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Canine Transmissible Venereal Tumour (CTVT)

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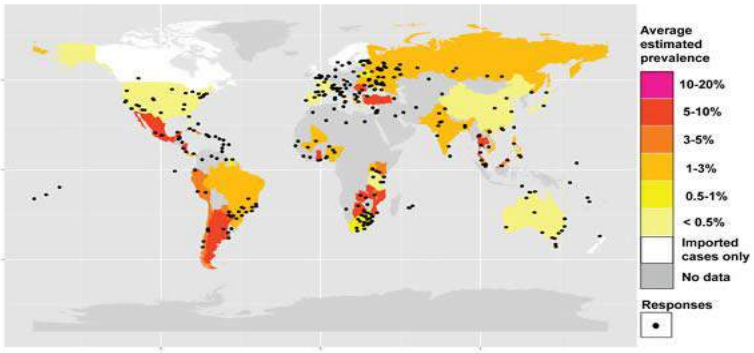
Transmissible venereal tumor (TVT), also known as infectious sarcoma, venereal granuloma, transmissible lympho-sarcoma or Sticker tumor, is a benign reticulo-endothelial tumor of the dog that mainly affects the external genitalia and occasionally the internal genitalia. As it is usually transmitted during coitus it mainly occurs in young, sexually mature animals. TVT also affects wild canids. Transmissible venereal tumour cells contain an abnormal number of chromosomes ranging from 57 to 64 and averaging 59, in contrast to the normal 78 of the species. The capacity of immunologic response of the host has a main role in the expansion of such tumors with an increase in severity seen in immunologically compromised animals.

Incidence

TVT has continued to be a serious problem around the world. Its global distribution is associated with the presence of free-roaming dogs. TVT causes tumours which are usually associated with the external genitalia of both male and female dogs having same frequency and incidence ranging from 2 to 43 percent of all tumors in temperate climates including india. It is commonly observed in dogs that are in close contact with one another, or in stray and wild dogs that exhibit unrestrained sexual activity. In India TVT is known to be the most frequently reported tumor in dogs ranging from 23-43 % of the total number of tumor in canine population. Uncontrolled sexual behaviour and a large stray dog population appear to be one reason for such a high incidence of TVT. The incidence of TVT is common at 2-5 years of age.



Spread

The tumor cells are themselves the infectious agents, and the tumor that form are not genetically related to the host dog. CTVT is spread by the physical transfer of living cancer cells between dogs. This usually occurs during mating, but CTVT

may also be transferred by licking, sniffing or parturition. The loss of mucosal integrity favours transmission.

Pathology

Canine TVT was initially described by Novinsky in 1876, who demonstrated that the tumor could be transplanted from one susceptible host to another by inoculating it with tumoral cells. The tumor growth appears 15 to 60 days after implantation. TVTs can either grow slowly and unpredictably for years or be invasive and eventually become malignant and metastasize. TVTs are immunogenic tumor, and it has been demonstrated that the immune system of the host has a main role in inhibiting tumor growth and metastasis. In young dogs or dogs with a compromised immune system, tumor may have a greater tendency to metastasis. Differences in cell types have been found between stages of tumor progression. Tumor in progressive growth have round cells with microvilli while regressing tumor present transitional rather fusiform cells. Moreover, regressing tumor have a high number of T lymphocytes. It is thought that substances secreted by the lymphocyte infiltrate are responsible for the tumor's regression by inducing cellular differentiation.

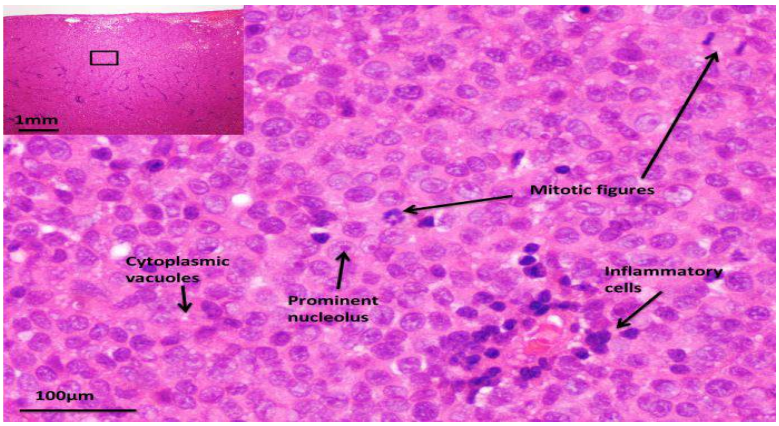
Grossly

Small pink to red, 1 mm to 3 mm diameter nodules can be observed 2 or 3 weeks after transplantation. Initial lesions are superficial dermoepidermal or pedunculated. Then, multiple nodules fuse together forming larger, red, haemorrhagic, cauliflower-like, friable masses. Tumor bleed easily and while becoming larger, normally ulcerate and become contaminated. In the male dog, the tumour is usually located on the caudal part of the penis, from the crura to bulbisglandis or the area of the glans penis, and occasionally on the prepuce. In the bitch, the neoplasm is usually found in the posterior part of the vagina, often at the junction of the vestibule and the vagina. It sometimes surrounds the urethral orifice and, if it is just within the vagina, it may protrude from the vulva.

Microscopically

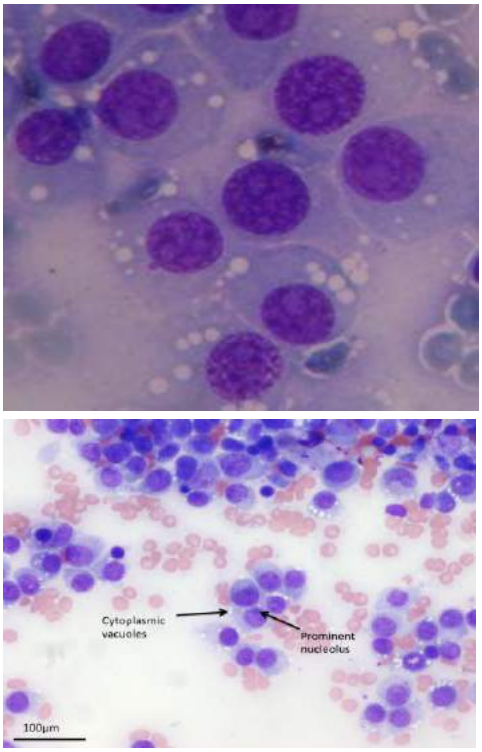
Histologically, TVTs are made up of a homogenous tissue with a compact mass of cells that are mesenchymal in origin and the borders of which cannot easily be differentiated. The cells are large, round, oval, or polyhedral with indistinct

outlines and poorly stained cytoplasm. There is variation in size of cell and having numerous mitotic figures. Other microscopic feathers include multifocal necrosis and infiltration of lymphocytes, plasma cells and macrophages.



Cytology

Cytological examination reveals the typical round to slightly polyhedral cells, with rather eosinophilic vacuolated thin cytoplasm and a round hyperchromatic nucleus with a nucleolus and a moderate number of mitotic figures. The nucleus to cytoplasmic ratio is large.



Diagnosis

Clinical signs vary according to the localization of the tumors. Dogs with genital localization have a hemorrhagic discharge. In males, lesions usually localize cranially on the glans penis, on preputial mucosa or on the bulbusglandis. Definitive diagnosis is based on physical examination and cytological findings typical of TVT in exfoliated cells obtained by swabs, fine needle aspirations or imprints of the tumors. There is marked aberrations in the numbers and morphology of the chromosomes of the constituent cells of TVT.

- TVTs should be differentiated from mastocytomas, histiocytomas or malignant lymphomas.

TREATMENT

Complete surgical excision, radiation therapy, and chemotherapy are effective treatments; however, chemotherapy is considered the treatment of choice. Vincristine sulfate (0.5–0.7 mg/m^2, IV, once weekly for 3–6 wk) is reported to be effective. Surgery may be difficult due to the location of these tumors. Surgery alone often leads to recurrence. Radiation therapy have been effective for those animals that do not respond to vincristine.

The prognosis for total remission with chemotherapy or radiation therapy is good, unless there is metastatic involvement of organs other than skin.

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Allele Mining For Crop Improvement

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Abstract

Allele mining is a promising way to dissect naturally occurring allelic variants of candidate genes with essential agronomic qualities. Development of superior and high yielding varieties made possible by accumulation of beneficial alleles from vast plant genetic resources existing worldwide. Still, a significant portion of these beneficial/ superior alleles were not used as these were left behind during evolution and domestication. Introducing novel alleles from wild crop plants to cultivated varieties have clearly demonstrated that certain alleles and their combinations potentially make dramatic changes in trait expression. Hence, the vast germplasm resources need to be relooked for novel alleles to further enhance the genetic potential of crop varieties for various agronomic traits. Allele mining can be visualised as a vital link between effective utilisation of genetic and genomic resources in genomics-driven modern plant breeding.

INTRODUCTION

Allele mining can be effectively used for discovery of superior alleles through 'mining' the gene of interest from diverse genetic resources. It can also provide insight into molecular basis of novel trait variations and identify the nucleotide sequence changes associated with superior alleles. It will help to trace the evolution of alleles, identification of new haplotypes and development of allele-specific markers for use in marker assisted selection. Realizing the immense potential of allele mining, concerted allele mining efforts are underway in many international crop research institutes. Allele mining can be visualised as a vital link between effective utilisation of genetic and genomic resources in genomics-driven modern plant breeding. A wealth of germplasm collections is available worldwide.Over **1,750 gene banks & 2,500 botanical gardens** conserve a total of **7.4 million germplasm** accessions and 80,000 species respectively around the world (http://www.fao.org).

What is Allele mining?

The process of identifying alleles of a known gene/locusthat are involved in a particular mechanism for any giventrait and their variants within other genotypes or identifyingnovel, superior and beneficial alleles from the germplasmor natural population is known as allele mining. Allelemining is a recently developed technique that promises todissect naturally occurring allelic variation in candidategenes that

regulate important agronomic traits and haspotential usage in crop improvement programs.Steps of allele mining are given in the figure 1.

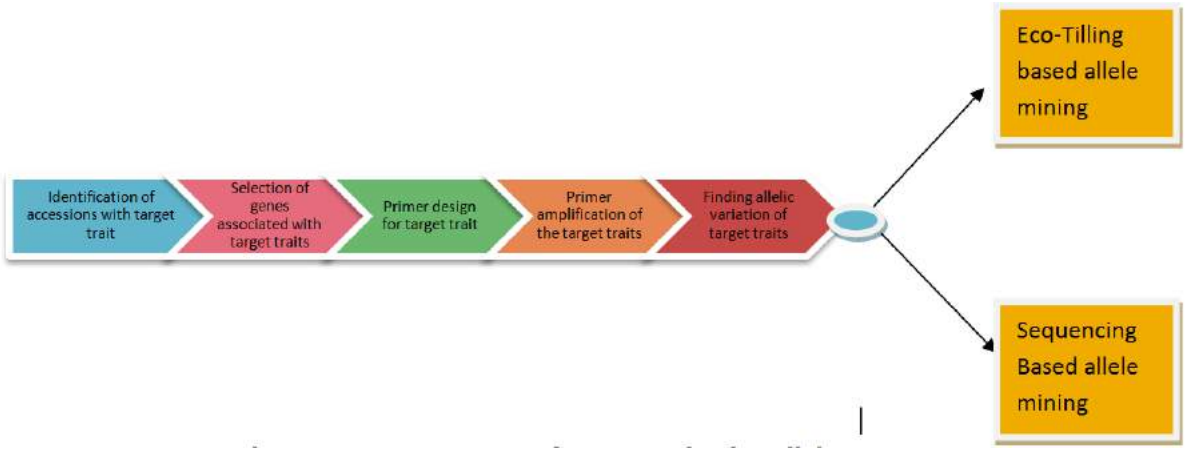
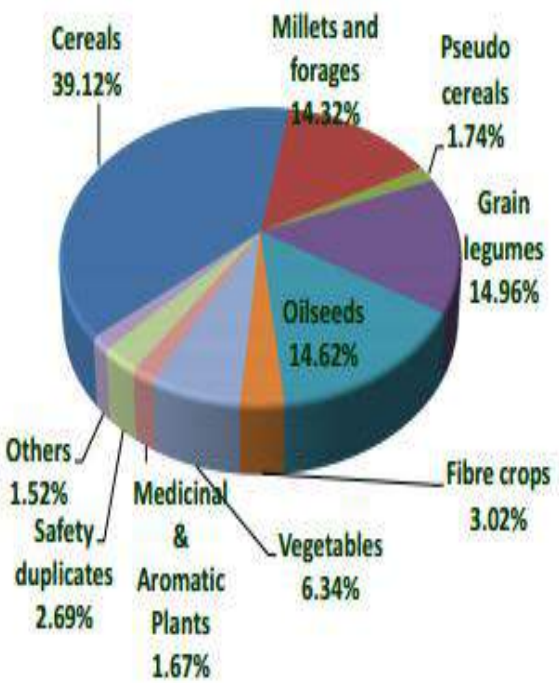


Figure 1. Schematicrepresentation of steps involved in allele mining.

Allele mining allows the validation of specific gene(s) responsible for an individual trait and mining of many favourable alleles from the gene bank. The DNA bank could be developed to utilise allele mining to determine unique germplasm that contains novel alleles as well as allele combinations.

Crop Group	Accessions
Cereals	1,49,289
Millets and Forages	54,639
Pseudo cereals	6,656
Grain legumes	57,111
Oilseeds	55,798
Fiber Crops	11,512
Vegetables	24,196
Fruits	530
Medicinal and aromatic plants	6,390
Spices & Condiments	2,831
Agro-Forestry	2,433
Safety Duplicate	10,235



***Source**: National Bureau of Plant Genetic Resource. (Total Accessions: 4,31,323)As on 25th Feb, 2017*

Huge number of accessions are held collectively by gene banks.These harbour a wealth of undisclosed allelic variants. The solution of the challenge to unlock this variation is Allele Mining.

APPROACHES OF ALLELE MINING

In general, there are two major approaches available for allele mining and/or identification of sequence polymorphisms for a given gene in a naturally developing population

(i) Modified TILLING (Targeting Induced Local Lesions in Genomes) (Comai*et al*., 2004), called Eco-TILLING and

(ii) Re-sequencing (Huang *et al*., 2009) or sequencing based allele mining.

A short description of these two methods is given in the following sections.

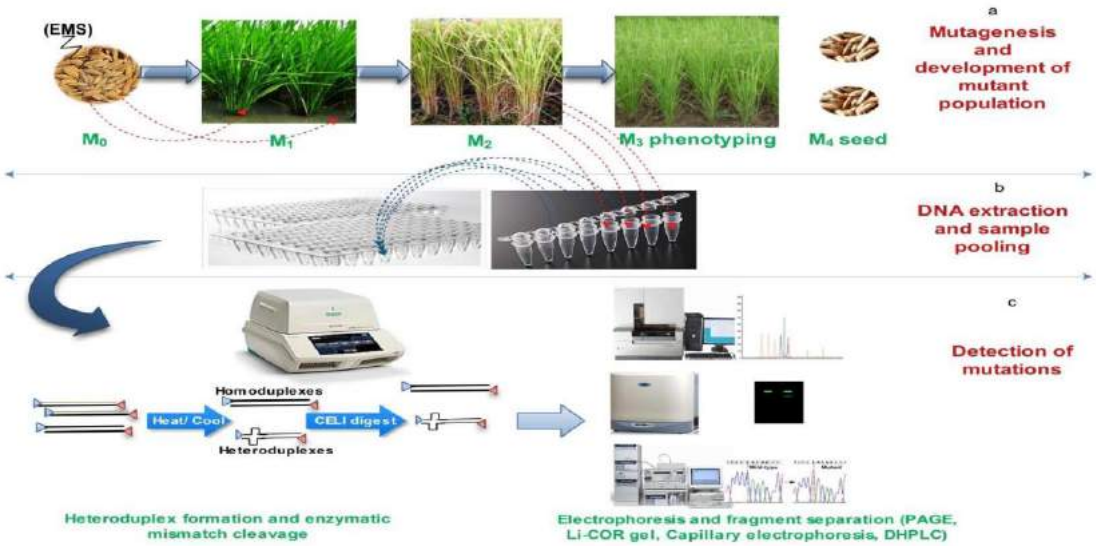
Tilling and Eco-Tilling

Tilling

It is a technique that can identify allelic variation/polymorphism (more specifically point mutation) resulting from induced mutations in a target gene by heteroduplex .A genralised procedure of is depicted in figure 2.

Requirement of tilling

- ❖ Chemical mutagenic agents (EMS)
- ❖ Targeted gene sequence information
- ❖ Two differential 5' end labelled gene specific marker
- ❖ Specific nuclease (CEL 1, S1 and mung bean nuclease)
- ❖ Li-Corgenotyper (Li-Cor, USA)



Source: Ashkani et al. (2015)

Fig 2. Generalised procedure of Tilling

GENERALISED PROCEDURE OF TILLING

- Seeds are mutagenized with EMS, which cause transformation of G/C to A/T
- The mutagenized seeds are sown in field to raise the M_1 population
- Then M_2 population are grown for screening from the harvested selfed seeds of individual M_1 plants.
- Extract DNA from individual plant of M_2 population and pooled DNA sample into eightfold to maximize the efficiency of mutation detection.
- These pooled DNA array on microtiter plate and PCR is performed.
- PCR is performed using two differentially 5'-end labelled gene specific primers to target the desired locus.
- Alternate heating and cooling of the PCR products results in heteroduplex formation due to base mismatch (heteroduplex DNA) in sequence between reference genome sequence available and test genotype.
- CEL 1 nuclease is used to cleave at heteroduplex DNA.
- Then, cleaved fragments are denatured and mutation is detected in PAGE through Li-Corgenotyper.
- Upon detection of mutation in pooled DNA, the individual DNA samples are similarly screened to identify the plant to carry mutation
- This rapid screening procedure to determine the location of mutaton with in ± 10bp of DNA amplicon that are 1Kb in size.
- After detection of mutation in plants, confirmatory sequences is to be done to determine the precise base sequence changes
- Comparison of sequence data with phenotypic data and identification of superior alleles.

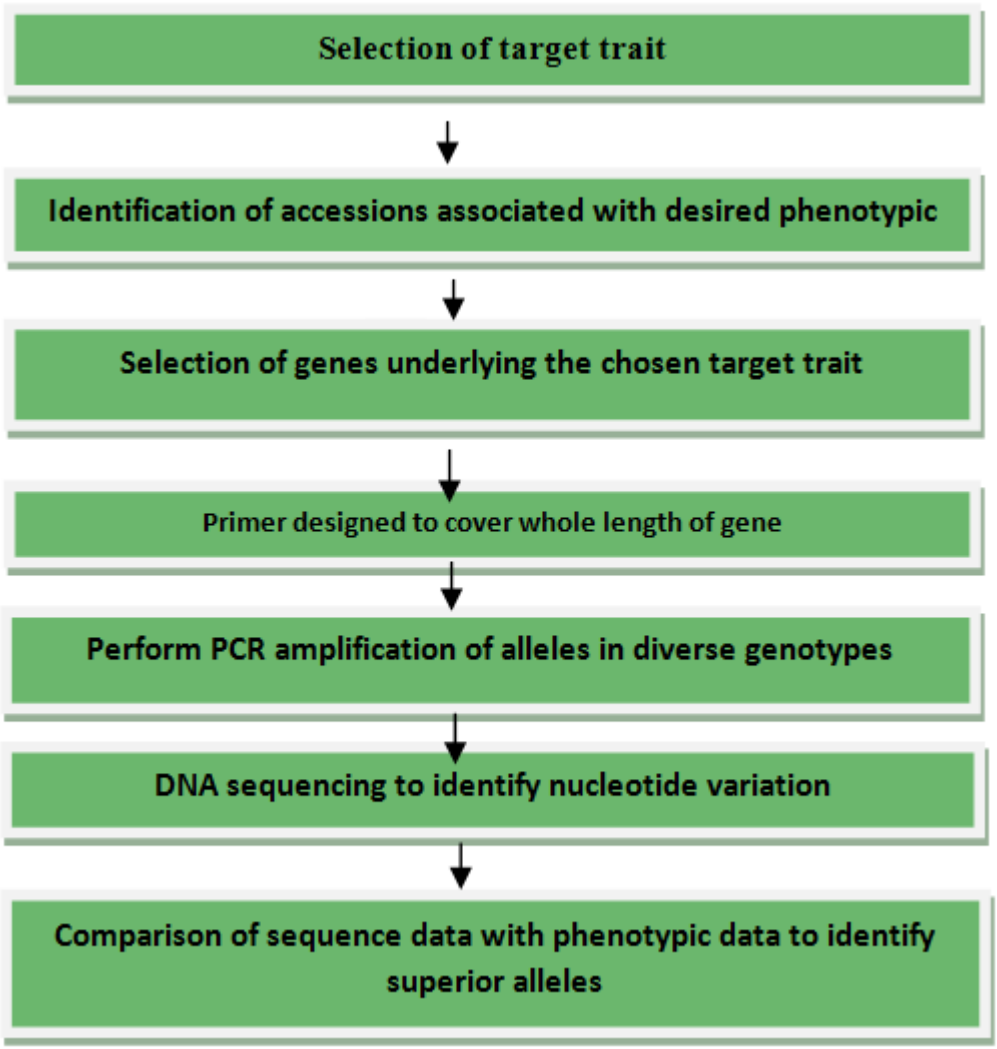
Eco-Tilling

It is an extension of Tilling and first proposed by Comai*et al*., 2004.Used to discover the polymorphism in a natural population.It does not use chemical mutation but use only natural variation present in individual. Aim of Eco-tilling is discovery of SNPs and haplotyping at these loci in natural population.Like Tilling, it also relies on the enzymatic cleavage of heteroduplexed DNA with a single strand specific nuclease followed by detection through Li-Corgenotypers.

SEQUENCING BASED ALLELE MINING

Sequencing-based allele mining involves PCR-based amplification of alleles of a gene in varied genotypes andthen DNA sequencing to recognise nucleotide variance in the alleles. Various alleles among the cultivars through this approach can be identified. The method would help to analyse individuals for haplotype structure and diversity to infer genetic association studies in plants.

PROCEDURE OF SEQUENCED BASED ALLELE MINING



APPLICATIONS OF ALLELE MINING

Allele mining can be successfully employed for the detection of additional alleles from the gene of interest indiverse genetic resources. Allele mining can offer insight into the molecular basis of variations for any trait torecognise the nucleotide sequence changes related to superior alleles. Other applications of allele mining are outlined in the figure below.

CHALLENGES OF ALLELE MINING

- Selection of germplasm to be 'mined'
- Handling genomic resources
- Demarcation of promoter region
- Characterization of regulatory region
- High sequencing costs

CONCLUSION

It is a promising approach to dissect naturally occurring allelic variation at candidate genes.It can be visualized as a vital link between effective utilization of genetic and genomic resources in genomics.It is certainly expected that sequencing based allele mining would emerge as a method of choice in revealing natural variations and in providing novel and effective alleles and would take centre stage for all crop improvement activities. It may pay the way for introgression of identified novel alleles from wild plant to cultivated crop varieties through MAS.

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Mapping opportunities in agribusiness sectors and selecting an agribusiness

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Abstract

India with its large arable land space, diverse agro climatic zones and the potential to cultivate a wide range of agricultural products acts as a significant source for food processing industry. Indian agriculture is moving towards agribusiness. India's transition from an agrarian economy to the world's food factory thus entails significant investments and knowledge support. Opportunities to do business with Indian Agriculture are enormous. Several companies and food chains are now sourcing agricultural products from India to feed their outlets across the world. Further, our exports in several agricultural sub-sectors are increasing.

INDIAN AGRICULTURE TO AGRIBUSINESS

India has the second largest arable land in the world with diverse agro-climatic zones across the country which offers tremendous production advantages in agriculture, with the potential to cultivate a vast range of agricultural products. This acts as a vast source for food processing. Indian agriculture is moving towards agribusiness. The domestic market is moving at a faster pace attracting the acceptance for Indian products in the international market. With a population of over 1.2 billion and growing at about 1.6 % per annum, India is a large and growing market for food products. However, the Indian F&A sector still remains largely unorganized and requires a significant amount of patience and expertise in educating the promoters, analyzing the unusual circumstances and also structuring complex investments. The evolving Indian F&A landscape therefore presents significant investment opportunities along with several industry-specific risks.

India's transition from an agrarian economy to the world's food factory thus entails significant investments and knowledge support. Besides capital, realizing India's potential in agribusiness would require an in-depth understanding of the international farming practices, technologies, application of food safety norms, global market linkages coupled

with a through appreciation of local knowledge and practices.

With structural transformation of the economy, the share of agricultural production (farming) is going down, and that of processing, distribution and trade is increasing. With the increase in backward and forward linkages, the distinction between agriculture and agro-industry is getting blurred.

In the developed countries, agribusiness is defined as the total output arising from farm production and product processing at both pre- and post- farm gate levels. In developing countries like India, the agribusiness sector encompasses four distinct sub-sectors, viz. agricultural inputs; agricultural production; agro-processing; and marketing and trade. All these add value or utility to the goods. Agribusiness is emerging as a specialized branch of knowledge in the field of management sciences. In this context, agribusiness can be defined as science and practice of activities, with backward and forward linkages, related to production, processing, marketing, trade, and distribution of raw and processed food, feed and fibre, including supply of inputs and services for these activities.

Need for transition from agriculture to agribusiness

Though agricultural marketing has faced tremendous change, it has changed the emerging demand for services. Some of the marketing system-related limitations have been as follows (Acharya, 2006):

(i) The market size is already large and is continuously expanding. The farmers' market linkages (both backward and forward) have also increased manifold, but the marketing system has not kept pace.

(ii) Private trade investment in marketing infrastructure is low due to excessive regulatory framework and dominance of unorganized sector.

(iii) Increased demand for value-added services and geographic expansion of markets require lengthening of the marketing channel.

(iv) Food processing industry has a high multiplier effect and employment potential.

Sound development of agribusiness provides a new frontier by creating an environment of much needed investment in agricultural marketing and trade. Development and promotion of agribusiness sector, which has strong linkages with the agricultural production, agro-processing, and service sectors, is capable of influencing each one of them through adequate investment in necessary activities. Transformation from 'agriculture'to'agribusinesses is being advocated and espoused. The basic philosophy of promoting agribusiness lies in the statement "Eat what you can and CAN what you cannot".

AGRIBUSINESS OPPORTUNITIES

To improve the efficiency of the marketing system, there is a need of substantial investment in marketing infrastructure, both physical and institutional. The investment needs and opportunities for investors exist in the following broad areas.

Opportunities to do business with Indian Agriculture are enormous. Some of them are stated hereunder.

a) Food grains
- Fruits
- Mango, Papaya, Pineapple, Guava, Pomegranate, Lime, Sweet orange, Banana, Grape, Sapota etc.

b) Vegetables
- Carrot, Cabbage, Cauliflower, Beans, Okra, Peppers, Tomato, Bell peppers, Gherkins, Onion, Peas etc.

c) Flowers
- Rose, Coronations, Gerbera etc.

d) Processed Fruits and Vegetables
- Fruit pulp, concentrates, flavors, extracts, frozen fruits, frozen vegetables, pickled products, assorted products.

e) Spices
- Black pepper, Red pepper, Garlic, Tamarind, Ginger, Basel leaves, Rosemary, Oregano etc.

f) Medicinal and Aromatic plants, Essential oils etc.

g) Mushrooms
- Button mushrooms in whole or sliced form in cans/bottles

h) Dairy products
- Milk, Milk powder, Butter, Ghee, Cottage cheese etc.

i) Poultry & Meat products

j) Aqua products
- Fish, Shrimp, Crab, Assorted, Value added products etc.

k) Organic products

- Fruits, Vegetables, Food grains, Mushrooms, Medicinal & Aromatic plants etc.

(i) Production
- Production of high-yielding seeds
- Production of high-quality planting material, including use of tissue
- culture methods of micro-propagation
- Nurseries, including hardening nurseries
- Organic farming
- Production of microbial cultures and vermicompost, and
- Floriculture

(ii) Processing
- Fruit and vegetable processing, including dehydration, canning, aseptic
- packaging, processing of underutilized fruits, and processing for other
- products like grape raisin, osmo air-dried fruits, fruit toffee, bleached
- dry ginger and spices' powders
- Processing of maize for starch and feed through improved mini/
- small mills and dry milling plants
- Processing of millets for various purposes, including malt from finger
- millets and RTE (Ready-to-Eat) products
- Processing of sugarcane for various jaggery products like spiced
- Jaggery, powdered jaggery, and jaggery cubes
- Processing of herbal and medicinal plants
- Processing of dairy products
- Processing for poultry products, including poultry dressing, and
- Processing of livestock products and livestock wastes

(iii) Infrastructure

- Cool chain infrastructure, including cold stores
- Storage and warehousing
- Specialized transport services
- Packaging infrastructure, including pack houses, and
- Agri-clinics and service centres

(iv) Trade and Others

- Procurement through contract arrangements, including contract
- farming
- Retailing
- Supply chain management, and
- Capacity building, including human resource development in
- agribusiness.

Many of these activities can be taken up by small and micro enterprises (SMEs). The employment potential of SME sector is very high. Several companies and food chains are now sourcing agricultural products from India to feed their outlets across the world. Further, our exports in several agricultural sub-sectors are increasing.

SELECTING AN AGRIBUSINESS

An enterprise in agricultural sector is any producing unit that combines resources to achieve its strategic objective(s). An enterprise could be a unit producing a particular crop, livestock and processing any raw resources to consumable goods.

The steps include the following:

Goal setting

Every individual has his or her own view of goals. These goals need to be more specific and action oriented. Furthermore, these goals should be measurable in some way and have a time frame associated with them. When writing down the goals, also write down the time frame and ways used to measure the achievement. This will help in evaluating the success of the business and in developing an implementation plan.

The following is a list of questions that can be used to help develop the list of goals:

- Whether the primary reason for farming is to maximize income, to have a rural lifestyle, to provide income for family members, or other reasons?
- What other activities are the person is involved in, and what are the priorities of these activities relative to the farm business?
- Whether full-time effort to the farm or farming to be a part-time activity is preferred?
- How much a person is willing to be restricted by time and capital demands of your farm business?
- Eventual transfer of the ownership of the farm to a partner or family member is needed?
- Is income from the farm and/or sale of the farm an important part of the retirement plan?
- What is the desired period between initial investment and cash returns?
- Whether learning of new skills through self-study or formal training is preferred?

The availability of resources will ultimately limit the choice of enterprises simply because the resource requirements among enterprises vary. A list of resources typically includes land, labor and capital. But there are other factors to consider such as climate, access

to information, management skills, and markets.

Access to markets is the most commonly overlooked factor in the enterprise selection process. But in fact it can be the most limiting constraint. Consider the market potential carefully. If it is a product that has never been tried before in the area of interest, plan to take several years to get established. Be realistic about the cash flow situation and plan accordingly. For each of the areas listed below create a list of the resources available. This will be compared later to the resources required by each enterprise under consideration. A written list will enable to easily check off the requirements on the enterprise resource requirement list later on.

1. Physical Factors
    a. Land
    b. Climate
    c. Irrigation Water
    d. Farm Structures
    e. Machinery and Equipment
2. Financial Factors
3. Management Factors
4. Personal Skills
5. Information Access
6. Labor Factors
7. Marketing Factors

Listing of possible enterprises

After identifying the goals and resources, develop a list of possible enterprises. The following set of questions would do the needful.

- Which enterprises are predominant in the area of interest?
- Are there enterprises which are of interest have been successful in other areas in similar soil and climate conditions (i.e., enterprises that have potential in the area of interest but have not yet been established)?
- Which are the enterprise types with which are feel more compatible: livestock, field crops, orchard crops, small fruits, vegetables, ornamentals, growing transplants, raising seed?

Determination of enterprises in compatible with the resource availability

Carefully evaluate the potential for each of the enterprises on the list. This can be done by systematically comparing the resource needs for each enterprise to the resources available.

Resource requirement determination

To start off with, the local resource producers may be contacted about the experience with the enterprise under consideration. The university and the state agricultural departments may be contacted for the initial details about the needs of the enterprise under consideration. This could also support the feasibility check of the project under consideration.

CONCLUSION

Several agri-business opportunities are wide open. To be in line with the existing agribusiness market one has to be updated on the current happenings in the market. The above discussion could be an eye opener on what are the basic aspects that differentiate agriculture as an occupation to agri business. Also the various possible areas that could be dived into as an agribusiness opportunity are also discussed.

Role of Immune Response in Herpes Simplex Virus Infection

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Herpesvirales is a huge order that includes numerous viruses which can potentially infect humans and almost all animal species, including insects, fish, mollusks, reptiles, birds, primates and finally mammals. It is known that the word 'herpes' has been used in human medicine for at least 2600 years due to early description of the disease causing eczema and cancer of the skin (Wozniakowski and Samorek, 2015). The most important diseases of animals caused by herpesviruses include bovine rhinotracheitis, Marek's disease, infectious laryngotracheitis and pseudorabies.

Family *Herpesviridae* are double stranded DNA viruses. Family name is derived from the Greek word *herpein* ("to creep"), referring to the latent, recurring infections typical of this group of viruse.These viruses are rather host-specific, with the exception of pseudorabies virus (Suid herpesvirus-1) which infects not only swine, but also sheep, cattle, dogs, cats and raccoons.

TRANSMISSION

- Transmission requires *close contact*, particularly mucosal contact (e.g., coitus, licking and nuzzling as between mother and offspring or between foals or kittens).
- In large, closely confined populations, such as found in cattle feedlots, modern swine farrowing units, catteries or broiler facilities, sneezing and short-distance *droplet* spread are major mode of transmission.
- In latently infected animals, the virus is occasionally reactivated; it can be re-excretedwithout any clinical sign and, by this way, transmitted silently to virgin animals.

PATHOGENESIS

Herpes simplex virus (HSV) is thought to be transmitted from animal to animal as cell-free virus. Abrasions help HSV gain access to living cells below the keratinized debris on skin surfaces. Local antibodies could neutralize virus prior to cell entry and no initial replication would

occur, preventing both neuronal infection and horizontal transmission (Quinn *et al.,* 2011). Subsequent to epithelial infection, HSV enters sensory nerve endings and ascends in a retrograde manner to neuronal cell bodies in ganglia. The neurons become productively infected, and virus is transmitted across synapses. Here, CD8 cells and natural killer cells play role in control of primary ganglionic infection. A further consequence of ganglionic infection is the establishment of latency in a variable number of neurons. Latency is associated with transcription of an RNA species termed LAT (latency-associated transcript).

Reactivation of latent HSV from isolated ganglia ex-vivo is promoted by anti-CD8 or anti-gamma interferon treatments, implying that resident CD8 cells and/or lymphocyte-derived cytokines contribute to the control of reactivation. Taken together, this implies that acquired immunity in general, and CD8 T cells in particular, may be important in both initial control and suppression of reactivation at the level of the ganglia (Owen *et al.,* 2013). After reactivation from latency, viral components travel down the axon and assemble for transmission to epithelial cells. Reactivation of HSV can lead to either subclinical shedding or symptoms and lesions. Because most sexual transmission occurs during asymptomatic shedding, it is critical to measure the effect of proposed preventative or therapeutic immunologic interventions on subclinical shedding. Among immune competent animals, rates of subclinical and clinical reactivations are directly related. When lesions occur, there is a brisk infiltration of NK (Natural Killer)) and CD4 cells followed by CD8 T cells. Antigen-specific cytotoxic T lymphocytic activity typically peaks after antigen-specific CD4 proliferative activity, and is correlated with viral clearance. Both CD4 and CD8 cells contribute to this cytotoxic T lymphocyte activity. Subclinical shedding in the absence of lesions or symptoms may be the outcome of particularly early or effective local cellular immune responses.

REACTIVATION AND RE-EXCRETION

In the veterinary field, the phenomenon of re-excretion is of great importance, from the epidemiological point of view. The re-excretion of latent herpesvirus is modulated by the level of specific immunity, which, in turn, is dependent on the schedule of previous infections, reactivations or vaccinations, and whether the immune response was induced by the multiplication of a wild-type or an attenuated virus. The sequence of events may be interpreted as follows: after a primary infection, the animal is able, by its immune system, to prevent the clinical effects of a re-infection with a virulent strain but cannot properly control an episode of re-excretion.

The first reactivation of virus with or without re-excretion produces an increase of the specific immune status and of the efficiency of some immune mechanisms (Thiry *et al.,* 1986). The animal is therefore able to control a further reactivation better and for a longer time and no re-excretion occurs. Reactivation of latent herpesvirus could be induced either by immune depression, or by a direct effect of the stimulus on the latently infected cells or by a combination of these two mechanisms. Stressful

conditions like, parturition, transport, superinfection by another virus, bacterial infection, re-housing, local irritation of the skin, poor housing condition, cyclophosphamide treatment and injection of glucocorticoid suppress the immune system of the animals and give stimuli for reactivation of latent herpesvirus.

ZOONOTIC POTENTIAL

Host specific herpesviruses may pose a threat for public health and also exert a negative impact on the economical aspects of animal production.

a) Herpes B virus (B virus) also called cercopithecine herpesvirus-1 (CeHV-1), occurs frequently among macaques. The virus shares a similar infection scheme to human herpesvirus-1. Infection may be transmitted through the saliva of monkeys or after being bitten by the animal (Wozniakowski and Samorek, 2015).
b) Transmission is also possible in laboratory conditions by the workers processing central nervous tissue or other internal organs of monkeys, especially kidneys. In the case of human infection, the incubation period lasts from 2–5 weeks. The clinical signs include formation of small vessels under the skin and hyperesthesia around the scratch or bite. Further signs include paralysis and encephalitis that lead to death.
c) Vaccinated birds are potential carriers of virulent Marek's disease virus and shed the virus into environment within particles of dust and fine skin scrapings (Karsten and Nikolaus, 2010). Therefore, not only birds are prone to inhalation of the virus particles but also animal holders and veterinarians.
d) Pigs and equines may also transmit herpesvirus infection to humans but incidences are very low.

CONTROL AND PREVENTIVE MEASURES

(i) All bite or scratch wounds incurred from macaques or from cages that result in bleeding should be immediately and thoroughly scrubbed and cleansed with soap and water.
(ii) Persons, who handle macaques, should be trained in proper methods of restraint and in the use of protective clothing to help prevent bites and scratches.
(iii) Antiviral medication should be given soon after potential exposure to virus (preferably within the first few hours after exposure) but only after first aid has been provided and cleansing has been done.
(iv) Inactivated, subunit and modified live vaccines are available for the control of herpesvirus infection in bovines. Vaccination reduces the severity of clinical signs but may not prevent infection (David and Lawrence, 2003). Modified live vaccines may cause abortion and should not be administered to pregnant animal.
(v) Strict biosecurity along with adequate hygiene and sanitation, all-in and all-out policy of rearing stocks along with vaccination, minimize the chances of infection.
(vi) Vaccine strains which are temperature sensitive are not

effective above 37°C and should be administered by intranasal route.

(vii) Appropriate serological tests should be performed to differentiate vaccinated animals from those infected with field virus.

(viii) Quarantine, to some extent will also help contain the spread after an outbreak.

(ix) Successful eradication programmes based on tests and slaughter policies have been carried out.

CONCLUSION

The herpesviruses constitute a virus group that, at the end of infection, take refuge in the host and become latent. Reactivation of the latent herpesvirus leads to a new episode of disease, in spite of the previous exposure of the immune system to the virus, and in spite of the presence of neutralizing antibodies. In immune-compromised hosts, herpesvirus infections can become life-threatening. Thus, the immune system in its response to the viral antigens plays an important role in reducing the severity of the infection caused by the herpesvirus and probably enhances the defences against further recurrencies of the virus. However, this does not prevent the production of the virus in individuals who carry a reactivable latent herpesvirus and its spread to individuals who have not previously been exposed to the virus.

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Management of Acid Soils: 7 Ways

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Soil reaction is a very important chemical property of the soil. It is measured in terms of pH. The soils having pH 7 are neutral in reaction and those below 7 are acidic and above 7 are alkaline, respectively. In neutral soils, satisfactory plant growth can be expected, provided all other agronomic practices are followed properly. But neither acid soils nor saline soils are suitable for most of the crops except a few tolerant ones. Acidity or salinity acts as a limiting factor in crop production. When the concentration of some elements which are naturally acidic in reaction, goes too high in the soil, soils become acid and their pH goes down below 7. These elements are basically hydrogen (H), aluminium (Al) and Iron (Fe). In fact, last two elements are not directly responsible for soil acidity but they have a tremendous potential to generate hydrogen ions (H+) in the soil which are direct cause of acidity. The more the number of hydrogen ions in a solution, the greater will be its acidity and the lesser pH count. Therefore, the soils having hydrogen ions concentration above a reasonable limit or pH below 7 are termed as acid soils.

Extent of acid soils in India:

Acid soils constitute about 30 % of the total cultivable area in India. These soils are formed due to drastic weathering under hot humid climate and heavy precipitation. Based on general estimations, nearly 25 million hectares of land is having pH below 5.5 and 23 million hectares fall under the pH range of 5.6 - 6.5. In all those tracts of the country where rainfall and temperature are high, acid soils are predominantly found. North-east region has the largest stretches of acid soils followed by neighboring states of West Bengal, Bihar and Orissa. In the coastal region of Kerala and Andhra Pradesh, high rainfall and temperature have contributed to the development of acid soils.

CAUSES OF ACID SOIL FORMATION:

- High precipitation leading to leaching loss of basic cations from soil.
- Excessive use of water or keeping the field submerged for a long time accompanied by improper drainage may lead to the development of acidity in the soil.
- Continuous use of acid forming fertilizers (e.g. Ammonium sulphate, Ammonium chloride, etc) for years may also lead to considerable reduction in soil pH.
- Continual removal of crop residue from field and no or little addition

of organic matter (e.g. FYM, compost, vermin compost etc.).

EFFECTS OF SOIL ACIDITY ON CROP:

- Reduction in the amount of nutrients being recycled by soil micro-organisms (e.g. nitrogen supply may be reduced) as the growth of microorganisms is affected by the soil acidity.
- Induced deficiencies of calcium, magnesium, sulphur, boron and molybdenum.
- Limited ability of plants to use subsoil moisture.
- Aluminium, manganese, iron may reach in toxic levels.
- Acidity itself may cause damage to root hairs and affects moisture and nutrient uptake
- Affect N-fixation by legumes.
- Imbalance in microbial population, soil fungi predominates over bacteria.

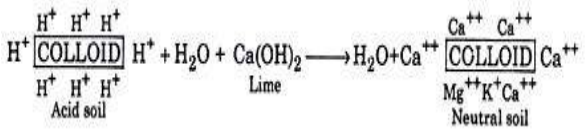
Management of soil acidity:

The 7 ways of managing an acidic soil are as follows:

1. Addition of Liming Material:

Soil acidity is the result of the accumulation of a predominance of hydrogen (H) ions over hydroxyl (OH) ions. The bulk of H ions are held in close association with the colloidal complex. When lime is added to moist soil, the soil solution becomes charged with calcium ions. These active Ca-ions exchange take place with hydrogen ions in the exchange complex. Hydrogen combines with OH-ions to form neutral water or with CO_3 to form unstable H_2CO_3, which is readily changed to H_2O and CO_2.

The reaction is given below:



2. Use of Basic Fertilizer:

Use of basic fertilizers like sodium nitrate, basic slag etc. reduces the acidity in soils.

3. Use of Rock Phosphate:

Phosphate fertilization is almost essential for sustaining crop production in acid soils. As it is known that acid soils fix phosphorus in the soil. Application of rock phosphate in acid soil, soils provide an ideal situation for release of Phosphorus (P) from rock phosphate (RP).

The efficiency of rock – phosphate increase with increasing fineness. A low pH (below 5.0) facilitates release of phosphate from rock phosphate and the effectiveness decreases with increasing pH above 5.0. It is advisable to apply rock-phosphate several months ahead of liming to permit dissolution of rock phosphate at low pH. Rock phosphates is preferred source of Phosphorous(P) in acid – soils as it is a cheaper source and contains 30 to 50% CaO. CaO increase available calcium (Ca) in the soil, thus raises soil pH and lowers exchangeable Al content.

4. Soil Management:

Proper soil and water management checks leaching of bases and enhances decomposition of organic matter.

5. Growing of Acid Tolerant Crops:

In acid soils, acid tolerant crops should be grown. Choice of crops may be done according to soil pH.

Crops can be divided into following groups:

(a) Highly acid tolerant crops: Rice, potato, sweet potato, oat, castor, Echinochloa, Paspalum etc.

(b)Moderately acid tolerant crops: Barley, wheat, maize, turnip, brinjal, cow pea, mung beans, pigeon peas, pea nuts etc.

(c) Slightly acid tolerant crops: Tomato, carrot, red clover etc.

6. Increasing the Efficiency of Nitrogen and Potassic Fertilizers in Acid Soils:

The need for nitrogen fertilizer can be minimized by introducing acid tolerant N-fixing legumes in the cropping system besides improving the efficiency of fertilizer nitrogen. Higher nitrogen (N) rates are recommended in high rainfall areas to compensate leaching losses. Split application of N definitely improves recovery.

The efficiency of potassium fertilizer can be increased by split application of k- fertilizer. The split application is quite essential in acid soils having sandy texture.

7. Water Management:

Acidification can be prevented by continuous flooding or saturation. Where that is not possible, the soils are drained and leached to remove the acid material. After submergence the soil pH rises due to precipitation of aluminium hydroxide and by the reduction of ferric ion.

Reclamation of Saline Soils

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Salinity poses a major management problem in many unirrigated areas where cropping is done under rainfed conditions. Saline soils are those in which the soluble salts contain appreciable amounts of calcium and magnesium. Dry land salinity has been a threat to the land and water resources in several parts of the world although only in recent years has the seriousness of the problem become widely known. Saline spots or areas occurring in the dry land fields have been known by several local names, but most commonly as saline seeps. These problem soils range from a slightly saline soil condition which reduces crop growth to extensive areas where cultivation is almost impossible.

Following methods may be used for removal of salts:

(A) Mechanical Methods:

(i) Flooding and leaching down of the soluble salts:

The leaching can be done by first ponding the water on the land and lowering it to stand there for a week. Most of the soluble salts would leach down below the root zone. After a week, standing water (dissolved with soluble salts) is allowed to escape. Such, 2 to 3 treatments are given to reclaim highly saline soils. Sometimes gypsum is also added to flood water when the soluble salts are low in calcium to check development of alkalinity.

(ii) Scrapping of the surface soil:

When the soluble salts accumulate on the soil surface, scrapping helps to remove salts. This is a temporary cure and salinity again develops on such lands.

(B) Cultural Methods (Crop, Soil and Water Management):

(i) Providing proper drainage:

If the soil is not free draining, artificial drains are opened or tile drains laid underground to help wash out the salts.

(ii) Use of salt free irrigation water:

Salt free good quality of irrigation water should be used.

(iii) Proper use of irrigation water:

It is known that as the amount of water in the soil decreases the concentration of salts in the soil solution increases, thus, moisture should be kept at optimum field capacity.

(iv) Planting or sowing of seeds in the furrow:

The salt concentration even in smaller amounts is most harmful to the germinating seedlings. Water generally evaporates from the highest surface by capillarity and hence, these points have maximum salt concentrations. If the seeds or seedlings are planted inside the furrows, they escape the zone of maximum salt concentrations and thus, can germinate and develop properly during their early growth stage.

(v) Use of Acidic Fertilizer:

In saline soil, acidic nature of fertilizers (e.g., Ammonium sulphate) should be used.

(vi) Use of organic manures:

The organic manures have very high water-holding capacity. When sufficient amount of these manures are added the water-holding capacity of soil increases and as a result the conductivity of the soil solution decreases.

(vii) Ploughing and leveling of the land:

Ploughing and leveling of the land increases the infiltration and percolation rate. Therefore, salts leach down to the lower levels.

(viii) Retardation of water evaporation from soil surface:

Water may be conserved in the soil retarding the water evaporation. Thus, salts may remain in the lower level with the water.

(ix) Growing of salt tolerant crops:

(a) High salt tolerant crops: Para grass, barley, sugar beet, etc.

(b) Moderately salt tolerant crops: Wheat, rice, sorghum, maize, flax etc.

(c) Low salt tolerant crops: Beans, radish, white clover etc.

(d) Sensitive crops: Tomato, potato, onion, carrot etc.

An Overview of Drip Fertigation Technology

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Water is an important natural resource among all resources on earth. No life form can be sustained without water on the planet. It is essential for all the important activities like food production, industries like energy, production and manufacturing. Although, we know water content and quality is depleting in the soil may be due to improper use of water or drastic climatic change or use of more chemical to increase productivity. Rapid increase in area under micro-irrigation, now fertigation is getting momentum in number of countries. The concept of fertigation is new to the Indian subcontinent growing popularity to accept of this concept making it easy to adopt 'Fertigation'. Here, drip fertigation is an important technology, which is defined as the injection of fertilizers, amendments or water-soluble products into the irrigation system. Moreover, fertigation is related to chemigation, which is the injection of chemicals into an irrigation system. In the drip fertigation system, water is emitting through the drippers at lower rate and nutrients from the fertilizers move along with the water. Nutrients are directly available in the vicinity of the root zone without much loss in the soil. In this system fertilizer solution is distributed evenly in irrigation. The availability of nutrients is very high therefore the efficiency is more. Drippers keep the soil moist thus roots in wetted area increase the efficiency of water and nutrient uptake. In this method liquid fertilizer as well as water soluble fertilizers are used. By this method, fertilizer use efficiency is increased from 80 to 90 per cent (Table 1).

Table 1: Fertilizer efficiencies of various application methods

Nutrient	Fertilizer use efficiency	
	Soil application	Fertigation
Nitrogen	30-50	95
Phosphorus	20	45
Potassium	50	80

ADVANTAGES OF DRIP FERTIGATION:

1. Increased nutrient absorption by plants.
2. Reduction of fertilizer, chemicals, and water needed.
3. Reduced leaching of nutrients into the water supply.
4. Reduced water consumption due

to the plant's increased root mass ability to trap and hold water.
5. Maximum use of available water.
6. Better yield and quality of products obtained.
7. Low labour and relatively low operational cost.
8. Improves infiltration in soil of low intake.
9. Ready adjustment to sophisticated automatic control.
10. Improves seed germination
11. Decreased to tillage operation.
12. Application of nutrients can be controlled at the precise time and rate necessary thus increases fertilizer use efficiency.
13. Minimized risk of the roots contracting soil borne diseases through the contaminated soil.
14. Reduction of soil erosion issues as the nutrients are pumped through the water drip system. Leaching is decreased often through methods used to employ fertigation.

DISADVANTAGES OF DRIP FERTIGATION:

1. Sensitivity to logging
2. Salinity hazards
3. High cost compared to furrow
4. High skils required for design, install and operation.
5. Concentration of the solution decreases as the fertilizer dissolves. This may lead to poor nutrient placement.
6. The water supply for fertigation is to be kept separate from the domestic water supply to avoid contamination.
7. It needs water-soluble fertilizers, the availability of fertilizers is limited.
8. Possible pressure loss in the main irrigation line.

Fertilizers used in fertigation (Table 2):

- ✓ Urea, potash and highly water-soluble fertilizers are available for applying through fertigation.
- ✓ Application of super phosphorus through fertigation must be avoided as it makes precipitation of phosphate salts. Thus phosphoric acid is more suitable for fertigation as it is available in liquid form.
- ✓ Special fertilisers like mono ammonium phosphate (Nitrogen and Phosphorus), poly feed (Nitrogen, Phosphorus and Potassium), Multi K (Nitrogen and Potassium), Potassium sulphate (Potassium and Sulphur) are highly suitable for fertigation as they are highly soluble in water. Fe, Mn, Zn, Cu, B, Mo are also supplied along with special fertilisers.

RULES FOR FERTIGATION:

A few rules should be followed to achieve maximum benefits of fertigation are following-

1. Type and amount of fertilizers used must be soluble enough to dissolve in the fertilizer tank.
2. Completed pressurized drip irrigation system is required before fertigation begin.
3. The fertilizers should be injected ahead of the filters to ensure that any undissolved particles are filtered out before fertilizer enters

the drip tape.

4. All fertigation units should be wired to the pump switch control or a flow control switch in the main line to prevent the uniform running when no water flows in the line.

Table 2: Fertilizers used in fertigation (Arora *et al*., 2015)

Name	N-P_2O_5-K_2O content	Solubility (g/l) at 20° C
Ammonium nitrate	34-0-0	1830
Ammonium sulfate	21-0-0	760
Urea	46-0-0	1100
Monoammonium phospahte	12-61-0	282
Diammonium phosphate	18-46-0	575
Potassium chloride	0-0-60	347
Potassium nitrate	13-0-44	316
Potassium sulfide	0-0-50	110
Monopotassium phosphate	0-52-34	230
Phosphoric acid	0-52-0	457

PRE-REQUISITES FOR SUCCESSFUL FERTIGATION:

1. Scientifically designed and well installed drip irrigation system.
2. Drip system material should be free from residues/deposits and fertilizers must not cause excessive corrosion of irrigation system components.
3. Irrigation system operation pressure variation should be minimum.

Selection of most appropriately fertilizer according to soil condition, plant requirements and cost.

Drip fertigation is found to be well suitable for horticultural crops. In India the adoption of this technology has resulted in enhancement of agricultural production. Water use efficiency and yield enhancement in vegetable production through drip fertigation is being mentioned in table 4.

Table 4: Water economy and yield enhancement in vegetable production through drip fertigation (Soman P., 2009)

Vegetable crops	Yield increased (%)	Water saving (%)
Toamto	50-60	40-60
Potato	20-30	40-50
Brinjal	20-30	40-60
Chilli	30-40	60-70
Cauliflower	60-80	30-40
Cabbage	30-40	50-60
Bottle gourd	30-40	40-50
French bean	55-65	30-40
Okra	25-40	20-30

CROPS SUITABLE FOR FERTIGATION:

Fertigation can be practised in large number of crops (Table 3). Row crops are most suited for fertigation.

Table 3: Crops suited to drip fertigation (Rajput T.B.S., 2010)

Orchard crops	Grapes, Banana, Pomegranate, Orange, Citrus, Lemon, Guvava, Papaya, Sapota, Litchi, Watermelon, Muskmelon and Mango
Vegetables	Tomato, Chilli, Cabbage,

	Cauliflower, Onion, Okra, Brinjal, Bottle gourd, Cucumber, Peas, Pumpkin, Ridge gourd etc.
Flowers	Rose, Gerbera, Jasmine, Lily, Mogra, Marigold, Anthurium, Dahilia etc.
Oilseeds	Sunflower, Oil palm, Groundnut etc.

CONCLUSION

Drip fertigation is most suitable alternate for farmers live in the area where water scarcity is the most common problem. Fertigation meets the nutrient demand of the crop direct in the vicinity of the root zone. Water and nutrient losses are reduced and decrement in weed growth therefore allows plant to accumulate more water and nutrients with increased uptake thus enhances the growth, quality and yield of the products and moreover the economic status of a farmer.

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Extension- Plus: New Face of Extension with Expanding Roles

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CONCEPT OF EXTENSION PLUS

Agricultural extension system in India, being one of the largest knowledge and information dissemination institutes in the world, has undergone several changes since independence. Still, a large number of smallholder farmers and other vulnerable groups remain unreached by the public extension system. A number of organizational performance issues hinder the effectiveness and efficiency of public extension system. These include inadequate staff numbers, low partnerships, and continued top-down linear focus to extension. According to the research studies, extension worker to farmer ratio is very wide in India, i.e. **1:2879** (estimated 60 thousand extension workers) which is far wider than Ethiopia (**1:476**) and China (**1:625**) whereas agricultural population to agent ratio is **1:9788** in Congo.

Extension-plus is a framework for investment in strengthening and reforming extension to be a strong partner and nodal agency within the Agricultural Innovation system and in particular Livestock Innovation system, providing technological and non-technological services to farmers. The larger goal of investments in extension-plus is to strengthen the capacity of extension and advisory services to play a much wider role (a bridging role) and at the same time enhance the ability of other actors in the AIS to support producers in an integrated way.

Worldwide, it is now widely recognized that agricultural extension needs to reform in ways that allow it fulfil a diverse set of objectives. This ranges from better linking of farmers to input and output markets, to reducing the vulnerability and enhancing voice of the rural poor, development of micro-enterprises, poverty reduction and environmental conservation and strengthening and support of farmer organizations. So while technology transfer is important, what is also required is the strengthening of locally relevant innovation processes and knowledge systems. Extension is being forced to embrace a broadened mandate that, while in reality has always existed, has rarely been addressed. The limitations of a single model of extension for all kinds of situations are now well recognized and there is an increasing realization that new extension

approaches need to emerge locally, based on experimentation, learning and adaptation to prevailing circumstances.

The need for this new and expanded view of extension is clearly emerging in the case of Indian agriculture, which is characterized by declining land and water availability, degradation of natural resources, an unfavorable price regime, low value addition, particularly in rural areas and increasing competition from import of agricultural commodities. Farmers thus find themselves in an ever more complex production and market environment, with an expanding need for information and services.

The key elements of Extension- Plus include:

a) A broad scope for service provision
b) The extensive use of partnerships to fulfill an expanded mandate.
c) A learning-based approach.
d) Negotiations with a wide range of stakeholders for developing workable and effective service arrangements.
e) An institutional mechanism to represent clients' interests at the management level, so the program remains accountable to its clients.
f) Use of Social Media
g) Gender responsive extension
h) Climate resilience

EXTENSION PLUS IN ACTION

Government initiative:

Kerala Horticultural Development Programme (KHDP) was conceived in 1992 as a project to improve the overall situation of fruit and vegetable farmers in Kerala; by increasing and stabilizing their income; reducing cost of production and improving the marketing system. KHDP used self-help groups (SHGs) as its key concept for promoting the development of farmers and experimented with different approaches to provide better access by farmers to technology markets and credit. Every SHG selects three master farmers; one each for production, marketing and credit related activities and each one of them are trained by KHDP. KHDP has so far constituted 2312 SHGs, involving 41913 registered farmers. KHDP has encouraged group marketing where farmers now form their own market and got traders to come and buy. In the year 2002-03, about 31 thousand tonnes of produce worth around Rs.29 crore was traded through 112 marketing centers. KHDP developed a unique credit package that could be availed by lease-land farmers and at the same time acceptable to the banks. Loans totaling Rs. 52 crore has been disbursed to farmers. To generate and access needed technologies for its farmers, KHDP contracted the state agricultural university for research and also undertook participatory technology development with farmers. With the end of funding support from European Union in 2001, the organization was registered as a company and it currently provide support to growers in 11 districts. An impact study reported a significant increase in area under fruit and vegetables in 86% of the SHGs and an increase in income in 75% of the SHGs7. The same study also reported that the number of farmers availing credit increased from 21% in the pre-KHDP period to 41% by 1999 and an increase in the efficiency of loan disbursal and increase in size of loans.

Agri-business initiative:

Mahindra ShubhLabh Services Limited (MSSL) was formed in 2001 as a subsidiary by Mahindra and Mahindra, one of the leading tractor manufacturing firm in India. The objective was to provide what the company describe as "integrated yield and profit solutions". The company has established through its franchises "Mahindra Krishi Vihar" (MKV), a one stop shop for farmers (who registers with them on a fee), that provide access to quality inputs and machinery, credit, access to advisory and field supervision services, buy back and better prices. MSSL initiated this service in paddy in Tamil Nadu and currently this service is being expanded to more crops and districts. In Tirunelveli, the Mahindra franchise, Bhuvi Care Private Ltd has successfully established this scheme in paddy and maize. In 2003-04 II season (October -February), 105 farmers have registered 305 acres of paddy at Rs.500/ per acre/season and 314 farmers have registered 1392 acres of maize at Rs.150/per acre/per season. In paddy, the participant farmers realized 12% increase in yield and 27% increases in net returns per acre and for maize, 10% and 40% respectively.

Financial institution initiative:

BASIX is a group of financial services and technical assistance companies, established for the promotion of sustainable livelihoods. It is currently operating in five states, namely, Andhra Pradesh, Karnataka, Maharashtra, Orissa and Jharkhand. According to BASIX, credit is necessary, but not a sufficient condition for generating sustainable livelihoods. In Andhra Pradesh, BASIX has identified a few sub-sectors in its area of operation (districts) such as groundnut in Anantpur, cotton in Adilabad and milk in Mahabubnagar.In Tamil Nadu (Virudhanagar) and Jharkhand (Ranchi), BASIX has initiated activities in vegetables9. Besides intervening in areas, which leads to direct increase in productivity or output, BASIX has been involved in finding out alternate market channels (eg: directly linking of cotton growers to spinning mills and groundnut growers to oil millers or wholesale traders) or value addition possibilities in these subsectors (eg; contracting with decorticating unit to decorticate groundnut by farmers) with an objective of raising the income of the primary producers. BASIX in all these cases worked in collaboration with local NGOs, or producer groups.

Producer Company initiative:

Sahaja Aharam, the producer company groomed under the aegis of CSA to help the farmers to market their own products. 25 blocks are covered by it, with active coverage of 112 villages from the three states. Products of the farmers are sold in the name of Sahaja Aaharam with attractive packing done by the farmers themselves. All farmer cooperatives are members by contributing a share capital of Rs.10,000. So the profits obtained will be divided among the farmer cooperatives itself."In a direct market, for every Rs. 100, a farmer makes a gain of just Rs 20. But in the cooperative society model, we ensure that at least Rs. 50 goes to the farmer. At the same time, our product pricing is affordable due to the direct access to farmer's cooperatives," says Mr. Ramanjaneyalu.

From policy to practice the key constraints

The National Agricultural Policy of India10 and the Policy Framework for Agricultural Extension11 (PFAE) acknowledges the need for extension to engage with issues beyond technology dissemination. The PFAE affirms that the "policy environment will promote private and community driven extension to operate competitively, in roles that complement, supplement, work in partnerships and even substitute for public extension10. However, to fulfil this expanded role, extension organizations need to change considerably both in scope and mode of operation.

While the need to provide a wide range of services as envisaged in extension-plus is all too apparent, a clear roadmap on reforming extension is not evident. States face a number of dilemmas: how much of past arrangements should be retained and which innovations in extension provision are desirable, affordable (bearing in mind current financial difficulties) and politically possible given opposition from staff unions, and declining enthusiasm from donors and political patrons for a standalone extension that deals with only technology dissemination. The learnings from the past do not seem to have made any difference to the way extension reform is approached. For instance, although the limitations of a single model of extension are well known (for example T&V), the merits are being considered of ATMA (Agricultural Technology Management Agency) as a model for extension that can be replicated across all states and districts.

Moreover, the planning and implementation of extension programmes still rests only on extending technologies to farmers. Public sector extension is yet to make any experimentation with perfecting new marketing arrangements that reduce the number of intermediaries, eliminate exploitative weighing and payment methods, and help farmers to get better prices. Current efforts that provide information on prices and market arrivals in major markets alone have limited operational merit. But policy can't seem to get beyond this impasse of prescription without subsequent analysis and refinement.

The cases described above suggest a number of broad principles: the need to build on existing structures and strengths in different locations; the need to establish new programmes in ways that explicitly recognize the experimental nature of the reform and change process; and the need to recognize the value of diversity of approaches and arrangements. Those involved in the reform process will need to build skills that allow them to reflect on progress (both successes and failures) and change course accordingly. It will require approaches that are less target-driven and more concerned with learning and the development of new capacities to deal with local circumstances.

However, the current organizational culture in general restrict the ability of public sector extension to realize the vision of extension-plus precisely because the principles outlined above are counter to deeply held norms in the public sector.

The following features typify this culture and need to be the focus of measures to

reform the existing extension arrangements.

- Rigid professional hierarchies and patterns of control, with highly centralized modes of planning. This tends to stifle deviation from prescribed procedures, restricting innovation, particularly by middle and lower level staff.
- A tradition of assessing performance in terms of technology adoption and hence a focus on improved technology transfer mechanisms at the expense of other activities that may have a perfectly legitimate role in supporting farmers.
- A history of only rewarding successes and thus a reluctance to report and analyze the reasons of failure of a technology or a new approach.
- A tradition of working independently and a mistrust of other agencies. This is particularly so with regard to external agencies, NGO's and private sector, but also with other public agencies including research organizations.
- A tradition of up-ward accountability for resource utilization rather than output achievement and client satisfaction.

Rules and conventions related to recruitment, qualifications, transfer, contractual appointments and performance assessment further prevent accessing a wider range of expertise. The combined effect of these professional and administrative traditions is a prevailing culture in public sector extension that views its operational mandate technology transfer in very narrow terms, but also a culture in which the incentives and capabilities to learn and innovate are highly restricted. It is perhaps this weakness in the current culture of extension agencies and associated planning bodies that need to be addressed as one of the key issues by the reform process.

WAYS FORWARD

The underlying principles of extension-plus include a broad scope of service provision; the extensive use of partnerships to fulfil an expanded mandate; a learning-based approach that includes negotiations with a wide range of stakeholders in order to develop workable and effective arrangements in line with specific local circumstances and objectives; and a larger degree of accountability to client groups. To operationalize extension plus, there is a need for a broad agreement on the need to reinvent extension as a nodal agency that provides technological and non-technological services to farmers. Extension needs to play a facilitating role enabling access to services by acting as a bridge connecting farmers, the poor and vulnerable groups with different service providers. Operationalizing extension-plus requires a new organizational culture. Next steps to developing this new culture might include:

a. **Capacity Development**. Shifting from training to a "learning by doing" approach whereby staff are encouraged and enabled to initiate small experimental projects that address broad livelihood needs and use partnership as a central approach. By treating small projects

experimentally and facilitating staff to reflect on their meaning and outcomes, this would build skills related to experimentation, learning and evaluating innovative extension approaches.

b. **New skills**. Constituting a core group of specialists at the district level with non-traditional extension skills such as: market development; institutional development; post-harvest; enterprise development and agribusiness management.

c**. O&M review**. An organizational and management review of existing extension system, primarily to explore possibilities of recruiting limited number of better qualified field staff, creating new incentive structures and to provide more administrative and financial freedom at the lower levels.

d. **Better informed policy process**. As part of the reform and planning process, resources should be used for systematic institutional analysis of promising extension innovations so that generalizable principles can be drawn and new strategies suitably informed.

Only if extension takes learning-based approach to changing its role and improving its performance, will reforms succeed. But if this cultural change is to flourish, it needs to be supported and legitimized wholeheartedly and unambiguously at the most senior levels of the extension services and in other allied organizations. Challenging as this may be, without a new organizational culture, the far-reaching reforms needed to operationalize extension-plus will not succeed.

Challenges in the Indian Dairy Industry

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Since the 1970s, most of the expansion in milk production has been in South Asia, which is the main driver of milk production growth in the developing world. Thanks to rapid urbanisation and rising incomes, Southeast Asia is consuming dairy at one of the fastest-growing rates in the world. Dairying in India has been a major occupation. India is the world's largest milk producer, with 18 percent of global production, followed by the United States of America, China, Pakistan and Brazil. India has witnessed approximately 4% growth of milk production annually in last three decades, which far exceeds the average global growth of about 1% (Singh, 2009).

In 1947 in undivided India , milk production was a mere 17 million tonnes however because of the commendable efforts of farmers, scientists, technical experts and to structural changes by the advent of dairy cooperatives.In year 2015-16 it has reached 155.5 million tonnes as compared to 137.69 million tonnes during 2013-14 recording a growth of 6.26 per cent. Whereas, the Food and Agriculture Organization (FAO) has reported a 3.1 per cent increase in world milk production from 765 million tones in 2013 to 789 million tones in 2014.. The per capita availability of milk in India has increased from 176 grams per day in 1990-91 to 337 grams per day by 2015-16. It is more than the world average of 294 grams per day during 2013. This represents a sustained growth in availability of milk and milk products for the growing population. Therefore, India can be said a self sufficient milk producing country in the world. Indian dairy can fulfil demand of the milk and milk products in Indian market.

It is the largest consumer of dairy products, consuming almost 100% of its own milk production. Dairy products are a major source of cheap and nutritious food to millions of people in India and the only acceptable source of animal protein for large vegetarian segment of Indian population, particularly among the landless, small and marginal farmers and women. In India, about three-fourth of the population live in rural areas. In 1986-87, about 73% of rural households own livestock. Small and marginal farmers account for three-quarters of these

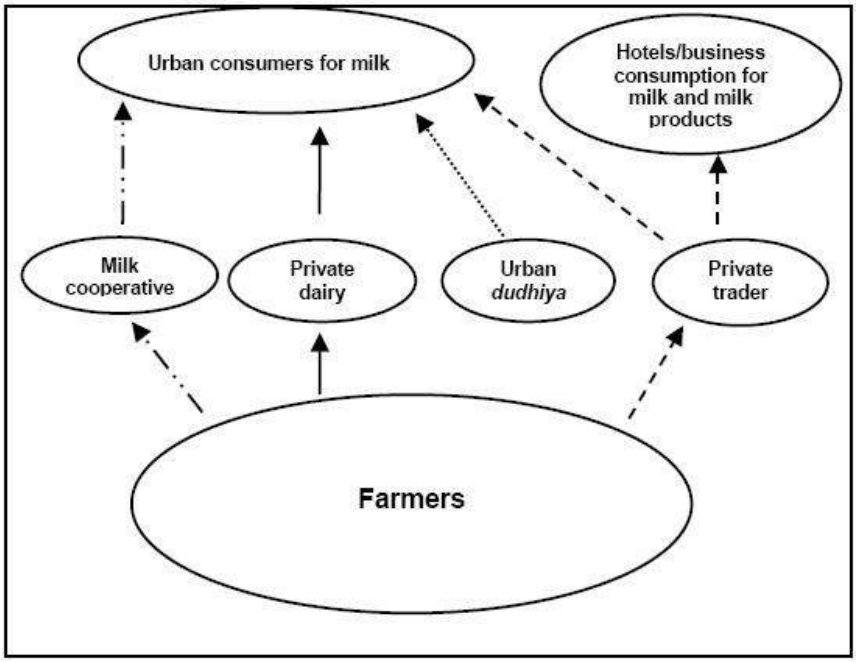
households owning livestock. The progress in this sector will result in a more balanced development of the rural economy.

The dairy sector can play an important role in providing jobs for rural communities. Dairy production and processing provide employment, not only to people who work on dairy farms or in dairy plants, but also to the whole sector, from upstream (inputs and services provider) to downstream (marketing of finished products)

DOMESTIC CONSUMPTION

According to the most recent data from the Food and Agriculture Organization, India has 75 million dairy farms, about half of all dairy farms in the world. More than 90% of India's milk production is concentrated in 14 states.India being a huge milk consumer owing not only to its large population size but also due to the largest vegetarian population in the world whose only source of animal based essential nutrient is milk, much low surplus is left for exports unlike other major dairy exporting countries.With rising incomes, urbanization, and demographic changes, demand for most of the value added milk products is rising. India's milk production is constrained mainly due to factors such as low genetic potential, falling water table, shrinking land resources due to urban sprawl, and insufficient feed and fodder resources

Out of this almost half of the milk is consumed at the production level and balance comes to the market for direct sales and processing. The ratio of unorganized to organized sector in milk procurement and trading is 60:40. Also it is in interest of both the consumer and the producer that this gap should reduce.The consumption pattern of dairy products in India is quite unique as compared to some of the western countries. Consumption is primarily skewed towards traditional products; however, westernized products are gradually gaining momentum in the urban areas. Interestingly, buffalo milk accounts for the largest share of the total milk produced in the country. Since the pricing of milk is based on the fat content, buffalo milk offers higher profit margins as compared to cow milk as it contains higher fat. Despite being the one of the largest milk producing countries in the world, India accounts for a negligible share in the worldwide dairy trade. The ever increasing rise in domestic demand for



dairy products and a large demand-supply gap could lead India to be a net importer of dairy products in the near future. In spite of having largest milk production, India is a very minor player in the world market. The major destinations for Indian dairy products are Bangladesh (23.1%), UAE (15.4%), US (15.6%) and Philippines (8.9%).

(i) Productivity of animals, cost of production and Competitiveness

Livestock population and average animal productivity :As per 19th Livestock census, 2012 (GOI, 2014) India's livestock sector is one of the largest in the world with a holding of 11.6% of world livestock population .India has huge livestock population of 512 million nos. which mainly includes cattle, buffaloes, goats, sheep and pigs. The total livestock population in India has decreased by 3.33% over the previous census. Contribution of cattle, buffalo, sheep, goat, pig and others in total livestock population is 37.28, 21.23, 12.71, 26.4, 2.01 and 0.5%, respectively.

The highest milk yield in the world by India is attributed to the increase in the number of dairy animals. India's average milk yield per cattle remains much lower compared to developed and even many other developing countries. The current milk yield per day per animal for croos bred cows, indigenous cows, nondescript cows and indigenous buffaloes is 7.33,3.41,2.16 and 5.76 per kg/day respectively. These figures are comparatively very lower as compared to the exotic breeds.

Feed and fofdder deficiency:The huge livestock population requires adequate and large quantity of quality feed and fodder to realize their potential for milk production Today the nation faces a 40% deficit in fodder production. This has impacted animal health and production. Doubling Today the nation faces a 40% deficit in fodder production. This has impacted animal health and production adversely. Against a total requirement of over 120 million tonnes of feed every year, the manufacturing facility is limited to just 8 million tonnes.

AI coverage At present the AI coverage in India is a mere 40% — another cause of poor animal productivity and a prime concern. there are a large number of bree dable but uncalved female population also there is a wide gap between available and requisite proven bulls All efforts should be undertaken to expand AI services and veterinary health services

The demand for quality dairy products is rising and production is also increasing in many developing countries. The countries which are expected to benefit most from any increase in world demand for dairy products are those which have low cost of production. India is characterized by a low input-low output system. While production costs are among the lowest in the world due to the inexpensive maintenance and feeding costs, yields are also below international averages

Therefore, in order to increase the competitiveness of Indian dairy industry, efforts should be made to reduce cost of production. Increasing productivity of animals, better health care and breeding facilities and management of dairy animals can reduce the cost of milk production.

(ii) Production, processing and marketing infrastructure

India's organized dairy sector comprises only 20 percent of the total milk production, which includes government

supported dairy cooperatives and private sector dairies.

Increasing milk processing capacity under organized sector is essential to preserve milk and give remunerative process to milk producers

lack of necessary physical infrastructure like connectivity,communication, testing and certifying labs, cold chain facilities, absence of international standards is also hampering the indian dairy sector.

Also the small size of milch animals holdings in India make it difficult to adopt mechanical system, cooling cnad chilled storage which ultimately affects the efforts to improve quality at farm level.

Lack of efficient cold chain: India does not have a sufficient cold chain infrastructure to cater the dairy industry and maintain the low temperature from 'milking to mouth' (M2M). Milk is highly perishable product and it can not sustain without contamination for more than 5 hours in higher temperature conditions of India. Therefore, milk and milk products can not reach to consumer safely and in good condition in such a scenario. Proper cold chain infrastructure will reduce wastage levels and will add to the quality of milk.

If India has to emerge as an exporting country, it is imperative that we should develop proper production, processing and marketing infrastructure, which is capable of meeting international quality requirements. A comprehensive strategy for producing quality and safe dairy products should be formulated with suitable legal backup.

(iii) **Buffalo milk based specialty**

India ranks first in milk production in world. buffaloes form about 30% of cattle population and contribute to about 54% of total milk yield in India buffalo milk is in no way inferior to cow milk in terms of its nutrirtive value and digestibility. The buffalo milk has bigger size of fat globules,higher protein content and the lower cholesterol content t of buffalo milk render The healthful aspects of buffalo milk are superior to cow milk.

Water buffaloes are preferred by farmers due to its higher fat content milk, which fetches higher prices since milk prices are determined by volume, fat, and solids-not-fat (SNF) content.

Dairy industry in India is also unique with regard to availability of large proportion of buffalo milk. Thus, India can focus on buffalo milk based specialty products, like Mozzarella cheese, tailored to meet the needs of the target consumers.

(iv) **Import of value-added products and export of lower value products**

The Indian dairy export basket has experienced diversification. The export of skim milk powder (SMP), butter, whole milk powder (WMP), casein and ghee have gone up considerably in value terms during the last decade.

The composition of imported products keeps changing each year depending on domestic and international demand-supply situation and prices. However, the chief dairy products imported by India include butter oil, whey products, cheese and milk powders..

With the trade liberalisation, despite the attempts of Indian companies to develop their product range, it could well be that in the future, more value-added products will be imported and lower value products will be exported. The industry has to prepare themselves to meet the challenges.

India's dairy imports are insignificant; however, there are irregular imports of

milk powder and butter to compensate for declines in domestic supplies

(v) **Quality milk production**

Therefore, the total share of the organized sector, both cooperatives as well as the private sector is barely 12%. What is, therefore, disquieting is that as much as 88% share of the total milk production is commanded by the unorganized sector – who specializes in selling sub-standard, unpasteurised milk more often than not adulterated with harmful chemicals

Quality milk production is always a challenge for dairy industry because of lack of good dairy practices from the stage of milk collection at farm to processing plant. The milk that comes at milk reception dock always has high 58 microbial count, acidity and dirt, barring few regions and places in India. The poor quality of raw milk hampers the scope of producing exportable quality milk products. Livestock farmers does not know Good Manufacturing Practices (GMP) and the processing industries are not strictly adhering to Good Laboratory Practices (GLP) which need to be corrected for the benefit of the farming community. The small scaleof production units , lack of technical knowhow, deficient physical infrastructure and further serve as bottleneck in implementing GMP and GLP.

India exports NFDM to regional milk-deficient countries such as Pakistan, Bangladesh, Afghanistan, Nepal, Bhutan, and United Arab Emirates. CY 2017 butter exports are forecast flat at 10,000 MT on expectations of steady demand. India also exports smaller volumes of casein (used for food processing or pharmaceuticals) to United States, EU and other countries.

An increasing demand worldwide is noticeably emerging at present, and the industry is globalizing, thus increasing the scope and intensity of the global dairy trade.At the international level, we have to ensure that provisions of SPS and TBT are based on application of sound scientific principles and should become defacto barriers to trade.

It is an urgent need for the Indian dairy industry to improve the quality of milk and milk products by adopting better handling practices from procurement to promotion of product. By putting advance technologies and testing facilities at different stages, until reaching its consumer. To ensure pure safe healthy hygiene milk for consumers, and export of products.

CONCLUSIONS

In conclusion with increasing demand of milk the focus shall have to shift on increasing the productivity of native animal genetic resources. The feed and fodder quality should be improved by latest technological advances coupled with better AI coverage and veterinary health service shall lead to lowering of cost of milk production. Increased investment in infrastructure right from production level to consumer level shall help production of quality and hygienic milk production. The potential of buffalo as drive engine of dairy products has to be realized.

Dairy has a lot of potential to improve rural incomes, nutrition and women empowerment, and hence is a very critical area for investment. A well-developed industry will enable millions of farmers to capitalize on the emerging opportunities and make a significant impact on rural incomes.

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Budget for better agriculture

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This year's budget was historical as it broke away from age old tradition to be presented on last day of February, merged with railway budget & union budget & departed from the categorization of plan and non-plan expenditure.

This year, union budget was presented amidst a host of uncertainties. Imminent GST and demonetization drive and also new administration in US *etc* made whole exercise very challenging. This year union budget gives farmers and rural population its top prime concern. Current budget signifies a major uplift for integrated sectors *viz*. horticulture and dairy sectors by significantly increasing allocation which is bound to show remarkable result in future. The agriculture sector is projected to register growth of 4.1 % from drought register grown 2% in 2015-16. The budget also gives a market reforms in agriculture sector increases funding for crop insurance and set a higher goal for farm credit. It also charges the apex rural bank, the National Bank for Agriculture and Rural Development (NABARD) with the venture of implementing schemes to improve access for irrigation & development of dairy sector.

The government has announces various initiatives in agriculture during the past two years with the resolve of doubling the farmer's income in next five years. These schemes include, "The Pradhan Mantri Fasal Bima Yojana" (PMFBY), "The Pradhan Mantri Krishi Sinchai Yojana" (PMKSY) and formation of national agriculture market for farm produce through an electronic platform (e-NAM). The union budget 2017-18 also proposes micro-irrigation fund of Rs. 5000 crore with NABARD which is salutation move as only 36.42% of the 159.6 million hectares of net cultivated area in India does have required irrigation facilities.

The coverage of e-NAM (electronic Nutritional Agriculture Market) is to ease farmers, traders, buyers, exporters and processors to a common platform for trading the commodities with a currently link 250 APMC (Agricultural Produce Market Committee) from across 10 states, with an assistance of up to Rs. 75 lac is being offered for foundation of cleaning, grading, packaging facilities. This move is likely to benefit the farmers by promoting value addition of their product.

PM launched the PMFBY (Pradhan Mantri Fasal Bima Yojana) on 18th

February, 2016. It envisages a uniform premium of only 2% to be paid by farmers for *kharif* crops and 1.5% for *rabi* crops. The scheme is dedicated to bring more than 50% of the farmers under its pinion within next 2-3 years. For the flagship crop insurances scheme "PMFBY", there has been a remarkable increase in the budget provision from Rs. 5500 crores in 2016-17 to Rs. 9000 crores in 2017-18 that will bring 40% of the cropped area under insurance and will increased by 50% next year. (2018-19).

The budget also stipulates that a model law on contract farming would be prepared and circulated among the states for adoption to integrate farmers who cultivate fruits and vegetables with agro-processing units for ensuring better price realization and reduction of post harvest losses. The states would also be urged to denotify perishables from APMCs for making the farmers independent from the clutches of the intermediary and allow them to sell their produce freely.

The soil health card scheme is initiated on 17th February, 2015. Under the scheme, the government plans to issue soil health cards to farmers which will carry crop-wise recommendations of nutrients and fertilizers required for the individual farms to help farmers to improve productivity through prudent use of inputs. The scheme is for strengthening the farmers with setting up the mini laboratories for soil testing in all the 648 Krishi Vigyan Kendras (KVK) across India. In addition, 1000 mini laboratories will be set up by qualified local entrepreneurs in assistance of the government. An amount of Rs. 568 crores is assigned by government for the scheme for making soil health card and setting up the laboratories.

The recently enacted Goods and Services Tax (GST) Act is also likely to have major implications for India's Agricultural sectors mainly in view of the fact that, these sectors are currently subjected to a wide array of direct and indirect taxes levied by the central and state government.

For better price realization and reduction of post-harvest losses, the government is planning to integrate farmers who grow fruits and vegetables with agro processing units. It has currently integrated 250 APMC in 10 states with the e-NAM in first phase, on which commodities worth of 421 crores has been traded. A mobile app has also been launched to access information related to prices of commodities traded on the e-NAM platform to encourage more farmers to take advantages of this new initiative. About 69 agricultural & horticultural commodities have been noticed for trading on e-NAM platform. The integration of these APMC's with the e-platform will also help to enhance farmer's income.

The union budget announced creation of dairy infrastructure development fund of Rs. 8000 crores over next three years with NABARD. In the first year, the government announced to give Rs. 2000 crores for creation of the fund. It is a gigantic investment and will create an additional rural income of Rs. 50,000 per annum. Thus going to transform farmer's livelihoods while also augmenting the percentage contribution of milk and processed milk items to overall agricultural output of nation. In line with the growing demand for packaged milk

and other products, dairy companies have also stepped up investments in cold-chain facilities for the procurement and marketing of milk and milk products. These growing trends for the demand of milk and milk products is expected to continue, with the sector experiencing strong growth in short and medium runs.

Vaccination Failure

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WHAT IS VACCINES

It is Preparation of antigenic material which is administered to induce active immunity in recipient animal against a specific organism. Vaccines may be single component or mixed combined preparation. Immune response usually specific for each agent although cross protection may occur.

Perfect Vaccine?

- Safe
- Efficacious (induces protective immunity in all vaccinated animals)
- Evokes long lasting immunity
- Minimal requirement for boosting
- Stable and easy to administer
- Commercial considerations: Cost, compatibility with other vaccine components etc.

A vaccine failure is when an organism develops a disease in spite of being vaccinated against it.

- Primary vaccine failure occurs when an animal's (host) immune system does not produce enough antibodies when first vaccinated.
- Secondary vaccine failure occurs when enough antibodies are produced (against antigen or vaccine) immediately after the vaccination, but their levels fall over time.
- While antibody levels always fall over time, this would be a more rapid loss of immunity than expected for that vaccine.
- In the vast majority of cases, it is not the vaccine that has failed, but an inadequate immune response to the vaccine has occurred.

MATERNAL ANTIBODY

- Newborn animals receive disease protection from their mother through the transfer of antibodies
- Antibodies are small disease-fighting proteins produced by certain types of cells called Plasma cells.
- The age at which animals can effectively be immunized is proportional to the amount of antibody protection the young animals received from their mother.

- High levels of maternal antibodies present in a animal's bloodstream will block the effectiveness of a vaccine.
- When the maternal antibodies drop to a low enough level in the animal, immunity (protection from disease) can be produced through vaccination.
- Window of susceptibility - This is the time when despite being vaccinated, a animal can still contract the disease.
- Some vaccines can stimulate active immunity in the young animal even when maternal antibodies are present.

INSUFFICIENT TIME BETWEEN VACCINATION AND EXPOSURE

- A vaccine does not immediately provide protection. It takes several days to a week or more for an animal's body to respond to the vaccine
- A young animal is susceptible to a disease if it is exposed to the disease before a vaccination has had time to stimulate the body's immunity.
- Too short interval between vaccination and exposure to disease can result in the animal developing the disease.
- In some cases, the same is true if the length of time between vaccination and exposure to disease is too long.
- The length of protection from a vaccine varies by the disease, type of vaccine, age at vaccination, and the immune system of the individual animal.

ANTIBODY TITER

- We can try to determine if a person or animal has protection from a disease by measuring the amount of antibodies in the blood. The result is often expressed as a 'titer.
- We should measure antibody titers before revaccinating an animal. If the animal has a protective titer, a vaccine would not be given.
- For some diseases, the level of antibody would not accurately assess the immune status of the animal because other parts of the immune system are more important for fighting off that particular disease.
- Another problem with titers is that the test will only tell us the animal's status at that point in time. It can not tell us what the animal's status will be 6 months from now.
- there is always the possibility of laboratory error. A test result may erroneously suggest an animal has a protective titer when he really does not.

DIFFERENT STRAIN OF BACTERIA OR VIRUS

- Vaccines only contain specific strains of the virus or bacteria that causes disease.
- A vaccine produced from one strain may not adequately protect against another strain.

Damage to vaccine

- If not handled properly, it is possible that a modified live vaccine could be inactivated.

- This is a very uncommon occurrence, but could occur
- if the vaccine was exposed to ultraviolet light,
- if there was a long time period between when it was reconstituted and when it was used, or
- if it was not stored at the proper temperature.

Improper administration

- If a vaccine is administered by a route different from the route for which it was developed, it may not be effective and could cause considerable harm.
- The entire dose of the vaccine should be given at one time.

Non adherence to vaccination schedule

Vaccine interference **:** If too short of a time elapses between doses of vaccines, vaccine interference can occur.

It is suggested that if more than one type of vaccine is to be given, they should be given at the same time, not several days apart.

- **Prolonged interval between vaccinations:** To provide the best response, the first time an animal is being vaccinated against a disease, repeated vaccinations are usually given 2-4 weeks after the prior vaccination.
- The first vaccine more-or-less primes the immune system, and the subsequent vaccination(s) increase the immune response.
- If a period longer than several weeks occurs between this first series of vaccinations, the immune system is no longer as 'primed' and less of an immune response may result from the subsequent vaccination.

Immunosuppression / immunodeficiency

- If the animal's immune system is not functioning adequately or is suppressed, as would be
- The case in animals with certain viral infections, and
- Those receiving certain cancer treatments or
- Very high doses of steroids

The vaccine would not initiate a proper immune response, and would not result in protection from the disease.

CONCURRENT DISEASE PROCESS

- Fever has been shown to inhibit the response of the immune system to canine distemper vaccination in puppies.
- Certain viral infections may also decrease the ability of the immune system to adequately respond to a vaccination.
- Even stress, such as boarding could decrease a cat's response to a vaccination.

NUTRITIONAL DEFICIENCIES

- Animals who are malnourished, like those who are ill, may not respond adequately to a vaccination.
- Poor nutrition, such as Vitamin A, Vitamin E, and selenium deficiencies, and restricted protein or *calories* can result in suppression of the immune system.

Cold Plasma Pre-treatment on Enhancement of Seed Germination of Different Seeds

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ABSTRACT

Plasma technologies have been successfully applied for various natural materials treatment. In agriculture these methods can be an effective substitute for the traditional pre-sowing seed treatment with chemical agents which are either expensive or harmful to environment and human health. This article gives some insights on the application of cold plasma for enhancing seed germination of different seed varieties. It influences the early growth of seeds by affecting the surface characteristics such as seed surface wettability and surface morphology. Particularly, the germination rate and yield of germinating seeds have been demonstrated to be enhanced by plasma treatment and also pre-treatments of seeds leads to suppression of fungal and bacterial plant pathogens.

Key words: Cold plasma, seed germination, germination rate and surface morphology

INTRODUCTION

Plasma is referred as the fourth state of matter comprised of positive and negative ions, electrons, positrons, excited and neutral atoms, free radicals, molecules in the ground and excited states, UV photons (Fridman 2008). Important reactive species in plasma are atomic oxygen, singlet oxygen, superoxide anion, ozone, excited and atomic nitrogen, nitric oxide, nitrates and nitrite ions. Plasma is subdivided into thermal (hot) plasma and nonthermal (cold) plasma based on thermodynamic temperature equilibrium of the constituents of plasma. The temperature of cold plasma never extends beyond 60 ^{o}C except for few plasma jets. Some of the widely used plasma sources for food applications are dielectric barrier discharges (DBD), plasma jets and corona discharges. In the past cold plasma is used for sterilization of sensitive materials, microbial disinfection, wastewater treatment, microfabrication of semiconductors. In recent years, many scientists and researchers have employed cold plasma in several food applications like microbial destruction, enzymatic inactivation, improving the cooking quality of rice varieties, starch modification, enhancing seed germination and promoting plant growth.

Amongst the several reasons for loss of the crop yield, loss of seed survivability due to contamination, low percentage of germination rates and longer germination times are few important reasons (Mitra *et al.,* 2014). The seedling growth during germination involves two key steps 1) primary cell elongation of the axial part of the embryo, and simultaneous or delayed cell division in the radicle meristem (Sirova *et al*. 2011). The treatment of seeds with cold plasma enhanced the seed germination by increasing the seed coating permeability, stimulating seed germination and seedling growth and altering enzymatic activity (Ling *et al.* 2014). Several approaches have been evaluated for enhancing the germination of seeds, including the use of magnetic fields and ultrasound treatment and exposure to electric fields. Among the constituents of plasma, reactive oxygen species (ROS) and reactive nitrogen species (RNS) are major active species.

REVIEW OF LITERATURE

Effect of cold plasma on seed germination of different seeds

Wheat (*Triticumaestivum*)

Thewetting properties of the surfaces of wheat were found to alter under the influence of cold plasma (Bormashenko *et al.*, 2012). The authors have studied the wettability of wheat seeds after treating at 20 W power levels for different time intervals. In particular, a dramatic decrease in the apparent contact angle hasbeen noted, which is partially attributed to the oxidation of seed surface by activespecies in plasma.The contact angle was decreased from 115^o to 0^o after the plasma treatment resulting in complete hydrophilicity of treated seeds compared to untreated seeds. The water imbibition of plasma treated seeds was increased by 30% after the 12 h of germination. Similar decrease in contact angle of plasma treated wheat seeds were reported by Dorbin *et al.,* (2015). The authors have observed the contact angle was decreased to 53^o from 92^o after the treatment. The difference in decrease of contact angle is the result of the intensity of power applied. The length of sprouts and water absorption of the cold plasma treated germinated seeds was more than the untreated seeds. The sprouts and roots of the plasma-treated seeds were heavier than those of the control samples (Dorbin *et al.,* 2015).

Lentils (*Phaseolus vulgaris*)

Lentils grains were exposed to inductive air plasma discharge under the following parameters: the plasma frequency was on the order of 10 MHz, power was 20 W, and pressure was 6. 7×10^{-2}Pa and the volume of the discharge chamber was 45 cm^3.The duration of plasma treatment was varied from 15s to 2min. The apparent contact angles (the angle between the tangent to the liquid-air interface and the apparent solid surface as macroscopically observed were established as 127±2° for untreated lentils. The 15s cold air plasma treatment of seeds decreased apparent contact angles to 20±1° for lentils. Thus, plasma treatment in this case caused a transition from partial to complete wetting. The change in wettability of lentils gave rise to a change in the water absorption (imbibition) of these seeds thereby increasing the germination rate (Bormashenko *et al.*, 2012).

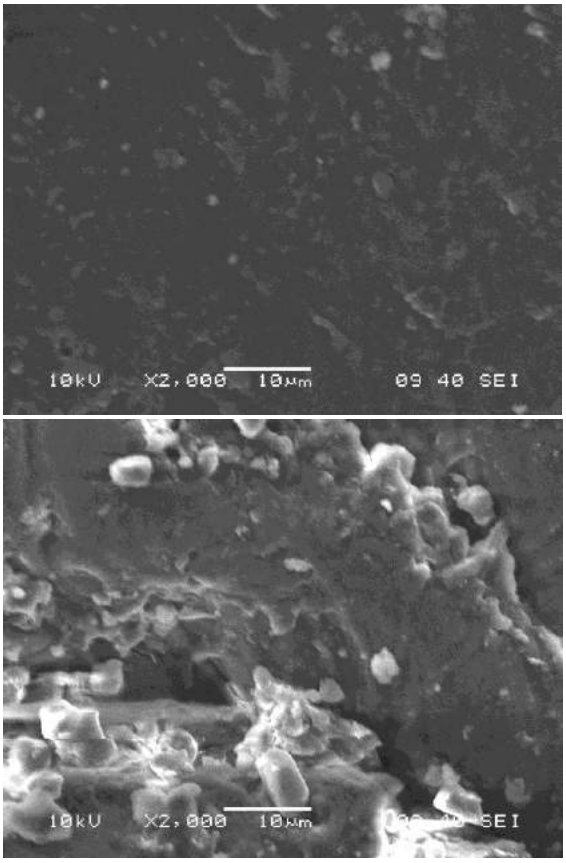

Fig. 1. Scanning electron micrographs showing the surface topography of seed kernel before and after plasma treatment (adopted from Thirumdas et al., 2016)

Tomato (Solanumlycopersicum)

The seeds were treated with magnetized arc plasma before they were sown. The dehydrogenase activity and activity of peroxidase enzyme was greatly influenced by the applied power of plasma. This resultedin increase of sprouting rate was 32.75%and the tomato yield by up to 20.7% (Yin *et al.,* 2005).The authors also reported that the cold plasma corona discharge treatmentof tomatoseeds reduced the seed dormancy by inhibiting the abscisic acid hormone. Similarly, Liu *et al.* (2010) also observed that the application of cold plasma decreased the abscisic acid hormone which is responsible for seed dormancy and inhibit seed germination.

Radish (*Raphanussativus var. Longipinnatus*)

The impact of atmospheric plasma treatment of seeds on growth regulation characteristics of radish sprout has been investigated by Hayashi *et al.* (2015). The "reduction type" thiol in radish sprouts, responsible for maintaining the redox state of plant cells and the activation of growth factors, is modified by cold plasma. The cold plasma not only increased the levels of reduction-type thiols, butalso the average length of sprouts as a function of the plasma treatment period. The growth regulation originates from the change in the antioxidative activity of plant cells induced by ROS generated in the oxygen plasma, which leads to the production of growth factor in plants. The plasma treatment had little effect on the germination rate, but influenced growth parameters. Higher root length was achieved by the plasma treatment as compared with the untreated samples. On the other hand, the sprout's length was about 1.6times more for the treated samples compared to control seeds.

Oat (*Avena sativa*)

Theseseeds have been exposed to both continuous and pulsed glowdischarge plasmas, with a pulse repetition rate of 0.5 Hz and pulse duration of150–200 ms in air under 0.1–0.2 Pa (Dubinov *et al.,* 2000). Stimulating effects ofplasma on the germination yield and sprout length were noticed. The number of germinated seeds after the exposure was increased more than 27% after the 5th day of germination. But the authors have observed the same length of sprouts in treated and untreated seeds.

Soybeans (*Glycine max*)

Plasma treatments with a radio frequency source operating at 13.56 MHz frequency has been shown to enhance seed germination and seedling growth of soybeans, germination rate and vigor indices (Ling *et al.,* 2014). Seed water uptake was improved by 14.03%, and apparent contact angle was observed to be decreased by 26.19%. Characteristics of seedling growth, including shoot length, shoot dry weight, root length, and root dry weightwas significantly increased by 13.77%, 21.95%, 21.42%, and 27.51% respectively compared with control. In addition, soluble sugar and protein contents were 16.51% and 25.08% higher than those of the control. From the results, the plasma treatment had a greater stimulatory effect on seed germination.

Pea (*Pisumsativum*)

Seeds have been treated using dielectric barrier discharge for different timeintervals from 60 to 600 s (Stolarik *et al.,* 2015). The plasma treatment has been observed to induce significant changes in the seeds surfaces, which has been associated with water permeability into the seeds. In addition to this effects of plasma, the germination percentage of pea seeds, the growth parameters (root and shoot length, dry weight), and the vigor of seedlings was also increased. The plasma treatment causes changes in endogenous hormones (auxins and cytokinins and their catabolites and conjugates), which correlates with increased growth of the pea seedlings. The results suggest an interaction among the modification of seed structure demonstrated by cold plasma in the induction of rapid germination and hormonal activities associated with plant signalling and development, during the early growth of pea seedlings.

Chickpea (*Cicer arietinum*)

A study was conducted by Mitra *et al.,* (2012) on the seeds of chickpeaafter exposing to cold atmospheric plasma. The plasma device, used in this study incorporates an electrode based on the surface micro-discharge (SMD) technology using ambient air. Furthermore, a 1 min CAP treatment showed a strongly improved seed germination (89.2%), speed of germination (7.1±0.1 seeds/day), and increased seed vigor, beside a decrease in the mean germination time (2.7 days) compared with controls. Increased seed germination was achieved with treatment times of up to 3 min (compared to untreated control), with an optimum performance at 1 min.

Oilseed rape (*Brassica napus*)

Effects of cold plasma treatment on seed germination, seedling growth, antioxidant enzymes, lipidperoxidation levels and osmotic-adjustment products of oilseed rape under drought stress wereinvestigated in a drought-sensitive and drought-tolerant cultivar. The cold plasma under drought stress, treatment significantly improved the germination rate by 6.25. Seedling growth characteristics, including shoot and root dry weights, shoot and root lengths, and lateral rootnumber, significantly increased after cold plasma treatment. The apparent contact angle was reduced by 30.38% after the treatment.Cold plasma treatment markedly raised superoxide dismutase and catalase activities by 18% and 13% respectively. Moreover, cold plasma treatment

significantlyincreasedthe soluble sugar and protein contents, but reduced the malondialdehyde content in seedlings. The results suggested that the cold plasma treatment improved oilseed rape drought tolerance byimproving antioxidant enzyme activities, increasing osmotic-adjustment products, and reducing lipid peroxidation, especially in the drought-sensitive cultivar. Thus, cold plasma treatment can be used in an ameliorative way to improve germination and protect oilseed rape seedlings against damage caused by drought stress (Ling *et al*., 2015).

Mung beans (*Vignaradiata*)

The seeds were treated at two different power levels 40 W and 60 W at different time intervals using RF cold plasma (Sadhu *et al.*, 2017).Results showed that, cold plasma significantly increased the germination rate by 36.2%, radical root length by 20% and conductivity of seeds by 102% when compared to the control samples. The surface etching caused by the plasma species increased the seeds coat conductivity and apparently reduced the contact angle making surface more hydrophilic. There is increase in soluble sugars and proteins after the treatment. There isalso increase in hydrolytic enzymes activity like amylase, protease and phytase after the treatment. The decrease in anti-nutritional properties like trypsin inhibition activity and phytic acid showed a positive effect of cold plasma treatment. Thus, cold plasma application can significantly benefit the seed germination during drought conditions (observed in fig.1)

On the other hand the plasma treatment can also be employed to delay the seed germination. Volin *et al.,* (2000) researched for alternative technologies for seed coating over traditional to delay the seed germination. They have stated that the cold plasma coating of seeds have the potential to delay the seed germination with the use hydrophobic gases like carbon tetra fluoride and octadecafluorodecalin. The change in germination of seeds is mainly attributed to rate of water imbibition by seeds. A coating of 5 µm thickness of hydrophobic layer on soybeans seeds delayed the germination of seeds by inhibiting the water uptake. Similarly, the same effect was also observed in cold plasma treated oat seeds.

CONCLUSION

It should be noted that the seed germination enhancement by the action of plasma not only beneficial for agriculture applications, but also in food processing sector. For example the food processing operations like malting, brewing, weaning foods, and specialty flours industry mainly rely on germination,any technology resulting in rapid germination could significantly reduce energy usage and time, thereby contributing toward sustainability in food processing.

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National Agriculture Market (E-NAM): Boon or Bane?

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The word market comes from the latin word *'marcatus'* which means merchandise or trade or a place where business is conducted. A market exists when buyers wishing to exchange the money for a good or service are in contact with the sellers who are willing to exchange goods or services for money. Thus, a market is defined in terms of the existence of fundamental forces of supply and demand and is not necessarily confined to a particular geographical location.

AGRICULTURAL MARKETING:

Agricultural marketing is the study of all the activities, agencies and policies involved in the procurement of farm inputs by the farmers and the movement of agricultural products from the farms to the consumers. The agricultural marketing system is a link between the farm and the non – farm sectors. It includes the organization of agricultural raw materials supply to processing industries, the assessment of demand for farm inputs and raw materials, and the policy relating to the marketing of farm products and inputs.

The marketing of agricultural commodities is different from the marketing of manufactured commodities because of the special characteristics of the agricultural sector (demand and supply) which have a bearing on marketing such as perishability of the product, seasonality of production, bulkiness of products, variation in quality of products, irregular supply of agricultural products, small size of holdings and scattered production and need for processing. (Acharya and Agarwal, 2006)

NEED FOR LAUNCHING NAM:

Agriculture marketing is administered by the States as per their agri-marketing regulations, under which, the State is divided into several market areas, each of which is administered by a separate Agricultural Produce Marketing Committee (APMC). APMC regulated market yards limit the scope of trading in agricultural commodities to the first point of sale only at the local mandi, typically at the level of taluka/tahsil or at best the district. Each APMC also imposes its own marketing regulation (including fees).

This fragmentation of markets, even within the State, hinders free flow of agri commodities from one market area to another as multiple licenses are necessary to trade in different market areas in the same state. Multiple handling of agri-produce and multiple levels of mandi charges end up escalating the prices for the consumers without commensurate benefit to the farmer. All this has led to a highly fragmented and high cost agricultural economy, which prevents economies of scale and seamless movement of agricultural commodities across district and state borders.

NAM seeks to address and reverse this process of fragmentation of markets by creating a unified market through online trading platform, both, at State and National level.

NATIONAL AGRICULTURE MARKET (NAM):

National Agriculture Market (NAM) is a pan-India electronic trading portal which networks the existing APMC mandis to create a unified national market for agricultural commodities. NAM has the caption, *"Uttam fasal, Uttam enaam"* which means "Best Crop, Best Reward". This initiative is part of implementation of the roadmap for doubling income of the farmers by 2022. The NAM portal provides a single window service for all APMC related information and services.

NAM is managed centrally by a lead implementing agency i.e. Small Farmers' Agribusiness Consortium (SFAC), which will network 585 selected markets in a span of three years (2015-16 to 2017-18) to create a unified national market for agricultural commodities. NAM is a "virtual" market but it has a physical market at the back end. While one time registration of farmers / sellers, lot details at the entry gate, weighment, quality assaying, auctions / trade transactions, payment by buyers to sellers and other agencies involved in the chain of transaction will take place online on e-NAM, actual material flow will happen physically through the market. Entire arrivals of agricultural commodities selected for trading on e-NAM will be traded online only thus reducing transaction costs and information asymmetry.

Nagarjuna Fertilizers and Chemicals Ltd. is the Strategic Partner (SP) who is responsible for development, operation and maintenance of the platform. The broad role of the Strategic Partner is comprehensive and includes writing of the software, customizing it to meet the specific requirements of the mandis in the States willing to integrate with NAM and running the platform.

OBJECTIVES OF NAM:

- To integrate markets first at the level of the States and eventually across the country
- To streamline marketing / transaction procedures and make them uniform across all markets
- To provide access to a nationwide market for the farmer
- To enhance transparency in auction process
- To promote efficient functioning of the markets
- To promote better marketing opportunities for farmers / sellers through online access to more buyers / markets

- To remove information asymmetry between farmer and trader
- To provide better and real-time price discovery based on actual demand and supply of agri commodities
- To provide liberal licensing of traders / buyers and commission agents
- To bring uniformity in quality standards of agricultural produce
- To provide infrastructure for assaying (quality testing) in every market to enable informed bidding by buyers
- To facilitate the emergence of value chains in major agricultural commodities across the country
- To promote scientific storage and movement of agricultural commodities
- To enable a single point levy of market fees, i.e., on the first wholesale purchase from the farmer
- To provide Soil Testing Laboratories in/ or near the selected mandi to facilitate visiting farmers to access this facility in the mandi itself.
- To establish prices commensurate with quality of produce, online payment etc. that contribute to marketing efficiency
- To promote stable prices and availability of quality produce to consumers

BENEFITS TO STAKEHOLDERS:

- **Farmers:** NAM promises more options for selling produce and making competitive returns.
- **Traders:** NAM will provide access to larger national market for secondary trading.
- **Buyers, Processers & Exporters:** NAM will enable direct participation in the local mandi trade, reducing intermediation cost.
- **APMCs:**
  - A reduction in book keeping and reporting system
  - Better monitoring and regulation of traders and commission agents
  - Completely transparent system which eliminates manipulation of tendering / auctioning process.
  - Improvement in the market fee collection by means of accounting all the transactions
  - Reduction in manpower requirements
  - Analysis and forecasting of the arrivals and prices
  - Availability of the activities of each APMC on the website directly.

PROCESS FLOW IN NAM:

The process that occurs in a mandi involved in NAM is shown in Fig. 1.

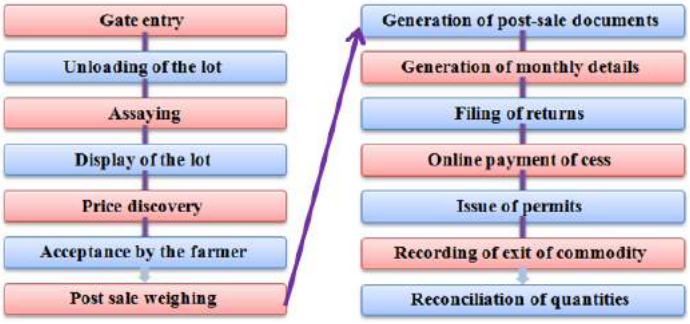

Fig. 1 Process flow in NAM

- **Gate entry** – Entering all particulars of the commodity at the time of entry (Fig.2) into the AMC and generation of a unique Lot ID number through the system (Fig. 3).

Fig. 2 Gate entry

Fig. 3 Lot ID generation

- **Unloading of the lot** – Concerned commission agents unload the lot in their premises. This automatically updates the inventory position of the goods with the commission agent.
- **Assaying-** Assaying the lots in labs provided in Market yards
- **Display of the lot** – The lot is displayed for inspection by buyers. Such display is a typical requirement when the lot is not sampled and tested. Testing of the lot would eliminate physical display; however, as testing is at the instance of the farmer, it may not be feasible to completely do away with display.
- **Price discovery** – Auctioning of the produce through the electronic platform (Fig. 4). If necessary changes can also be made for more competition.
- **Acceptance by the farmer** – Details of the winning bid to be communicated to the farmer through SMS. He is given the opportunity to reject the bid. Once accepted, complete the sale process and winner details to be communicated to all the market participants by way of SMS, display mechanism, etc.
- **Post sale weighing** – Weighing of sold lots to determine the total sale consideration. Though weighing would continue as at present, the department should commence procurement of electronic weighing machines, with the capability of automatically transmitting weight details of the lot to the auction platform. Alternatively, other means of integrating weighing and the platform may be explored.

- **Generation of post-sale documents** – System Based

Documents (Takpatti, invoice, etc.) to be given to the farmer, commission agents, traders, etc., evidencing trade details. The formats of these documents to be standardized across all markets.

- **Generation of monthly details** – The system to provide consolidate monthly details to commission agents, traders, etc., to assist them in arriving at the commission earned, cess payable, etc.
- **Filing of returns** – Electronic filing of returns, thereby eliminating the manual process. Ease of reconciliation of returns with market data.
- **Online payment of cess** – Doing away with manual collection of cess. Payment directly to the bank account of the AMC and automatic reconciliation of cess collection.
- **Issue of permits** – Reforming the process of issue of permits and introducing e permits. Permits to be generated by commission agents/traders for stock in their accounts after payment of market fee. Generation of permits to be through secured means (like use of pre-printed stationary, bar codes, etc.) and provide alerts to market authorities. Various aspects like full payment of market cess for generation of permits, enabling secretaries of AMCs to have overriding power to disallow specific commission agents from generating permits, permits to be generated not to exceed the available stock, measures to prevent reuse of permits, online verification of permits or through SMS etc., have to reckoned.
- **Recording of exit of commodity** – Every exit of commodity to be recorded
- **Reconciliation of quantities** – Reconciliation of quantity entering the AMC, the quantity sold, the quantity moving out of the AMC, the quantity with the commission agent and cross verification with the particulars submitted by the commission agent.

CHALLENGES

- Poor broadband penetration and digital infrastructure in rural India
- Minimal internet-literacy among farmers which might lead to exploitation by middlemen
- Poor bargaining power of small and marginal farmers while negotiating with large companies
- Collusion of traders quoting a low price for farmer's produce
- Low awareness about the NAM platform
- Need amendments in APMC Acts by states
- Fruits and vegetables are kept outside the purview of NAM, the volatility in prices would continue, thus depriving farmers from getting better prices.
- Barriers hampering interstate transfer of agricultural commodities also have to be removed.
- Very few big buyers are likely to be interested in buying the small lots that farmers will have to offer. Hence aggregators will be needed and these should not be the same aggregators who control the mandis that get to dominate NAM.
- Failure of the software to accommodate the heavy volumes of the peak season arrivals have been reported in few APMCs which has to be addressed immediately.

CONLCUSION

According to Socrates, *"The secret of change is to focus all of your energy, not on fighting the old but on building the new"*. Changing from old system of agricultural marketing to NAM may be difficult at first with challenges in implementation. However NAM authorities can work to create awareness among farming community about NAM. There is also an immediate need to provide technical knowledge to the farmers about the electronic trading mechanism to avoid being cheated by traders. In case of software failure such as internet server being down or poor connectivity, alternatives should be provided to the farmers rather than making them wait till the next day to avoid deterioration of product quality. Necessary infrastructure and well trained personnel should be made available to the APMCs adopting NAM. Once NAM is implemented successfully, farmers would be encouraged to produce better quality crop and meet exchange standards. Hence with wide participation and perfect cooperation between markets and stakeholders, NAM can be successful. The success of NAM will depend upon whether farmers get a higher price for their produce or not and whether this reduces price volatility.

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The Importance of Soil Testing

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Why is it important to test the soil?

Soil analysis is a valuable tool for your farm as it determines the inputs required for efficient and economic production. A proper soil test will help ensure the application of enough fertilizer to meet the requirements of the crop while taking advantage of the nutrients already present in the soil. It will also allow you to determine lime requirements and can be used to diagnose problem areas. It is very important that your sampling technique is correct as the results are only as good as the sample you take. Soil testing is also a requirement for farms that must complete a nutrient management plan.

Time of sampling:

The best time of year to soil sample is in the fall directly after the crop is removed. Since results can vary depending on the time of year, it is best to sample at the same time each year. Soil tests should be completed every 2-3 years for most crops. For crops grown on very sandy soils particularly if the crops remove large quantities of potassium such as corn silage and alfalfa, you should soil test every 1-2 years.

Tools Required:

Farm Map, Soil Probe, Garden Trowel, Measuring Cup, Spade, Knife, Clean Plastic Bucket, Soil Boxes and Sample Submission Forms.

Sampling Procedure:

Before you get started…. If you do not already have a farm map, then draw one with outlined boundaries.

- Assigning all fields a permanent number. It is important to keep this map and results in your records filing system. Crop history is also important information to record such as rotations, past problems liming amounts, etc.
- Remember to repeat sampling process for each area that is different elevation, soil type, treatment history, cropping pattern, color and poorly drained land separately.

Sampling Steps:

1. Take one composite sample for every 10 ha (25 acres).
2. The number of cores in each composite sample should be at least 20 no matter how small the sampling area.
3. Samples should be taken randomly throughout the entire area, travelling in a zig zag pattern to ensure uniform distribution.
4. Take samples using your soil probe at a depth of 10-15 cm for sod crops and 15-Page 2 of 3 20 cm for most other crops.

5. Place samples in clean plastic bucket. Remove plant residue, rocks, break clumps and mix well.

6. If the sample is wet it will need to air dry in a non-contaminated area before the sample can be mixed and a composite taken.

7. The composite sample should be about 2 cups in size.

8. Place sample in box labeled with sample number, field number and your address.

9. Fill out form for sample submission. Select crop name on back of the form in order to receive a fertilizer recommendation.

Words of Caution:

- Do not sample old fencerows, areas of manure/hay/ lime storage, dead furrows and areas close to trees/roads and windrows.
- Do not sample areas of high erosion.
- Sample areas with different elevation, soil type, treatment history, cropping pattern, color and poorly drained land separately.

Fill up the sampling form and submit the samples to the nearby soil testing centres along with your details such as name, mandal, village, district, etc.

Site Specific Nutrient Management

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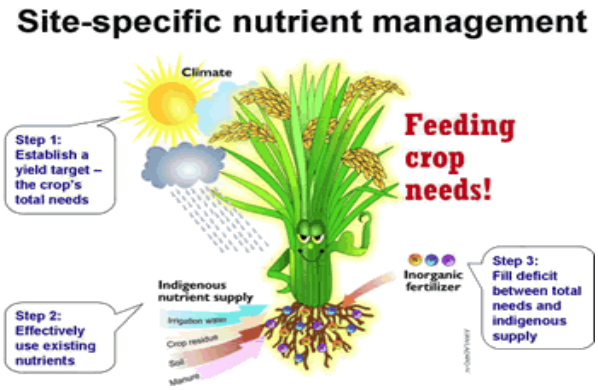
Site specific nutrient management is a set of nutrient management principles combined with good crop management practices that will help farmers to attain high yield and achieve high profitability both in the short and medium-term. The principles of SSNM are generic and also applicable to other crops including rice. SSNM provides an approach for the timely application of fertilizers at optimal rates to fill the deficit between the nutrient needs of a high yielding crops and the nutrient supply from naturally occurring indigenous sources, including soil, crop residues, manures and irrigation water. Applying the right nutrient source, at the right rate, at the right time, in the right place is essential to nutrient stewardship and is the core of the 4 R's. Such 4 R nutrient stewardship for fertilizer best management practices is an approach that considers economic, social and environmental dimensions of nutrient management.

Concept of Site Specific Nutrient Management (SSNM):

Nutrient management and recommendation process in India is still based on response data arranged over large domains. The SSNM provides an approach for need based feeding of crops with nutrients while recognizing the inherent spatial variability. It involves monitoring of all pathways of plant nutrient flows/supply, and calls for judicious combination of fertilizers, bio-fertilizers, organic manures, crop residues and nutrient efficient genotypes to sustain agricultural productivity.

SSNM avoids indiscriminate use of fertilizers and enables the farmer to dynamically adjust the fertilizer use to fill the deficit optimally between nutrient needs of the variety and nutrient supply from natural resources, organic sources, irrigation water etc. It aims at nutrient supply at optimal rates and times to achieve high yield and efficiency of nutrient use the crop. SSNM approach involves three steps *viz*., establishing attainable yield targets, effectively use existing nutrient sources and application of fertilizers to fill the deficit between demand and supply of nutrients. Soil nutrient supply potential and its spatial variability, productivity potential and targets for crops and cropping systems, estimation of nutrient requirements and fertilizer use efficiency besides assessment of resource quality and socio-economic background of the farmers are essential for developing site specific IPNS.



The soil, crop, nutrient and resource related parameters that are essential for suggesting and practicing site specific IPNS include:

i. Soil testing-nutrient supply potential.
ii. Productivity targets of crops and cropping systems and nutrient needsâ€"each ton of grain removes about 82 kg nutrients which do vary with crops and productivity,
iii. Efficiency of nutrient sourcesâ€"fertilizers organic nutrient sources like FYM, green manures.
iv. Composts, bio fertilizers, organic industrial wastes and soil amendments.
v. Nutrient efficient genotypes.
vi. Selection of suitable crops and cropping systems involving N fixing crops and their management.
vii. Correction of soil and nutrient related problems.

Soil Test based Nutrient Management:

Evaluation of soil fertility and making fertilizer prescriptions for sustained crop production is of importance to the farming section. Considerable progress has been made to understand the contribution of soil and fertilizer to crop nutrition and the influence of nutrient levels and management on crop productivity and nutrient use efficiency.

Soil testing to assess the nutrient supply capacity provided an opportunity for practical solutions to nutrient management. Soil test based recommendations will be useful only when it is based on important factors like soil, crop, variety, fertilizer and management interaction for a given soil condition.

The soil test based crop response (STCR) project of Indian Council of Agricultural Research (ICAR) provided the right impetus to understand the variability in the soil and crop with practical solutions to enhance nutrient use efficiencies narrowing down to each farm or field. The on-farm trials provided further need and scope for refinement, and recommendations of fertilizer nutrient use over large domains.

Any deficit application of fertilizers will limit crop yields, facilitate nutrient mining and result in depletion of soil fertility. Excessive or imbalanced application not only wastes limited sources but also has the potential to pollute the environment. An approach towards mitigating such concern is site specific nutrient management (SSNM), which takes into account spatial variations in the landscape.

Use of GPS and GIS Systems:

Wide spread adoption of SSNM technologies based on soil testing require extensive soil sampling and analysis which could be a hindrance considering the available infrastructure. Use of Global Positioning system (GPS) and Geographical Information System (GIS) and mapping can provide the right support as cost effective alternative.