities including both vegetable and animal sources

METHODOLOGY

Secondary data on production and productivity has been collected from agricoop website. Food consumption pattern of various income groups has been collected for NSSO reports (different issues). Descriptive Statistics has been used for analyzing the data. Average, compound annual growth rate (CAGR) has been calculated.

RESULT AND DISCUSSION

Table 1: Production Status of Pulses and Food Grains in India

	Total food grains			Total pulses		
Year	Area	Production	Yield	Area	Production	Yield
1950-51	97.32	50.82	522	19.09	8.41	441
1960-61	115.82	82.02	710	23.56	12.7	539
1970-71	124.32	108.42	872	22.54	11.82	524
1980-81	126.67	129.59	1023	22.46	10.63	473
1990-91	127.84	176.39	1380	24.66	14.26	578
2001-10	121.05	196.81	1626	20.35	11.08	544
2010-11	125.73	244.49	1921	26.28	18.24	694
2014-15	122.07	252.68	2070	24.52	17.52	714
CAGR	0.0039	0.0280	0.0240	0.0043	0.0127	0.0083

Source: Directorate of Economics and Statistics, DAC&FW

Area in Million Hectares; Production in Million Tones; Yield in Kg. /Hectare

Table 1 depicts the status of area, production and yield of total food grains and total pulses in India from 1950-51 to 2014-15. It can be observed from the table that there is a huge improvement in area, production and yield from 1950-51 to 2014-15. In case of total food grains, the cultivated area was only 97.32 million hectares in 1950-51, which has improved to 122.07 hectares in 2014-15 with a compound annual growth rate (CAGR) of 0.39 per cent. In addition to the cultivated area, production has also shown an improvement from 50.82 mt in 1950-51 to about 252.68 mt in 2014-15 with a CAGR of 2.8 per cent. Similarly, the growth in yield has also increased over the years. Between the years (1950-51 to 2014-15) the CAGR of total food grains yield is about 2.4 per cent and at present, the productivity rate is about 2070 kg/ha which was only 522 kg/ha in 1950-51.

In case of total pulses, the cultivated area was improved over years from 19.09 million hectares in 1950-51 to about 24.52 million hectares in 2014-15 with a CAGR of 0.43 per cent. Production has also enhanced over years 8.41mt in 1950-51 to 17.52 mt in 2014-15 but with a very miserable CAGR (1.2 per cent). Although there is an increase in the yield of total pulses from 441 kg/ha (1950-51) to 714 kg/ha, the compound annual growth rate (0.83 per cent) is not on par.

India has achieved a considerable growth in production of pulses over years. However, it is very meager when compared with the growth in total food grain production, which was only 50.82 mt in 1950-51, has been sky rocketed to 252.68 mt in

2014-15. Hence, more emphasis must be given for enhancing the technology which would possibly help in increasing the production and productivity of pulses.

Table2: Water Requirement of Various Crops

S.No	Crops	Duration in Days	Water Requirement (mm)	No. of Irrigations
1	Rice	135	1250	18
2	Groundnut	105	550	10
3	Sorghum	100	350	6
4	Maize	110	500	8
5	Sugarcane	365	2000	24
6	Ragi	100	350	6
7	Cotton	165	550	11
8	Pulses	65	350	4

Source: TNAU, Agritech Portal

Table 2 expounded the water requirement of various crops. Cereals and Sugarcane requires more amount water (1250mm and 2000mm) when compared to millet and pulses. It is evident from that table that, pulses require comparatively very less amount of water and no. of irrigation required is only four. In forthcoming years, there is a chance for water scarcity in India. Hence it is better to concentrate on less water consuming crops. Among which pulses is one of them. Therefore, revolution in pulses is essential for nutritional security and water scarcity.

Table3: Per Capita Availability of Total Pulses in India over years

Year	Per Day (Gram)	Per Annum (Kg)
1951	60.7	22.1
1961	69.0	25.7
1971	51.2	18.7
1981	37.5	13.7
1991	41.6	15.2
2001	30.0	10.9
2011	43.0	14.4
2012	42.6	15.2
CAGR (%)	-0.55	-0.58

Source: eands.dacnet.nic.in

Though the production and productivity has been increased over the years, growth in the total pulse production is not on par with the population growth of India. Food grain production and productivity has increased due to the technological efficiency and impressive growth in agriculture sector. The per capita availability of pulses which was 22.1 Kg in 1950-51 has decreased to 15.2 Kg in 2012 (Table3). Per capita availability has decreased over the years even though there is an improvement in the production and productivity of total pulses, which implies that, more importance has to be given for enhancing the productivity of pulse crops.

Table4: Proximate Composition of Pulse Grains (Per 100g)

Pulses	Energy (Kcal)	Protein (g)	Fat (g)	Carbohydrate (g)	Total Dietary Fiber (%)
Bengal gram	368	21.0	5.70	61.0	22.7
Red gram	342	21.7	1.49	62.0	15.5
Black gram	347	24.0	1.60	63.4	16.2
Green gram	345	25.0	1.10	62.6	16.3
Masur	346	27.2	1.00	60.0	11.5
Field pea	345	25.1	0.80	61.8	13.4
Rajma	345	23.0	1.30	63.4	18.2
Cowpea	346	28.0	1.30	63.4	18.2
Horse gram	321	23.6	2.30	59.1	15.0
Moth bean	330	24.0	1.50	61.9	-

Source: Pulses for Human Health and Nutrition, Indian Institute of Pulses Research

Table 4 represents the proximate composition of various pulse grains. It is clear from the table that we can get ample amount of nutrients from pulses itself. For instance, from 100g of chick pea, we can gain nearly 368 Kcal of energy. Likewise, we can acquire 28g of protein from cow pea, 5.70g of fat and 22.7 per cent of dietary fiber from chickpea. Hence, there is no need of nutrients from other sources like meat, fish etc. which is very costly and exorbitant to low income people and it could be possible to depend solely on pulses for all the nutrients.

The quantity of pulses consumed determines the quantity of intake of different nutrients by the household. From Table 5, it is estimated that high income households have obtained 198.63 grams of protein in a month through consumption of pulses and pulse products. It was higher as compared to the middle (143.92 grams) and low income (108.20 grams) households.

Likewise, the intake of fat & energy through consumption of pulses was also higher by the high income households than the middle and low income households. Red gram was the most important source of protein and energy for all the income categories of

households contributing more than 25 per cent of total protein consumption through pulses.

Table5: Share of nutrients in different pulses in low, middle and high income households in India (Grams/Kg)

Nutrients	Red gram	Bengal gram	Green gram	Masur	Black gram	Peas	Other pulses	Total nutrients
Low-income households								
Protein	32.91	3.93	10.12	26.37	12.34	17.24	5.3	108.20
Fat	2.51	1.06	0.5	0.74	0.72	0.96	0.29	6.77
Energy	494.37	70.3	143.73	360.31	178.35	275.62	81.89	1604.57
Middle-income households								
Protein	51.83	7.72	23.08	27.59	19.4	7.71	6.6	143.92
Fat	3.95	5.5	1.13	0.77	1.13	0.43	0.36	9.85
Energy	778.54	1084.64	327.82	377.01	280.42	123.23	102.05	2127.17
High-income households								
Protein	72.2	14.78	37.8	24.29	33.07	4.65	11.63	198.63
Fat	5.5	3.98	1.85	0.68	1.93	0.26	0.63	14.84
Energy	1084.64	264.35	536.94	334.73	478.2	74.37	179.73	2952.97

Source: Umanath et al (2016) Consumption Pattern & Nutritional Security intake of Pulses by segregated income Groups in India

Followed by red gram, Masur and peas were the major sources of protein for low income households. In case of middle and high income households, green gram, Masur & black gram contributed to total protein intake after red gram. Despite being cheapest source it is not available to low income groups. The reason may be because of lower per capita availability.

Table 6: Cost of Protein from Different food Commodities

(Rs. /kg of Protein)

Food Commodity	Rural	Urban
Peas	154	192
Lentils/ Masur	208	223
Gram (chickpea) flour	217	226
Black gram (urad)	235	259
Green gram (moong)	259	284
Pigeon pea/arhar/tur	260	290
Egg	447	437
Chicken	447	463
Beef/Buffalo meat	490	478
Milk	613	731
Fish/Prawn	611	758
Goat meat/Mutton	1094	1220

Source: Government of India (2016), based on NSS survey, 68th Round

Table 6 designates the cost per Kg of protein from different food commodities in rural and urban areas. It is evident from the table that, the cost per Kg of protein

obtained from pulses is not as much of other protein sources such as chicken, meat and fish products. For instance, the cost per Kg of protein from pulses ranges from Rs.100 to Rs.260. But in case of meat and meat products the cost per Kg of protein is extravagant. Hence, pulse is the cheapest source of protein in India.

CONCLUSION

To sum up, pulses are important for the daily diet of majority of the Indian population. In recent years, the food consumption is changing, which move towards more intakes of fat and reduction in the intake of protein. Further, consumption of food products of animal origin like milk, meat, cheese, etc. is increasing over the years. Though there is an improvement in the production and productivity of pulses over the years, it could not compete with the population growth. As a result, per capita availability of pulses is decreasing over the years. Besides, pulses are eco-friendly, which consumes less water during the growing period and enriches the soil by atmospheric nitrogen. By considering all the results, the paper concludes that a technical and technological revolution is essential to improve the nutrient security of Indian population.

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Secrets of Indian herbs

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India is one of the twelve mega biodiversity centers having about ten per cent of the world's biodiversity wealth which cover over 19.49 per cent of total geographical area of India, which is distributed across sixteen agro-climate zones of the Country. Out of 17,000 species of higher plants reported to occur within India, 7500 are known to have medicinal uses which are being used by several ethnic communities in India. Whereas, non-timber forest produce accounts to seventy per cent of India's forest product exports and the demand for photochemical products is expected to increase in future as a new frontier for trade.

India has probably the oldest, richest and most diverse cultural traditions in the use of medicinal plants. According to estimates, the Trans-Himalayas possess 700, Himalaya regions 2500, Desert areas 500, Semi-arid areas 1000, Western Ghats 2000, Deccan Peninsula 3000, Gangetic Plain 1000, North-East India 2000, Islands 1000 and Coasts 500 medicinal plants. These plants are the secret of Indian health from more than 3000 years. Ayurveda, the oldest medical system in the Indian sub-continent, has alone reported approximately 2000 medicinal plant species, followed by the Siddha and Unani therapy. The Charaka Samhita, an age old written document on herbal therapy, reports on the production of 340 herbal drugs for curing various ailments. Currently, approximately 25 per cent of drugs are derived from plants, and many others are synthetic analogues built on prototype compounds isolated from plant species in modern pharmacopoeia. More than 7.00 lakh practitioners of Ayurveda, Siddha, Unani, Yoga, Naturopathy and Homeopathy are registered in the Indian systems of Medicine and also sizeable numbers of practitioners are yet to be registered.

Figure 1 Traditional way of producing Herbal Products (Ref; https://ayurbethaniya.nowfloats.com)

There are 9493 manufacturing units, 22,635 dispensaries and 1335 hospitals of the Indian systems of Medicine. Approximately 800 species of the medicinal plants are in active trade and but still there is a wide gap of 40,000 metric tons in the demand and supply of medicinal plants. The major source of medicinal plants is from forest, and about 90 per cent of medicinal plants are collected from the wild, which generates about 40 million man days of employment (Ved and Goraya, 2007).

Exploration for forest based plant produce for new pharmaceuticals and the demand for medicinal plants are increasing in both developing and developed countries. Surprisingly, the bulk of the traded material is still from the wild and a very small number of species are cultivated. According to the data compiled by the International Trade Centre, Geneva, India is one amongst the top exporting countries, after China.

Recent trends have indicated further increase in this trade with the herbal cosmetic industry, which plays a major role in fuelling the demand for herbals worldwide. Indian skin lightening market valued worth of $ 191 million, with an annual growth rate of 16 per cent. Fairness is the largest and most important segment in the skin care category, standing at Rs. 434 crores as of 2008 and growing at a phenomenal 18 per cent. A recently conducted survey reports that, there is a huge potential market for whitening products among the age groups of 25-40. There would be around 100 per cent increase in demand for these products. In addition to the international trade, there is a substantial volume of internal trade of medicinal plants in India.

As per the estimation by National Medicinal Plants Board, New Delhi and Foundation for Revitalization of Local Health Traditions, Bangalore the annual demand for botanical raw drugs (Dry Wt.) during 2005-06 by Herbal Industry is 1.77 lakh metric tons, Rural households 86,000 metric tons, Exports 56,500 metric tons which amounts to 3.19 lakh metric tons, which accounts for an Annual Trade value of Rs. 627.90, 86.00, 354.80 and 1068.70 crores, respectively (Ved and Goraya, 2008). The expanding trade in medicinal plants has serious implications on the survival of several plant species, many of which are under serious threat of becoming extinct. Today, this rich biodiversity of medicinal plants is facing a serious threat because of the rapid loss of natural habitats and over exploitation of plants from the wild resources. To meet the demands of the Indian herbal Industry, medicinal plants are being harvested every year from an area of 1.65 lakh ha of forests.

Due to over exploitation of vulnerable medicinal species has brought them to the verge of extension, among them some of the medicinal plants includes *Aconitum chasmanthum* is commonly known as Gaping monkshood, an endemic species to Himalayan region of India, *Chlorophytum borivilianum* is a tuberous herb known as Safed musli in Hindi and White gold in English, another endemic species to India, distributed in parts Gujarat, Rajasthan and Maharashtra. *Gentiana kurroo* is a perennial herb and known as Karu in Hindi, Himalayan Gentian in English, which is having antiperiodic, expectorant, antibilious, stomachic, antithelmintic, blood purifier and carminative properties.

Some of the other species of medicinal plants from India have been considered to be endangered and threatened for over a decade: *Acorus calamus, Alpinia galanga,*

Commiphora wightii, Dendrobium nobile, Dendrobium pauciflorum, Dioscorea deltoidea, Diplomeris hirsute, Gentianakurroo, Nelumbo nucifera, Paphiope dilumdruryi, Podophyllum hexandrum, Rauvolfia serpentina, Santalum album, Saussure alappa, Saraca asoca, Picror rhizakurroa, Costus speciosus, Berberis aristata, Gloriosa superba etc.

- **Some of the endangered medicinal species of greater important** (Anurag Dhyani, 2016)

a. **Sweet Flag:** *Acorus calamus* belongs to family Acoraceae family Known as Vacha in Sanskrit, Vashambu in Tamil. It is used for counteracting hallucinations, and detoxifies the toxins present the body and some traditional folks believe that it can be used to improve memory and speech by tying roots around the neck of children. In India, it is given to infants in small quantity. But U.S. FDA. has banned use of sweet flag after several experiments revealed that intake of sweet flag in larger quanity may stimulate cancerous cell formation. But, we can rule out that sweet flag still hold beneficial effects when used under medical supervision.

Sweet Flag in Stagnant Water **Sweet Flag Dried Roots**

(Ref. http://www.naturalether.com)

b. **Thai Ginger:** *Alpinia galanga* belongs to Zingiberaceae, known as Doddarasa Gadde in Kannada and Aruttai in Tamil. It is the common ingredient in Thai cuisine, it is used as remedy for sore throat, cough and common cold by mixing powdered rhizome with hot water or honey to check the bad odor of mouth, improves the appetite and digestion. Traditionally it is used as anti-inflammatory as agent. Besides, it also has antimicrobial and radical scavenging effect of leaf and rhizome extracts.

c. **Malabar glory Lily:** *Gloriosa Superba* belongs to family Colchicaceae, known as Gouri gadde in kannda and Kalai pai in Tamil. Regarded as national flower of Zimbabwe and state flower of Tamil Nadu. Grown. It is grown as perennial herb. The name Glory Lily derived because of its eye catching and multicolored glorious flowers. Glory lily is used from long ago, as in Ayurveda it is used for treating wounds, swelling, skin disease, bite from poisonous animals, and difficulty during labor and kill intestinal worms. It is has been reported that seeds contain high content of colchicine.

Figure 2 Thai Ginger plants with Roots

Bright Glory Lily Flowers and Roots

(Ref. https://garden.org and https://www.exportersindia.com)

d. **Sarpagandha:** *Rauvolfia serpentina* belongs to family Apocynaceae, known as Snake root plant, a treatment for snake, scorpion and reptile bites, known as Sarpaghandi in Kannada, Sarpagandha comprises of more than 50 bio active compounds. And it is a finest remedy for blood pressure and is also used for sedative and tranquilizing agents. Nowadays, Sarpagandha is used as miracle drug in pharmaceutical industry, as an effective remedy for treatment of anxiety, psychosis and epilepsy.

Sarpagandha plants with flowers

(Ref. http://www.planetayurveda.com)

Indian Podophyllum*: Podophyllum hexandrum* belongs to family Podophyllaceae. Which is extensively used as purgative, besides, used as remedy for gonorrhea, typhoid fever, jaundice, dysentery, chronic hepatitis, scrophula , rheumatism, skin diseases, tumerous growth, kidney and bladder problems.

Indian Podophyllum Plant
(Ref. www.penlanperennials.co.uk)

India is rich in its biodiversity, it consists of three out of thirty four biodiversity hotspots, in which medicinal plants form a numerically large group of economically important plants which provide basic raw materials for medicines, perfumes, flavors and cosmetics. These plants and their products not only serve as valuable source of income for small holders, entrepreneurs and pharmaceutical industries but also helps in contributing to the country's GDP by way of export. In this technological era, medicinal plants are at increasing risk from destruction of their habitats due to forest fires and besides, on the other side virgin forest lands are lost to industries and urbanization, bio prospecting for new sources, and overharvesting of known medicinal species. So, it is the responsibility for each of us to conserve and efficiently use these vulnerable plants, as they are the treasures for future human existence.

CONCLUSION

Plants played a major role in the development of human civilization, where they were used as food, clothing and fodder for there livestock's. India has been listed among those countries, where the saints and sadhus practiced traditional medicine preparation from long ago to many diseases. We all aware that India is rich in biodiversity especially in medicinal crops, but larger part of the forest is being lost to urbanization, industrialization and other greed's of the man. Being the citizen of this country it's our sole responsibility to conserve these resources and traditional knowledge and pass on to the future generation.

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Drought Mitigation & Climate Resilient Technologies: An Effective Crop Management Practices in Dryland & Rainfed areas

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The Agricultural droughts are a natural disaster with serious and long term socio-economic implications; hence, there is vital need to develop appropriate drought management measures to stabilize the productivity and profitability in rainfed agriculture. Drought management should not be treated as an isolated problem but as an integral and key factor in sustainable agriculture. Drought management strategies need to adopt from the beginning of the season in order to be effective, these practices are to be planned before planting the crop even if forecast is for a good year. There should be consortium approach to implement the program of drought mitigation with active commitment of government, NGO sectors and Research & Development institutions. Crop production depends on monsoon rainfall both in terms of quantity and its distribution, since the rainfall is unpredictable, there is need to adopt suitable crop management practices for stable productivity. Normally the aberrant rainfall conditions that prevail in rainfed regions are timely onset of monsoon followed by prolonged dry spells delayed onset of monsoon & early withdrawal of monsoon and extended monsoon. The Agricultural droughts lead to

- loss of crops
- malnutrition of human beings and cattle
- loss of economic activities
- spread of diseases
- rise in prices
- changes in socio-economic values
- migration of people and livestock

Drought mitigation through crop management practices can be grouped into post and pre drought mitigation measures

1. Timely onset of monsoon followed by immediate dry spells

- Dry spell soon after sowing result in poor germination due to soil crusting, withering of seedlings & Poor establishment of plant stands due to inadequacy of soil moisture

- There may be too many gaps either in a row or gaps in rows
- Under such situations, gap filling with same variety or short duration variety of same crop or short duration variety of other crop may be considered
- Alternatively transplanting of seedlings of same crop from excessive seedlings growing at some places in same location may also be adopted.
- In Bangalore regions, gap fills the fields of groundnut and finger millet with seeds of cowpea, horse gram, Niger or sunflower in the event of gaps more than 25% of area.
- At Dharwad, hybrid maize was dibbled in the gaps in groundnut + Pigeonpea intercropping (3:1) with fresh showers
- When there is severe dry spell and population is too poor, re-sowing of entire field using either same or new crop matching remaining effective growing rainy season is suggested

Management of intermittent dry spells

- If the drought occurs during vegetative phase of crop growth, it might result in stunted growth, low leaf area and reduced plant population & suitable management practices for mitigating dry spells at early and midseason crop growth stages are
- Mulching: Helps in conservation of soil and water, creating dust mulch through frequent Interculture help to reduce the evaporation of soil moisture, secondly build up greater reserve of soil moisture for subsequent use at vegetative phase, this enhances the productivity of castor, sunflower, Pigeonpea, rabi sorghum, chickpea by 15 to 20% at Bellary, doubling of water Use Efficiency and crop yields was observed by providing dust mulch.
- At Parbhani, use of Gliricidia, mimosa and maize Stover mulch @5 t/ha enhanced the maize yields by 367, 435 and 199 kg/ha compared to no mulch.
- In Northern Karnataka, use of gravel sand (7.5 cm to 10 cm depth) on soil surface in vertisols increased the yield of Greengram, groundnut, rabi sorghum and sunflower from 600 to 1100, 700 to 1000, 800 to 1500 kg/ha respectively.
- In rainfed Alfisols, use of Gliricidia mulch @ 5 t/ha in sorghum + Pigeonpea-castor system reduced the runoff by 56% and soil loss by 72% and increased the castor bean equivalent yield from 328 to 984 kg/ha.
- Incorporation of Greengram residues, in situ incorporation of cucumber, ridge guard and bitter guard in vertisols enhanced the productivity by 64% over traditional practice

Additional N application after relief of dry spell

- Application of 10 kg N/ha was found to be superior during the early stress in upland rice and Rabi sorghum. In late season drought, 2% urea spray was effective. Additional application of 20 kg N/ha at vegetative or flowering of primaries increased the bean yield.
- Application of 10-20 kg N/ha to sunflower and sorghum + Pigeonpea intercropping system increased the yields.

Altering plant population

If moisture stress occurs during early growth period, thinning by removing every third row at the time of drought increased the productivity of sorghum from 1550 to 2110 kg/ha at Bellary. At Sholapur, thinning in sunflower increased yield by 19 and 28% due to 24 and 34 % reduction in population and at Bijapur, thinning weaklings, alternate row increased the yield of Rabi sorghum

Anti-transparent: Is any material applied to transpiring plant surfaces for reducing water loss from the plants.

1) Stomata closing.
2) Film forming.
3) Reflective type.
4) Growth retardant.

1) <u>Stomata closing</u>

- PMA (Phenyl Mercuric Acetate) - 1 x 10^{-4}.
- Growth hormones like Alkanyl Succinic Acid, ABA, cycocel, Ethrel, Abscisic acid.
- Metabolic inhibitors like Hydroxysulphonates, potassium metabisulphite.

2) <u>Reflectant types</u>

- Hydrated lime, Chalk powder
- Kaolin spray, china clay

3) <u>Thin film forming chemicals</u>

- Hexadecanol, Cetyl alcohol, Methanol, Paclobutrazol.
- Fatty alcohols, Wax or Plastic emulsions, Natural rubber.
- Liquid polythene, Cellulose acetate, Cellophane, Silicone.

4) <u>Polyethylene material forming thick film</u>

- Mobileaf, Folicot, Waxol

5) <u>Growth retardants</u>

- CCC – 2 chloro ethyl trimethyl chloride in cotton, sorghum @1000 ppm.
- Phosphin – 2-4 dichloro benzyl trimethyl phosphonisem.
- TIBA – 2, 3, 5 tri-iodo benzoic acid – soybean – 56 g/ha.

Advantages of Anti-transparent	Disadvantages of Anti-transparent
Form thin layer	Reduces photosynthesis
Resistant to passage of water vapor than CO_2	Closes stomata
Should maintain continuity and should not break	Cost is higher.

Research work on Anti-transparent

- ❖ Narang et al. (1988) reported that alachlor and Atrazine increased the grain yield of maize at 20 mg/lit of water
- ❖ Kaolin (1.25%), Hico-110R along with ascorbic acid (500 ppm) + PMA (10 ppm) once at peak flowering after termination of rainfall increased cotton yield by 10%
- ❖ At Dhantiwada, crop residue mulch + Kaolinite (5%) application gave the highest yield in castor
- ❖ Persistence of anti-transparent is only for 10-15 days & minimum 2 sprays are advised for getting economic yields.

2. Stripping of old leaves

a. In sorghum, normally 12 to 15 leaves are produced.
b. When plants at flag leaf stage stripping of bottom 3-4 leaves helps in drought mitigation

3. Ratooning

a. In pearl millet when dry spell exceeds 30-35 days, harvest the crop for fodder and allow ratoon for further growth with subsequent rainfall
b. For quick rejunavation, supplementation of additional N fertilizer is suggested
c. Same may be practiced for kharif sorghum.

4. Delayed onset of monsoon

a. <u>Seed hardening</u>

- ✓ Seed soaking in wheat (24 hrs), groundnut (8 hrs), Greengram (4 hrs) followed by shade drying (8 hrs)
- ✓ Soaking seeds of rabi sorghum (8 hrs), chickpea (0.5 hr) and sunflower (8 hrs) in $CaCl_2$ and shade drying for 8 hrs increased the yield by 20-25%
- ✓ Soaking seeds of rabi sorghum (8 hrs) and chickpea (8hrs) in cow urine (25% conc.) and shade drying for 8 hrs increased the yield by 20%

b. <u>Selection of crops matching growing season</u>

- ✓ To meet aberrant situations and also under delayed onset of monsoon, AICPDA with network of 26 research centers developed appropriate alternate crops in rainfed environment.
- ✓ Certain crops are grown more for convenience or by convention due to the household need of the farmer and feed to his animals.
- ✓ They are not necessarily the most efficient with regard to productivity, moisture use, monetary returns and labor utilization pattern.
- ✓ The mismatch between rainfall distribution and crop water needs is the major cause of unsuitability of certain crops in some dryland areas.

c. <u>Dry seeding:</u>

- ✓ It has to follow based on probability of rains (> 60%). Sowing of bold seed crops like castor, cotton, Pigeonpea is found to be advantageous

- ✓ At Parbhani, dry sowing of sorghum (24th Std MW) was found more stable and productive and gave 25% higher grain yield
- ✓ At Bijapur, dry sowing of rabi sorghum with 1.5 times seed rate gave higher yield.

d. Raising nursery and transplanting

- ✓ In endemic areas, community nurseries using farm pond or tank water need to be raised and seedlings could be transplanted
- ✓ In Bangalore, medium and late varieties of finger millet with transplanting maintained yield levels under delayed conditions

e. Wider row spacing:

- ✓ When soil moisture is limited, it would be advantageous to increase inter row spacing and decreasing intra row spacing. Intra row competition would result in smaller plants and in inter row, reservoir of soil moisture would be maintained over longer period of growing season

f. Early withdrawal of monsoon

- ✓ Monsoon terminates earlier than usual.
- ✓ It cuts the length of growing season.
- ✓ Normally crops are in their maturity stage.
- ✓ Those growing on shallow soils suffer heavily & Sowing of Rabi crops also gets affected.

g. Protective irrigation

- ✓ Life saving irrigation or supplemental irrigation from rainwater collected through farm pond is one of the important practices to mitigate drought experienced during the life cycle of crop.
- ✓ Medium vertisols at Bijapur, one life saving irrigation increased yield of crops by 33 to 92%
- ✓ The response of horticulture crops viz., ber, guava and fig was varied from the highest 122.6% (guava) to the lowest (41.7%)
- ✓ Supplemental irrigation of 5 cm either at early (vegetative phase) or mid (flowering) stages gave 14 to 37% additional bean yield and monetary returns in castor over control.

h. Extended Monsoon

- ✓ Such aberration is rarely experienced
- ✓ This situation is favourable in medium to deep soils where double cropping is feasible
- ✓ After harvesting of kharif crop, attempts can be made to take short duration pulse crop preferably a pulse or fodder crop (horsegram). In crops like kharif sorghum, ratooning can also be practiced and additional gains could be obtained

i. Pre-mitigation measures for drought

- ✓ Nutrient Management and Organic recycling
- ✓ In situ moisture conservation measures & tillage
- ✓ Cropping systems for moisture economy & crop diversification
- ✓ Alternate Land use systems etc.

Table 1 Potential cropping system in relation to rainfall, water availability and soil type

	Rainfall (mm)	**Soil type**	**Water availability period (weeks)**	**Potential cropping system**
1	350-600	Red soils and shallow black soils	20	Single *kharif* crop
2	35-600	soils	20	Single *kharif* or *rabi* crop
3	350-600	Deep black soils	20	Single *rabi* crop
4	600-750	Red soils, black soils, sandy soils	20-30	Intercropping
5	750-900	soils, deep black soils, red soils	> 30	Sequential cropping-double cropping
6	>900	soils, deep black soils, red soils	> 30	Sequential cropping-double cropping (assured)

Table 2 Efficient cropping systems for different dryland areas based on water availability

Soil zone and region	**Water availability period (days)**	**Double cropping system**	**Intercropping system**
Vertisols and related soil zone			
Malwa Plateau	210-230	Maize-Safflower/Chickpea	Maize + Soybean (2:2)
	191-210	Sorghum-safflower/chickpea	Soybean + Pigeonpea (4:2) Sorghum + Pigeonpea (2:1)
Vidharbha	190-210	Groundnut-Safflower	Sorghum + Pigeonpea (2:1)
		Sorghum-Safflower	Cotton + Pigeonpea (2:2)
			Pigeonpea + Greengram (1:3)
	170-190	Greengram-Sorghum/Safflower	Pearl millet + Pigeonpea (2:1)
			Sorghum+Greengram
Northern Karnataka	130-150	Cowpea-sorghum	Pearl millet +Pigeonpea (2:1)

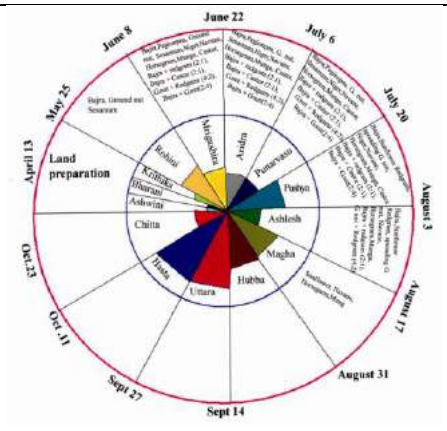
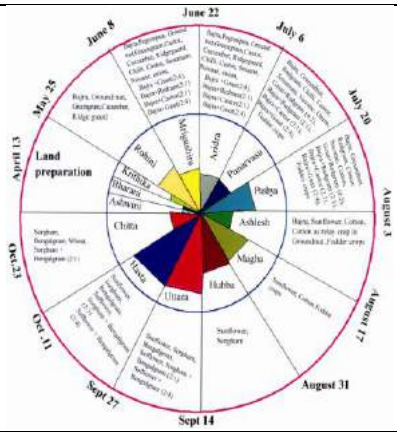
Table 3 Selection of suitable cultivars

Region	Rainfall	Crops	Varieties
Anantapur	570 mm	Sorghum	CSH 5, SPV 104, ISC 577
		Bajra	BJ 104
		Groundnut	Kadri 71-1
	890 mm	Ragi	PR 202, Indaf 8, Indaf 9
		Groundnut	TMV 2, DH 3-30
		Pigeonpea	TTB 7, Hy 3c
	930 mm	Sorghum	CSH 5, CV 604
		Pigeonpea	Hy 1
		Pearl millet	BJ 104
Bijapur	560 mm	Pearl millet	ICTP 8203, ICMV 221
		Groundnut	TMV 2
		Pigeonpea	
	1400 mm	Upland rice	DR 92
		Ragi	A 404, PR 202
		Pigeonpea	BR 83, BR 65

Table 4 Crops choice in relation to stored soil moisture in vertisols (Bellary centre)

Avg. Moisture storage (mm)	Crops	Varieties
> 500	Sorghum	M 35-1, SPV 86
	Safflower	A-1, A 300, 7-13-3
	Chickpea	A-1
375-500	Sorghum	CSH 2, CSH 3
	Safflower	A-1, A300, 7-13-3
250-375	Safflower	A-1, A-300, 7-13-3
	Chickpea	A-1

Fig 1 Different soil status and its role crop production in dryland areas

Shallow Black Soil	Medium to Deep black soil
	

INFERENCE

On the basis of the information described in the present article, some points are represented as conclusion as the response of crop towards Drought Mitigation & Climate Resilient Technologies: An Effective Crop Management Practices in Dryland & Rainfed Areas will be beneficial to increase yield attributes by minimizing abiotic stress. However, more information about these procedures is needed and this topic needs more study and research. On the basis of the information described in the present article, some points are represented as conclusion.

Nano-fertilizers: an efficient technique for smart agriculture

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In the past decade an eruption in the world's population has increased the pressure on already over burdened agricultural system, particularly in developing countries. Now days, agriculture is facing a lot of challenges like – reduced and stagnated productivity of crops, reduced nutritional quality of products, wide spread deficiencies of nutrients in the soil, low use efficiencies of inputs applied and degraded soils due to over doses of chemical fertilizers. Addition of large quantities of chemical fertilizers is deteriorating the soil, by disturbing the natural nutrient recycling and by causing harm to soil microflora. In addition to this, chemical fertilizers are prone to losses, they contribute to environmental pollution and their residues are also entering the food chain, thereby disturbing the whole ecosystem. Under these circumstances, we need a smart and intelligent technology, that facilitates target site application of nutrients, so that over use can be minimized and severe problems like environmental pollution can be reduced. As a possible solution to this problem, nano technology is expanding its wings. Nano structured fertilizers are specially designed to supply plant nutrients directly to target sites and they are reported to increase rate of seed germination, plant growth, photosynthetic activity, nitrogen metabolism, carbohydrate and protein synthesis.

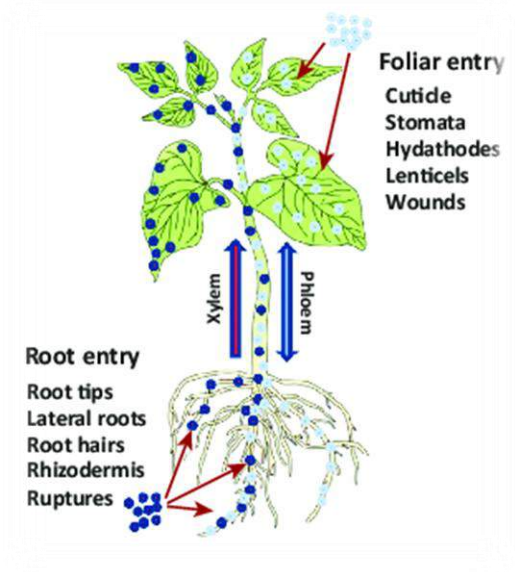
What are nano fertilizers?

Nano fertilizers are molecularly modified or synthesized form of traditional fertilizers, which can supply nutrients for plant growth, improve performance of conventional fertilizers and can be delivered in a timely manner to targeted sites i.e. rhizosphere of foliage of plants. The bulk fertilizer material is converted into nano sized particles by application of nano technology and then it is used for betterment of agriculture in terms of yield, nutritional quality and soil health. A traditional fertilizer material can be converted into a nano sized particle by any one of the following procedures: 1) Encapsulation of nutrient inside the non porous material, 2) Coating of nano sized particle is done with a thin polymer film, 3) Particles or emulsions of nano scale dimensions are applied directly over the plants.

Mode of entry of nano fertilizers in plants:

The nano fertilizers are very small sized particles and their size varies from 1 nm to 100 nm. When they are applied to plants they get absorbed either by roots or by foliage.

Root entry takes place by root tips, lateral roots, root hairs and below ground rupture parts of the plants, whereas foliar entry takes place through cuticle, stomata, hydathodes, lenticels and wounds (Fig 1).



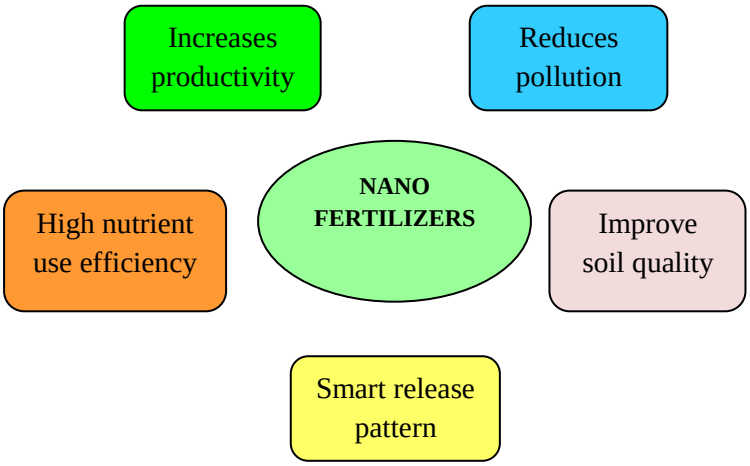


Fig 1. Mode of entry of nano fertilizers in plants **Fig 2. Role of nano fertilizers in agriculture**

- Particle size of nano fertilizers is very less and in contrast to that their surface area is very high; therefore, more number of particles are present per unit area, which facilitates their fast absorption and efficient utilization.
- They are highly soluble in water; thereby losses due to sedimentation and fixation in soils can be avoided.
- Nano fertilizers are capable of releasing nutrients at a slower rate; therefore, nutrients are available to plants for a longer period of time and release pattern is in synchronization with the uptake pattern of the plants.
- As the plants are able to utilize the nutrients in an effective manner, the losses due to denitrification, leaching, volatilization and fixation in soil can be avoided to a very large extent and that's why it is considered to be an ecofriendly technique.
- Use of nano fertilizers prevents excess use of fertilizers and thus saves a considerable portion of them.
- It helps in increasing the nutritional quality of the crops by increasing the nutrient concentration in the plants.

Issues and future thrust:

Although nano fertilizers seems to be an excellent source of nutrients that can replace traditional fertilizers, but few issues related to it needs addressing like: realization of their full potential, opportunity for large scale commercial production, effect on environment and human health, extension and technology transfer to farmers, residual effects and economics etc.

CONCLUSION

Nano fertilizers serve as a bridge between bulk materials and atomic or molecular structures. In present scenario, we are focused to achieve higher agricultural productivity, but that should not be attained at the cost of sustainability, environmental protection and human health. Under such conditions nano fertilizers seems to be one of the finest precision agriculture technique that can help us achieve this target.

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Nanotechnology: a new approach in agriculture world

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Nanotechnology in agriculture has gained momentum in the last decade with an abundance of public funding, but the pace of development is modest, even though many disciplines come under the umbrella of agriculture. Nano technologic intervention in farming has bright prospects for improving the efficiency of nutrient use through nano formulations of fertilizers, breaking yield barriers through bionanotechnology, surveillance and control of pests and diseases, understanding mechanisms of host-parasite interactions at the molecular level, development of new-generation pesticides and their carriers, preservation and packaging of food and food additives, strengthening of natural fibers, removal of contaminants from soil and water, improving the shelf-life of vegetables and flowers, clay-based nano resources for precision water management, reclamation of salt-affected soils. Nanotechnology will play a vital role in the development of the agricultural sector, as it is capable of being used in agricultural products that protect plants and monitor plant growth and detect diseases. Nano technology devices and tools, like nanocapsules, nanoparticles and even viral capsids, are examples of uses for the detection and treatment of diseases, the enhancement of nutrients absorption by plants, the delivery of active ingredients to specific sites and water treatment processes. The use of target-specific nanoparticles can reduce the damage to non-target plant tissues and the amount of chemicals released into the environment. Nanotechnology derived devices are also explored in the field of plant breeding and genetic transformation. Nano materials and nanostructures with unique chemical, physical, and mechanical properties like electrochemically active carbon nanotubes, nanofibers and fullerenes have been recently developed and applied for highly sensitive bio-chemical sensors. Nanotechnology is considered as one of the possible solutions to problems in food and agriculture.

WHAT IS NANOTECHNOLOGY?

Nanotechnology is defined as the science of understanding and control of matter at dimensions of roughly 1–100 nm, where unique physical properties make novel applications possible. Other attempts to define nanoparticles from the point of view of agriculture include particulate between 10 and 1,000 nm in size dimensions that are simultaneously colloidal particulate. The application of nano materials in agriculture

aims in particular to reduce applications of plant protection products, minimize nutrient losses in fertilization, and increase yields through optimized nutrient management.

What are Nanoparticles?

The simple answer to this question is any particle less than 100 nm. But like most things in particle technology a more thorough discussion is required to achieve an unambiguous and complete response. The experts from the ISO and ASTM standards shown below provide additional nuances to the definition. The current agreement among the standards groups is that the scale from 1 – 100 nm defines the size range of nanoparticles. Below 1 nm may be excluded in order to avoid calling clusters of atoms a particle, but the literature contains references to particles < 1 nm.

Role of nanotechnology in different domain of agriculture sciences

1. Role of nanotechnology applications in agriculture

Nature is a great teacher, and nanotechnology applications in agriculture can be successful if natural processes are simulated in greater scientific sophistication/articulation for successful implementation. For example, the goal might be to make soils more capable in order to improve efficient nutrient use for greater productivity and better environmental security. Nutrient management with nanotechnology must rely on two important parameters, ions must be present in plant-available forms in the soil system, and since nutrient transport in soil-plant systems relies on ion exchange (eg, NH_4^+ $H_2PO_4^-$, HPO_4^{2-}, PO_4^{3-}, Zn^{2+}), adsorption-desorption (eg, phosphorus nutrients) and solubility-precipitation (eg, iron) reactions, nonmaterial's must facilitate processes that would ensure availability of nutrients to plants in the rate and manner that plants demand. Nanofabricated materials containing plant nutrients can be used in aqueous suspension and hydrogel forms, so as to enable hazard-free application, easy storage, and a convenient delivery system.

2. Role of nanotechnology in animal production and health care

Livestock, poultry and aquaculture are related with agriculture, and have an important role and will continue to play an important role in human nutrition. There are a large number of constraints in animal production such as production efficiency, animal health, feed nutritional efficiency, diseases including zoonoses, product quality and value, by-products and waste, and environmental footprints. Nanotechnology can provide state-of-the-art remedies for these challenges.

3. Role of nanotechnology in improving feeding efficiency and nutrition

The main challenge in sustainable agriculture is to minimize the inputs and to maximize the output. Feedstock is the most important input in animal production. Feeding efficiency is inversely related with demand of feed, discharges of waste, environmental burden, production cost and competing with other uses of the grains, biomass and other feed materials. Nanotechnology has the potential to improve the profile of nutrients and their efficiency. To supplement them with nutrients is an efficient way of elevating the efficiency of protein synthesis and utilization of minor nutrients in animals. Similarly, cellulosic enzymes can help in better utilization of the energy in plant-derived materials.

Moreover, micronutrients and bioactives can help improve the overall health of animals, ultimately achieving and maintaining optimal physiological state.

4. Role of nanotechnology in water quality

Currently, provision of clean and abundant fresh water is one of the most important challenges faced by the world for human use and industrial applications such as agriculture. According to a survey, more than one billion people in the world are deprived of clean water and the situation is getting worse. In the near future, it has been estimated that average water supply per person will drop by a factor of one third, which will result in the avoidable premature death of millions of people. A large amount of fresh water is required in agriculture, but in turn, it contributes to groundwater pollution through the use of pesticides, fertilizers and other agricultural chemicals. During the treatment of wastewater, critical issues like water quality and quantity, treatment and reuse, safety due to chemical and biological hazards.

NANOTECHNOLOGY AND AGRICULTURAL SUSTAINABLE DEVELOPMENT

The nano technology cans takes an important part in the productivity through control of nutrients as well as it can also participate in the monitoring of water quality and pesticides for sustainable development of agriculture. Nano-materials have such diverse assets and activities that it is impossible to deliver a general assessment of their health and environmental risks. Properties (other than size) of NPs have the influence on toxicity include chemical composition, shape, surface structure, surface charge, behavior, extent of particle aggregation (clumping) or disaggregation, etc. may associate with engineered NPs. For this reason even nano-materials of the same chemical composition that have different sizes or shapes can exhibit their different toxicity. The implication of the nanotechnology research in the agricultural sector is become to be necessary even key factor for the sustainable developments. In the agri-food areas pertinent applications of nanotubes, fullerenes, biosensors, controlled delivery systems; nano-filtration, etc. were observed. This technology was proved to be as good in resources management of agricultural field, drug delivery mechanisms in plants and helps to maintain the soils fertility. Moreover, it is being also evaluated steadily in the use of biomass and agricultural waste as well as in food processing and food packaging system as well as risk assessment. Recently, nanosensors are widely applied in the agriculture due to their strengths and fast for environmental monitoring of contamination in the soils and in the water. Several sensors based on nano-detection technology such as viz. biosensors, electrochemical sensors, optical sensors, and devices will be the main instruments for detecting the heavy metals in trace range. Nan materials not only directly catalyze degradation of waste and toxic materials but it also aids improve the efficiency of microorganisms in degradation of waste and toxic materials. Bioremediation uses living organisms to break down or remove toxins and harmful substances from agricultural soil and water.

Nano fertilizers

In the recent decade nano fertilizers are freely available in the market, but particularly the agricultural fertilizers are still not shaped by the major chemical companies. Nanofertilizers may contain nano zinc, silica, iron and titanium dioxide, ZnCdSe/ZnS core shell QDs, InP/ZnS core shell QDs, Mn/ZnSe QDs, gold nanorods, core shell QDs, etc. as well as should endorse control release and improve the its quality. Studies of the uptake, biological fate and toxicity of several metal oxide NPs, *viz.* Al_2O_3, TiO_2, CeO_2, FeO, and ZnONPs were carried out intensively in the present decade for agricultural production. The deficiency of zinc has been documented as one of the main problems in limiting agricultural productivity in the alkaline nature of soils.

Nan pesticides

The use of nano materials in plant protection and production of food is under-explored area in the future. It is well known that insect pests are the predominant ones in the agricultural fields and also in its products, thus NPs may have key role in the control of insect pests and host pathogens. The recent development of a nano encapsulated pesticide formulation has slow releasing properties with enhanced solubility, specificity, permeability and stability. These assets are mainly achieved through either protecting the encapsulated active ingredients from premature degradation or increasing their pest control efficacy for a longer period. Formulation of nano encapsulated pesticides led to reduce the dosage of pesticides and human beings exposure to them which is environmentally friendly for crop protection. So development of non-toxic and promising pesticide delivery systems for increasing global food production while reducing the negative environmental impacts to ecosystem.

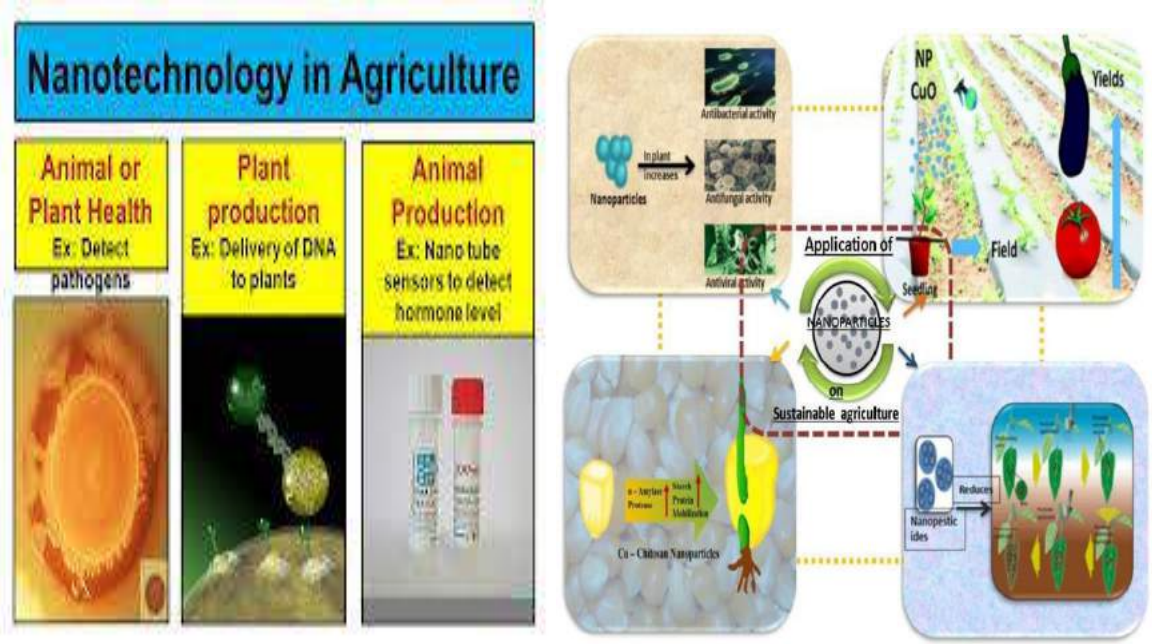

Fig.1 Application of Nano Particles on Sustainable Agriculture

CONCLUSION

Nanotechnology has great potential as it can enhance the quality of life through its applications in various fields like agriculture and the food system. Around the world it has become the future of any nation. But we must be very careful with any new technology to be introduced about its possible risks that may come through its positive potential. However, it is also critical for the future of a nation to produce a trained future workforce in nanotechnology. In this process, to inform the public at large about its advantages is the first step, which will result in tremendous increase in the interest and discovery of new applications in all the domains. With this idea in mind, this article has been written by referring many numbers of articles and papers form different domain. The theme of this articles paper is based on the provision of basic knowledge about the applications of nanotechnology in agriculture and their prospects in the near future with reference to the current situation around the world.

Synthesis of extension model: Farmer FIRST

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There is growing perception that the emerging demand of the farmers about the recent technological and institutional needs is not adequately addressed. Also many times, research system is not getting adequate feedback to plan and conduct demand driven research thereby, a huge gap exists in the quality of research output required at the farm level and that being developed. It is also being perceived that the research system should play a pro-active role in reaching to the farmers for getting first hand information, farmers' perceptions, feedback on generated technologies and develop new more appropriate processes, methodologies and technologies for diverse farm environments.

Why farmer FIRST model

In the past ICAR led in responding the contemporary challenges and other issues of Indian agriculture whether it was Green Revolution (complimented with National Demonstration, 1964), upliftment of small & marginal farmers (complimented with Lab to Land Programme, 1979), watershed development, soil improvement, crop protection, focus on weaker section (complimented with Operational Research Project, 1974), technology assessment and refinement (complimented with IVLP, 1995), etc., its response was timely and need based.

Now the situation has changed drastically in terms of increased number of smallholders, growing proposition of women-led agriculture, need for higher return per unit area and addressing the changing socio-economic environment, etc. This necessitates new approach for project development involving innovation and technology development with the strong partnership of the farmers for developing location specific, demand driven and farmer friendly technological options.

Applying farmer FIRST

The new proposed project – 'Farmer FIRST' is an ICAR initiative to move beyond the production and productivity and to privilege the complex, diverse & risk prone realities of majority of the farmers through enhancing farmers-scientists contact with multi stake holders-participation. Farmers tend to face problems related to production and natural resource management but they might not have found out solutions to

overcome them. In such situations, Farmer FIRST is an opportunity for the researchers, extension professionals and farmers to work together and find appropriate ways through assessing different solutions. During the production process, farmers often evolve new ideas to improve their cultivation and natural resource management activities. This creates a space for researchers, extensionists and farmers to design and organize new experiments. Farmer FIRST can be applied not only at household level but also at village and community level as community experimentation.

Farmer FIRST will create linkages between farmers-researchers and extensionists to support farmers to conduct appropriate experiments selected by them. It will help researchers and extensionists understand and know real needs of villages. In this process, priority does not come from researchers or extensionists but from the end users of results of research and technology development.

Objectives

1. To take up technology development based on feedback with the participation of farmers and landless for enhancing production, productivity, income and equitability of the households.
2. To build a network of linkages with different entities around the farm house holds viz., technology institution, input support system, market, etc. for facilitating access of information, technology and marketability of produce for higher returns.
3. To find out the technical, socio-economic and environmental impact of the project to develop a database on performance of NARS technologies; perception of the farmers on technologies; agriculture as a profession in the rural settings; migration, etc.
4. To identify and integrate economically viable and socially acceptable entrepreneurial activities as models of enhanced earnings to the farmers in different agro-ecological situations.
5. To initiate special modules for farm women to enhance their participation in agricultural activities for higher earnings and livelihood security.
6. To utilize the strength of the technology institution (partners) to develop commodity specific contents for knowledge sharing among various stakeholders specially farmers.

Components

i. Enhancing Farmer –Scientist Interface

Enabling involvement of researchers for continuous interaction with farm conditions, problem orientation, exchange of knowledge between farmers and other stakeholders, prioritization of problems and setting up of research agenda.

ii. Technology Assemblage, Application and Feedback

Integrating components of technology for application in different agro-ecosystems with focus on innovations and feedback

iii. Partnership and Institution Building

Building partnerships involving different stakeholders, development of rural based institutions, agro-ecosystem and stakeholders analysis and impact studies

iv. Content Mobilization

Using the platform of the project having institutions as partners to develop specific contents for e-enabled knowledge sharing

Benefits to farmer

- Farmers get an opportunity to solve their problems or try out new ideas that they themselves could not do without the support of the researchers and extensionists.
- Improve experimenting and technology development capacity.
- Learn and share production experience with outside actors and other farmers.
- Better access to extension programmes, services and information about technologies, market prices, etc.

CONCLUSION

The farmer-first model envisages the supply and demand for innovations as a circular process beginning and ending with farmers, rather than a linear process beginning with scientists and ending with farmers. The circle has no particular point of departure since it involves a continuous interaction; on a basis of partnership between scientists and farmers and the components of the process need not take a particular order.

Seed priming: quality enhancement technique

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High germination and uniform plant stand establishment is essential to maintaining profitable yields. Improvement in plant stand establishment can be obtained by seed quality enhancements. These are value-added treatments that improve the germination, seedling growth or facilitate the delivery of seeds and other material required at the time of sowing. The purpose of these treatments is to shorten the time between planting and emergence. Seed enhancement through priming has led to great improvements in farmer's ability to achieve above goal in the field and under controlled environment.

Seed priming is the process of controlled hydration of seeds to a level that permits pre-germinative metabolic activity to proceed but prevents actual emergence of the radicle. During seed priming, the uptake of water occurs in three phases. (1) Phase I: seed hydration process related to passive imbibition of dry tissues associated with water movement first occurring in the apoplastic spaces; (2) Phase II: activation phase associated with the re-establishment of metabolic activities and repairing processes at the cell level and (3) Phase III: initiation of growing processes associated to cell elongation and leading to radicle protrusion. Phases I and III both involve an increase in the water content while hydration remains stable during Phase II. It is commonly considered that before the end of Phase II, germination remains a reversible process: the seeds may be dried again and remain alive during storage and able to subsequently re-initiate germination under favourable conditions.

TYPES OF PRIMING

Several methods of seed priming have been developed in order to invigorate seeds and alleviate the environmental stresses. A common feature of water-based priming techniques which distinguishes them from other pre-sowing treatments, is partial seed pre-hydration and the activation of early germination events in seed. Priming efficiency is affected by many factors such as chosen priming technique and strongly depends on treated plant species. Physical and chemical factors such as osmotica, water potential, priming agent, duration, temperature, presence or absence of light and aeration. Seed condition also influence priming success and determine germination rate and time, seedling vigour and further plant development.

1. Hydro-priming- Hydro-priming is the simplest method of seed priming which relies on seed soaking in pure water and re-drying to original moisture content prior to sowing. No use of additional chemical substances as a priming agent makes this method a low-cost and environmentally friendly. The main disadvantage of hydro-priming is uncontrolled water uptake by seeds. This is a consequence of free water availability to seeds during hydro-priming so that the rate of water uptake depends only on seed tissue affinity to water. Moreover, this technique may result in unequal degree of seeds hydration thus leading to lack of simultaneous metabolic activation within seeds followed by unsynchronized emergence. Considering these limiting factors, it is highly important to define accurate treatment duration, temperature and water volume used in hydro-priming to ensure desired level of seed hydration and to prevent radicle protrusion.

2. Osmo--priming- This is also known as osmo-conditioning or osmotic conditioning. In this technique, seeds are soaked for a certain period in osmotic solution with low water potential instead of pure water. Due to low water potential of osmotic solutions, water enters seed slowly which allows gradual seed imbibition and activation of early phases of germination but prevents radicle protrusion. Usually water potential of priming agent varies from −1.0 down to −2.0 MPa. However, values of water potential together with duration of the priming treatment should be always adjusted to species, cultivar and sometimes seed lot. Different compounds are used in osmo-priming procedure including polyethylene glycol (PEG), mannitol, sorbitol, glycerol and inorganic salts such as NaCl, KCl, KNO_3, K_3PO_4, KH_2PO_4, $MgSO_4$ and $CaCl_2$. Priming with salt solutions is often referred as "halo-priming". Most common chemical employed in osmo-priming treatment is PEG, mainly owing to its specific characteristic. The large size of PEG molecules prevents its penetration into seed tissues thus reducing toxic side effects on seeds. The disadvantages of using PEG are its relatively high cost, problems with removing it from the seed coat after priming, obtaining uniform aeration during priming and environmental hazards with PEG disposal. Seed priming with PEG has been shown as an effective method to improve seed germination, seedling emergence and stress tolerance of several crop plants under unfavourable conditions such as salt, water, chilling and nano-ZnO stress.

3. Solid matrix priming (SMP) - During solid matrix priming, seeds are mixed and incubated with wet solid water carrier for a certain period. Afterward, seeds are separated from matrix, rinsed and back-dried. The use of solid medium allows seeds to hydrate slowly and simulates natural imbibition process occurring in the soil. For successful SMP, materials utilized as matrices should possess specific physical and chemical features such as low matrix potential, minimal water solubility, high water holding capacity, high surface area, no toxicity to seeds and ability to adhere to seed surface. In fact vermiculite, peat moss, charcoal, sand, clay and some commercially offered substrate such as Celie or Micro Cell are exemplary solid carries applied in solid matrix priming.

4. Hormo-priming- During hormo-priming, seeds imbibition occurs in the presence of plant growth regulators which can have direct impact on seed metabolism.

The following regulators are commonly used for hormo-priming: abscisic acid, auxins, gibberellins, kinetin, ethylene, polyamines and salicylic acid (SA). Gibberellic acid (GA_3) and PEG priming improved photosynthetic proper- ties, antioxidant system, seedling emergence and growth of white clover on heavy metal polluted soil. Various naturally occurring growth promoting substances such as moringa leaf extract, chitosan, sorghum water extract and seed weed extract are also used for seed priming. Moringa (*Moringa oleifera* L.) as a natural source of plant-growth regulators contains cytokinins as zeatin. In addition, moringa leaf extracts contain higher concentrations of various growth enhancers such as ascorbates, phenolic compounds, potassium and calcium.

5. Bio-priming- Bio-priming involves coating of seeds with biological agents like bacteria. As other priming methods this treatment increases rate and uniformity of germination but additionally protect seeds against the soil and seed-borne pathogens. Nowadays, the use of bio-priming with plant growth-promoting bacteria (PGPB) as an integral component of agricultural practice shows great promise.

6. Nutrient priming- Nutri-priming is a technique in which seeds are soaked with solutions containing the limiting micro-nutrient instead of pure water. The idea of this method is to obtain nutritional effect together with biochemical advantages of priming in order to improve seed quality, germination parameters and seedling establishment. Among micronutrients; Zn, B, Mo, Mn, Cu and Co is highly used as seed treatment for most of the field crops. Seed treatment with micronutrient is a potentially low-cost way to improve nutrition of crops.

CONCLUSION

Seed priming is an old empirical strategy used since centuries by farmers and since decades by seed companies to improve germination processes in cultivated plant species. The underlying mechanisms involved in this positive impact of pre-sowing treatments remained obscure for a long time.

Diagnostic approaches for Detection of Subclinical and Clinical Mastitis in Farm Animals

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India is the largest producer of milk in the world and produces 155.5 million tonnes of milk with 337 ml per capita availability during the year 2015-16. Several measures have been initiated by the Government to increase the productivity of milch animals, which has resulted in increasing the milk production significantly from the level of 102.6 million tonnes at the end of the Tenth Plan (2006-07) to 127.9 million tonnes at the end of the Eleventh Plan (2011-12). Milk production during the year 2014-15 and 2015-16 was 146.3 and 155.5 million tonnes respectively showing the annual growth rate of 6.27 %.

Cattle population of India is 190.9 million which mainly comprises of crossbred (39.7 million) and indigenous (151.17 million) animals. During the year 2015-16 milk production from crossbred animals were 26% and that of indigenous cattle were 12% of the total milk production. The average milk yield per day per animal in crossbred cattle is 7.33 Kg/day whereas it is 3.41 Kg/day in indigenous cattle. Although crossbred cattle produce more milk, they are more susceptible to hot and humid climatic conditions, and as compared to indigenous cattle they are more vulnerable to production diseases. At present mastitis has become the most economically imposing disease for dairy producers around the world. It has been reported that the incidence of mastitis is more in high yielding crossbred cattle than the indigenous cattle. Mastitis is the inflammation of the mammary gland resulting mainly from the invasion of contagious or environmental pathogens into the teat canal. Based on the severity of the inflammatory response, mastitis manifests itself in clinical or sub-clinical forms both leading to substantial economic losses. The annual economic losses incurred by dairy industry on account of udder infection have been estimated about 6053.21 crore. Out of this, loss of 4365.32 crore (70-80%) has been attributed to sub- clinical version of udder infection. During invasion of microorganism into teat canal the parenchyma tissue gets affected and results into phagocytosis. This phagocytosis is characterised by breaking cells of white blood cells, and thereby produces increased level of neutrophils. Due to the concentration of these WBC which are popularly called as somatic cells, the quality of milk gets affected. Due to occurrence of mastitis, both quality and quantity of milk get affected. The prevalence of mastitis ranges from 10 to 50%. Epidemilogical

analysis revealed that most of the prevalent agents associated with mastitis are *Staphylococus aureus (S. Aureus),* Streptococcus strains and *Escherichia coli* (*E. coli*) pathogens. Vaccination programmes may be required to further control of mastitis however; no effective vaccines are currently available.

1) External examination of udder:

In clinical mastitis udder of the animal may turn hard, red and hot to the touch. Palpation of the udder may be painful to the cow. These symptoms arise from the changes in vascularity and blood flow of the gland when inflammation occurs.

2) California Mastitis Test (CMT)

The test is based upon the amount of cellular nuclear protein present in the milk sample. CMT reflects the SCC level quite accurately and is a reliable indicator of the severity of infection. The CMT reagent dissolves or disrupts the outer cell wall and the nuclear cell wall of any leukocyte, which are primarily fat (detergent dissolves fat). DNA is now released from the nuclei and together forms a stringy mass. As the number of leukocytes increase in a quarter, the amount of gel formation will increase linearly. The CMT provides only an indication of somatic cell count, not an exact value.
CMT can be carried out to screen the animals as follows:

1. Each teat can be cleaned with alcohol.
2. Small amount of milk (3 ml) is squirted from each quarter into the appropriate quadrant of the paddle.
3. Equal ratio of reagent can be mixed with milk.
4. Reading is recorded and analysis can be carried out.

Table 1 CMT result analysis

CMT Score	Interpretation
N	Healthy Quarter
S	Early Subclinical Mastitis
G	Subclinical Mastitis
M	Clinical Mastitis

N- No thickening, homogeneous.
S- Slight thickening. Reaction disappears in 10 seconds.
G- Distinct thickening, no gel formation.
M- Thickens immediately, begins to gel, levels in the bottom of cup.

3) Electrical conductivity

Electrical conductivity meter (Draminski® Electronics in Agriculture) can be used to measure the electrical conductivity of milk. When a cow is exposed to an intramammary infection, the electrical conductivity of the milk increases due to an increased concentration of Na+ and Cl caused by destruction of tight junctions and the active ion-pumping system.

The test is based on the ionic changes which occur during Intra mammary inflammations (IMI). Since the sodium and chloride concentrations increase in milk, the electrical conductivity of milk increases which can be detected by an Electrical conductivity meter.

Procedure

1. Small amount of milk (3 ml) can be squirted from each quarter into the Electrical conductivity meter
2. The conductivity of milk can be determined for each quarter separately
3. The readings displayed in the display window of the Electrical conductivity meter should be recorded promptly.

Interpretation

1. **Readings below 250 units**: This is a clear indication of a rapid increase in the severity of infection as subclinical or impending clinical mastitis.
2. **Readings between 250 and 300 units**: Readings between 250 and 300 units trigger warning signals to the operator that regular monitoring is necessary. If the figures in this category are only in one quarter and are at least 50 points below the lowest of the other quarters then this is a chance of mastitis infection present in the low numbered quarter.
3. **Readings above 300 units**: Most commonly the reading between 330-360 units indicates the normal samples. For cows with 1-2 lactations the readings generally average 390 units, whereas for the cows with more than three lactations, the reading observed is 320 units.

4) Somatic Cell Count

a) Somatic cell count (SCC) can be measured through digital reader Port check (PortaSCC®).

Procedure:

1. The required number of porta-strips should be removed from the pouches and placed on a flat surface with the sample well facing up.
2. The cow /sample Identification number should be written on the strip.
3. The samples should be mixed and drawn into the pipette by squeezing and holding the bulb of the pipette.
4. The tip of the pipette should be placed into the milk sample, so that the tip can be completely submerged.
5. The bulb can be slowly released to draw milk into the pipette.
6. A single drop of milk sample can be dispensed by holding the tip approximately ¼ inch above the sample well and gently squeezing the bulb, and care should be taken not to allow the pipette tip to touch the sample well during drop formation.

7. After the milk gets soaked completely into the sample well pad, 3 drops of activator solution should be added into the sample well from the dropper bottle, and allowed for 45-60 minutes for colour development.
8. A blanking strip is to be slided (sample well down and forward) into the digital reader.
9. The blanking strip then remov and wait for flashing strip symbol to appear in the display. A developed test strip could be slided fully into the Portacheck digital reader with the sample well down and forward.
10. The result can be recorded, and the displayed number was multiplied by 1,000,000.

5) Identification of pathogenic micro-organisms from milk of sub-clinically affected animals through PCR method

Five major bacterial species responsible for incidences of mastitis viz. *Staphylococcus aureus*, *Staphylococcus epidermis*, *Streptococcus agalactiae*, *Streptococcus dysgalactiae* and *Escherichia coli* can be identified using PCR based diagnostic technique. DNA could be extracted from milk samples.

PCR amplification for identification of specific region of bacteria from Genomic DNA

PCR amplification of the specific region for bacterial genomic DNA should be required for proper identification of mastitis causing micro-organisms.

Plastics: A Major Concern for Marine, Environment, Human and Animal Health

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The English word "plastic" or "plastics" originated from the Greek word "plastikos," which means to "grow" or "form." The name "plastic" directly means the "capability to be formed" one of the features of plastics (Joel FR. 1995)

Plastics and plastic industry:

Plastic is material consisting of any of a wide range of synthetic or semi-synthetic organic compounds that are malleable and so can be molded into solid objects. Due to their low cost, ease of manufacture, versatility, and imperviousness to water, plastics are used in a multitude of products of different scale

The versatility of these materials has lead to a great increase in their use over the past three decades, and they have rapidly moved into all aspects of everyday life (Hansen, 1990; Laist, 1987) Plastic material is gaining notable importance in different spheres of day to day life.

The plastic Industry is making significant contribution to the economic developments and growth of various key sectors in the country like Infrastructure, Agriculture, Horticulture, Healthcare, Automotive and construction industry.

In developed economies, about a third of plastic is used in packaging and roughly the same in buildings in applications such as piping, plumbing or vinyl siding.Other uses include automobiles , furniture, and toys In the developing world, the applications of plastic may differ — 42% of India's consumption is used in packaging. Plastics have many uses in the medical field. From the casing of an open MRI machine to the smallest tubing,. Things like disposable syringes, intravenous blood bags and heart valves are now made of plastic.

Plastic is made from petroleum, a product of oil, using heat and a catalyst to change the propylene into polypropylene. Since these are unnatural products, not found in nature, there are no organisms capable of decomposing the material, so it will not degrade as does other plant and animal waster. They don't rot. They last for centuries possibly forever they are non-biodegrade.

THE INDIAN SCENARIO:

According to The World Economic Forum study done on plastic pollution, if plastic pollution continues to rise then oceans will have more plastics than fish by 2050. India's contribution to plastic waste that is dumped into the world's oceans every year is a massive 60%. India generates around 56 lakh tonnes of plastic waste annually, More than 15,000 tonnes of plastic waste are generated in India every day, of which 6,000 tonnes remain uncollected and littered. India has an open garbage system, which means open garbage and dust bins on the roads with stinking waste. Dogs, monkeys, and cows eat whatever they can find to survive. In cities and towns, large numbers of cows on the roads eat from garbage bins, foraging for fruit, vegetable leftovers, anything edible and anything smelling like food.

Most of India's cows are owned by dairy farmers who let them loose in the city streets to look for free food instead of feeding them. People put vegetable peels, dirt, etc in a plastic cover and then throw it. No One bothers organic waste from plastic and glass,

Plastic utensils, covers and even razors mix with vegetable and fruit peels and leftover food, many cows ingest the entire package plastic bags, rotten food and garbage. These bags spill out either on the road or from municipality dustbins. Since the plastic bags are knotted at the mouth, cows, unable to undo the knot, eat food leftovers including the plastic. Slowly, over time, they build up a huge amount of plastic inside their stomachs. It gets entangled with different materials and it becomes hard like cement inside their rumens, which is the first belly of the cow. This results in a drastic reduction in their milk production ability, and even death.

Plastic bags not only clutter up the city, but also pose a threat to animals which eat them while foraging for food. Plastics are lightweight, strong, durable and cheap, characteristics that make them suitable for the manufacture of a very wide range of products. These same properties happen to be the reasons why plastics are a serious hazard to the environment (Pruter, 1987). Along India's rivers, there are thousands of temples, villages and towns, where untreated sewage and garbage flows in the water. Hundreds of kilometres downstream, garbage and plastic are deposited at places where livestock and wildlife feeds and drinks. Many animals die a painful and unobserved death. The absence of garbage recycling industries, especially the plastic materials are usually not disposed in a correct manner, and hence they were eaten by the grazing animals (Desiye and Mersha, 2012)

WHY ANIMALS EAT PLASTICS?

The bovine species does not have highly sensitive prehensile organs, such as lips and tongue, nor are a discriminating sense of taste and ingestion and lodgement of foreign bodies common due to indiscriminate feeding habits. In almost all semi urban, and pilgrim towns of India hundreds of cow are stranded on the roads and feeding on the left over plastic bags, plastic polythene and plastic bottles of the tourists visiting the city. The trend has been increasing in tourist and pilgrim spots Areas where animals are confined (like in the zero grazing units), if not well supplemented with minerals, animals become mineral starved get attracted to tasty materials or licking something near them Such animals will swallow plastic polythene bags that hang around. Some animals are also tethered along the roads while others are left to graze openly. During this time of grazing, they get exposed to these dangerous plastic materials and are forced to scavenge for food in garbage areas. Plastic bags contain polymers and chemical toxins like lead, cadmium, mercury and carcinogens, and direct contact with these substances over a long period can lead to serious consequences.

With time, used polythene bags get carried away by wind. Gradually they get settled in drains. When animals are forced to drink water from such sources plastics are accidently ingested by them these plastic bag remains intact even after the death and decomposition of the animal. Thus, it lies around in the landscape where another victim may ingest it.

CLINICAL SIGNS AND SYMPTOMS

The plastic bags along with other foreign bodies in cattle affect the health and cause economic loss to the owner. There are several symptoms seen in the affected animals. These plastics are indigestible and thus accumulate in the stomach (rumen for cattle) with time and get entangled with different materials, forming a hard cement-like ball. The animal shows depression and restlessness the animal becomes anorectic and weak. There is decline in milk production if animal is lactation and the rumen motility may cease and atony may incur sometimes experiences bloat due to

stomach blockage. The animal may also start drinking a lot of water. Rumination is suspended Diarrhoea and dehydration may set in soon. This animal's condition gets poorer every day to an extent of showing extreme discomfort, and if left untreated , the animal dies.

Vanithal et al (2010) reported that clinical rumen indigestible foreign body impaction was characterized by pale mucous membrane, complete cessation of rumination, reduced rumen motility, absence of stratification, hard pellet mucous coated dung and in appetence. Affected animals showed a lack of feces in the rectum, foamy salivation, recumbency and in appetence (Athar, 2010)

TREATMENT:

There is no vaccination to keep animal safe from ingesting plastic bags.There are no drugs for destroying plastic bags in the animals' stomach Some people have successfully used laxatives given to the animal to help breakdown solid materials and smoothen plastic to increase chances of slippery passage. Animals may pass plastic out when consumed in smaller pieces. This on the other hand, could complicate diarrhoea.

A rapid and quick way for saving animal from death is surgery (rumenotomy) to remove the plastics plus other waste items from the stomach. Rumenotomy along with transplantation of fresh ruminal cud is the best technique for restoration of ruminal function at fluid level for ruminal impaction due to plastics in cattle and buffaloes (Boodur et al,2008)

As prevention is better than cure, keep the animal surrounding free of plastics, be selective on where to tether your animals to forage and ensure mineral supplements are available to the animals.

PATHOLOGY:

Adverse effects caused by ingested plastic will vary, depending on the animal digestive system, the amount and type of plastic ingested and the developmental stage of the animal. One major effect of ingestion is reduced appetite, as it cause the stomach to feel full and ingested plastics reduced the volume of the stomach and therefore the meal size. The most common symptom observed in the affected animal is bloat. The other clinical symptom are depression, complete or partial anorexia followed by loss of weight, ruminal impaction, reduction of milk yield and suspended rumination. Milk and weight reduction in the affected animals was variable according to the stage of lactation, quantities of foreign bodies ingested and severity of the bloat (Kohli et al., 1998).

The various pathological conditions that are encountered due to ingestion of

plastic / polythene materials in animals are indigestion, impaction, tympany, polybezoars and immunosuppression (Singh, 2005).

Indigestion: The polythene and other plastic material do not degrade in rumen / reticulum and remain as such. When it is mixed with feed that the animal consumes, the feed ingredients are also trapped in between polythenes gradually it becomes tight due to ruminal movements and froms a lump like structure. This whole process also affects the rumen micro flora leading to indigestion of feed.

Impaction: large quantities of polythene bags / plastics in rumen get accumulated gradually and this leads to rumen antony and finally results in decreased in rumen motility.

Tympany: When polythenes present in rumen and reticulum, they partially or completely occlude the orifice of reticulum and omasum leading to accumulation of gases in rumen.. Accumulation of gases in rumen give rise to bloat or tympani which becomes fatal, if the left untreated. Sometimes the poly bags presents in rumen may also occlude esophageal orifice leading to hindrance in eructation. Acute bloat causes more pressure over the diaphragm and ribs which limits the respiratory movements, leading to hypoventilation and decreased venous return to the heart. Lack timely treatment of acute bloat may give rise to dysponea and lead to cattle mortality.

Polybezoars:

The formation of stones in digestive tract and around polythenes is known as polybezoars. In this the principal constituent is polythene and plant material, around which salts are deposited that gives rise to the information of hard stone like mass in stomach. Such hard mass not only causes hindrance in food passage but also leads to pain and inflammation of rumen.

Immunosuppression:

Plastic contains several chemicals like cadmium, lead, acrylamide, polythene, etc., which are known immunosuppressant. In addition to this the animals becomes off feed due to indigestion and impaction and animal become weak and immunodeficient of cancer. The presence of toxic chemicals may also damage epithelial lining that leads to urolithiasis particularly in kidneys.

It has been observed that cows with polythenes in their stomach also suffer from immunosuppression that leads to increased sensitivity to various infections particularly of haemorrhagic septicaemia (Pasteurellosis).

When the conservative line of treatment fails to correct these aliments of rumen, the only alternative is rumenotomy, which is surgically opening the rumen for treating its various ailments and to remove a variety of plastics.

Measures To Counteract The Foreign Body (Polythene Bags) Menace

Plastic bags are being openly used by vendors, especially by small vendors like vegetable and fruit shops as well as grocery shops. These are mainly low-quality bags. Steps must be taken to address this concern

1. In order to save the life of cattle, residents should not pack and throw the food items in plastic bags.
2. Rearing of the livestock in urban and semi-urban areas near to market places and roadsides are is to be discouraged as the animals try to feed upon the road side waste and garbage pits.
3. The dietary supplementation should have enough provision for mineral if the animals are stall fed or therered.
1. 4. The livestock grazing areas should be away from industrial areas well protected from pollution of wastes and plastic materials.
4. Popularise the slogan "No to carry bags when you can carry things in your hand" can be another way to avoid the incidence of the problem.
5. The open garbage system should be discouraged and is possible should be penalized by the competent authorities.
6. Creating awareness among city residents regarding indiscriminate use and disposal of plastic bags will be a good option to overcome the problem in future

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*Note- Photographs taken from internet are just used to disseminate information in more appropriate manner. Authors not claiming these as their personal.