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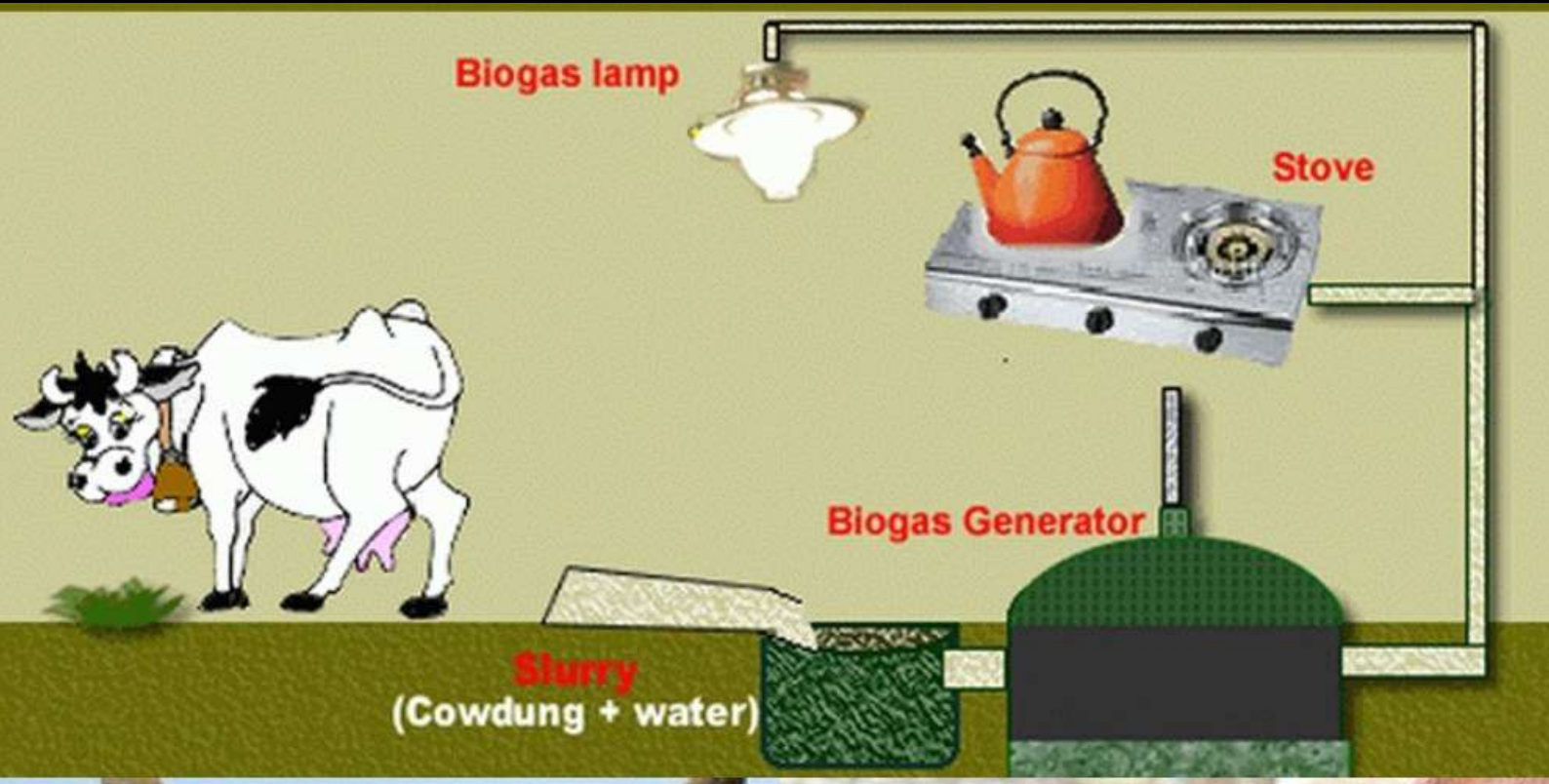

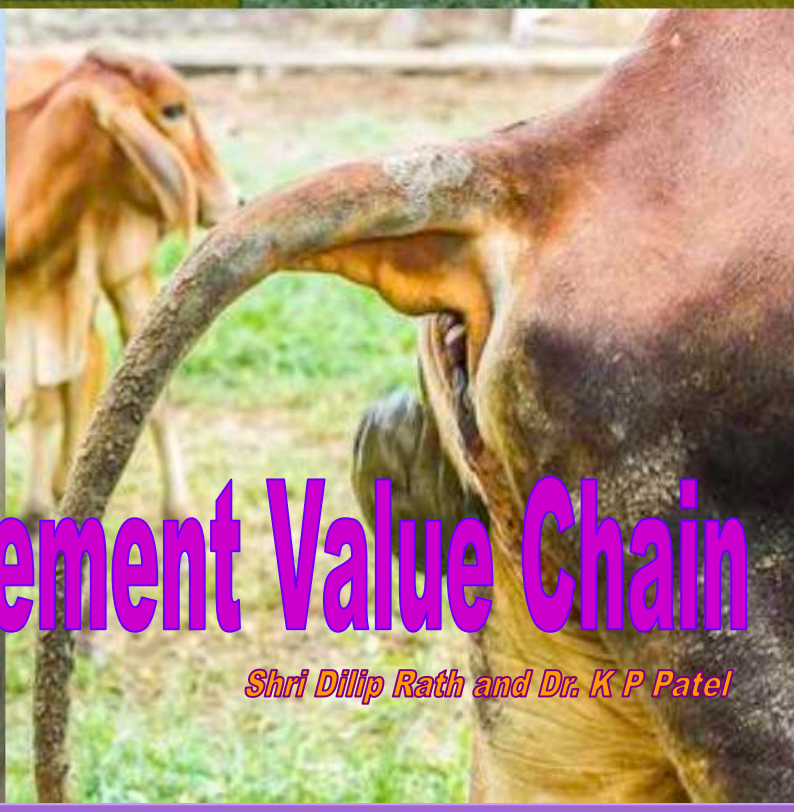

Manure Management Value Chain

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Manure Management Value Chain- An Efficient Model for Doubling of Farmers' Income

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ABSTRACT

Livestock dung plays a vital role in rural economy. Apart from milk, which is a significant economic contributor, efficient use of livestock resources in biogas systems can help generate localised clean cooking energy for rural masses. At the same time, biogas spent slurry, a by-product of biogas plant is a potential source of major and micronutrients besides organic matter. Its proper utilisation after processing has a vast potential in meeting the nutrient requirement of the crops and thereby reducing use of chemical fertilizers besides providing sustenance to soil health.

In India, about 170 lakh families affiliated to village level Dairy Co-operative Societies own on average 3 dairy animals per family. It is estimated that about 443.5 lakh tonnes of solid bio-slurry could be made available from these dairy animals. This bio slurry can be processed to produce bio fertilizerswhich can meet the India's requirement of NPK and micronutrients (Fe, Mn, Zn, Cu) by about 4.5% and 0.4% respectively.

Taking forward this idea, National Dairy Development Board has established an end to end Manure Value Chain in two village of Anand. The bio fertilisers developed from the bio slurry are branded as SuDhan products. Their use in agriculture has shown encouraging results with enhancement in the yield of different crops in the range of 14 to 36 percent over farmers' traditional practices under demonstration trials conducted on farmers' fields during *kharif* and *rabi* seasons of the year 2019-20.

The use of such bio slurry based bio fertilisers has huge potential to reduce expenditure of farmers on chemical fertilizers at the same time enhance their income through improved yield.

NDDB's Manure Management Model offers interesting solution not only to fulfil clean energy requirement of rural masses and address environment challenges but also is a step towards sustainable agriculture practices ensuring improved yield and incomes.

Key-Words: Manure management, Manure Value Chain (MVC), Bioslurry, Green Energy, SuDhanBio fertilisers, Biogas, NPK, Micronutrients

INTRODUCTION

With theadvent of green revolution in India, use of chemical fertilizers increased immensely. But the excessive application of chemical fertilizers have brought its own challenges in terms of deteriorating soil health, hazards to human health and adverse impact on environment. Monetarily also such fertilisers are becoming unaffordable to small and marginal farmers. Today, lack of adequate nutrient supply and poor soil structure have become the main constraints to agricultural production systems in low-input agriculture systems like India

Hence, an alternative to chemical fertilizers such as biogas slurry, compost which are cheaper than other sources of nutrients and are relatively safe are being explored extensively. Going forward, recycling of organic wastes, especially cattle dung, through biogas plants seems to have a great potential. In addition to providing manure, it also provides biogas useful for cooking and at high capacity,generating power. Furthermore, it is of greater significance from the stand point of public hygiene, pollution control and environmental protection.

Biogas slurry is a by-product obtained from the biogas plant after the digestion of dung or other biomass for generation of methane rich gas. It contains appreciable amounts of organic matter (20 to 30%), easily-available plant nutrients and it is considered to be a good source of organic fertilizer as it contains considerable amounts of both macro (N, P, K) and micronutrients (Zn, Fe, Mn, Cu, B etc) that are necessary for plant growth. It enhances water holding capacity, soil aeration, accelerates root growth and inhibit weed seed germination. It can be used to build up health of soil for higher crop production which provides a sustainable way for agriculture, environment and farming communities.

A huge quantity of bio-slurry could be obtained from the large animal population (About 300 millions) in India (*20th Animals Census-2019; Gagandeep et.al. 2017*).According to an estimate, about 60% of the generated dung is practically available to utilize in biogas plants and 1 kg of dung *(gobar)* can be converted in to 0.3 kg solid processable bio-slurry (*Kumar et al. 2015*). About 170 lakh families affiliated to the Dairy Co-operative Societies across the country, rear around 3 animals per unit (family).Based on average15 kg dunggeneration per animal per day, about 2660 lakh tonnes of liquid bio-slurry (80 % of dung and water mixture 1:1) could be produced annually OR about 443.5 lakh tonnes of solid bio-slurry could be made available for processing of bio fertilizers.

Further, the biogas plant spent slurry (BSS) contains on an average N- 1.5%, P- 1.1%, K- 1% K; and micronutrients viz., Zn- 144 ppm,Fe- 3,550 ppm,Mn- 188 ppm and Cu- 28 ppm; equivalent to the chemical fertilizers requirement in terms of NPK and micronutrients (Fe+Mn+Zn+Cu) by about 4.5% and 0.4% respectively*(Table 1).*

Table 1: Potential of Bioslurry in Meeting the NPK and Micronutrients Requirement for Crops in India(Households of Indian Dairy Cooperatives)

Details	**N**	**P**	**K**	**Total NPK**	**Zinc Sulphate**	**Ferrous Sulphate**	**Manganese Sulphate**	**Copper Sulphate**	**Total Micronutrients**
	Million Tonnes				'000 tonnes				
Consumption (2016-17)*	16.7	6.7	2.5	**25.9**	192.7	21.6	4.3	1.6	**220.3**
Requirement (2018-19*	20.6	8.9	5.7	**35.2**	196.9	21.9	7.8	2.5	**229.2**
Potential of Biogas slurry									
Supplementation	0.7	0.5	0.4	**1.6**	0.03	0.8	0.03	0.05	**0.09**
Eqv. INR(Billion)	8.0	23.9	11.8	**43.6**	0.3	11.8	1.2	6.4	**19.6**
Contributiontowards Requirement (%)	**3.2**	**5.5**	**7.8**	**4.5**	**0.02**	**3.6**	**0.4**	**2.1**	**0.4**

*Source: *Fertilizer Statistics 2017-18; Speciality Fertilizers and Micronutrient Statistics 2017-2018 (7th Ed.), The FAI, New Delhi.*

Market Prices considered Major nutrients (Rs/kg): N- 12; P_2O_5- 50; K_2O- 27 ;Micronutrients (Rs/kg): Zinc sulphate 40,Ferrous sulphate 15,Manganese sulphate 35,Copper sulphate 120. .

Keeping the above facts in view, a Manure Management Value Chain pilot project (Model)was developed by the National Dairy Development Board, Anand as a step towards doubling the farmers' income (Karade *et al*. 2020). The objectives also included biogas generation for use of farmers as clean fuel for cooking in their households and the bio-gas slurry for production of organic products ("SuDhan" brand). The organics were utilized in field demonstration trials for enhancing growth and yield of different crops on farmers' fields.

MANURE MANAGEMENT MODEL

There are plenty of bottlenecks to use manure in the form of biogas production and bio-slurry at national scale; however,it could be achieved by leveraging existing dairy cooperative network. NDDB conducted a pilot project in the village Mujkua of Anakalav taluka and Zakhariyapura of Borsad taluka ofAnand district by providing flexi biogas plants to 417 women dairy farmers in cluster mode. The Manure Management Value Chain Model is developed as shown in Fig 1

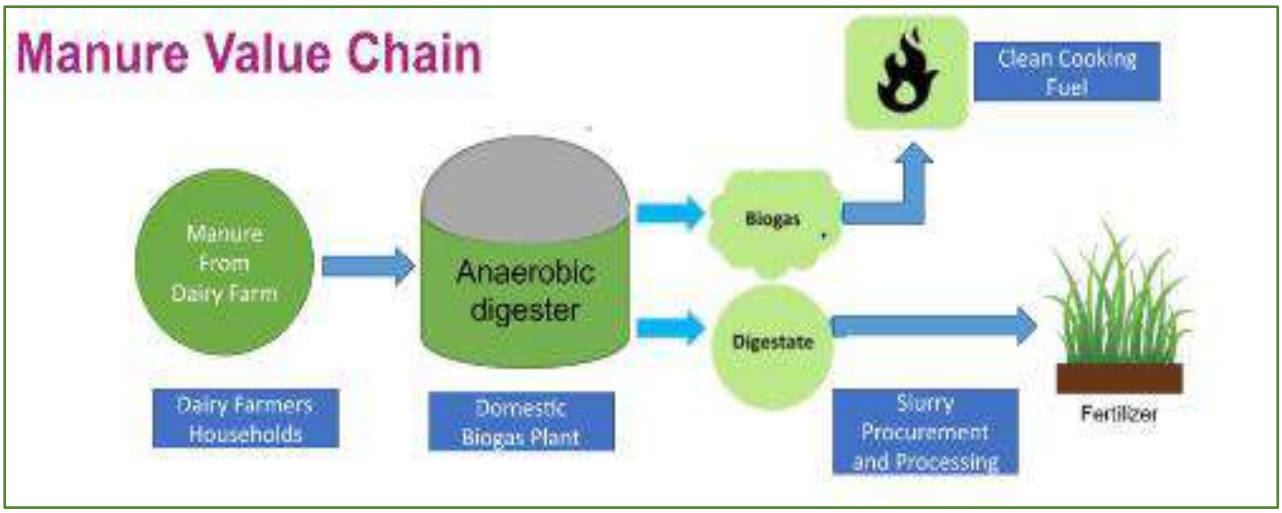

Fig 1: Manure Management Value Chain utilizing Gobar under Pilot Project

Biogas, a mixture of different gases produced by anaerobic fermentation of organic matter from methanogenic bacteria, mainly constitutes methane (50–65 %) and CO_2 (25–45 %). One kilogram of cow manure can produce 35–40 litre of biogas or about 1 m^3 biogas is produced from 25 kg of gobarwhen mixed with equal amount of water with hydraulic retention time (HRT) of 55–60 days maintained at an ambient temperature of 24–26 °C (Rao *et al*. 2010; Gupta *et al.* 2016).

The gas is being used by the women farmers to satisfy their cooking needs and each women farmer now can earn/save in excess of Rs.3000/- month from the savings on cooking fuel and sale of surplus biogas slurry(sold after retention for their captive agriculture usage) through their own all women manure cooperative. The cost of bioslurry varies andisarrived on the basis of its ElectricalConductivity and Brix Index Values as quality parameters.

The surplus bio slurry procured from these women farmers is processed to produce bio fertilizers *(after consumption in their own agriculture fields)*

Fig 2: Biogas plants installed at Mujkua (Anand) and Zakhariyapura(Borsad) of Anand district

The bioslurry based organic input products are being produced by utilizing the protocol of M/s Swasti Agro and Bioproducts Pvt Ltd. Pune,for inoculation of beneficial microbes*(Behera et al. 2011) and* branded as "SuDhan" bio fertilisers.These products are being made available to the dairy farmers through local dairy cooperative societies.

The production of enrichedbio fertilisers in solid and liquid formis carried out byseparation of solid and liquid from the slurry. The liquid form isenriched with trace elements viz., Fe (2.0%), Mn (0.5%), Zn (8.0 %), Cu (0.5%), B (0.5%) as per Gujarat Government approved Grade (III) of multi-micronutrients mixture fertilizer. The micronutrients are very well required for the better plant growth.The solid organic product is developed, named as SuDhan-PROM (Phosphorus Rich Organic Manure) for soil application. Six other SuDhan brand products are developed for their use as foliar application in different crops(Fig 3).Details on composition and actions to provide beneficial effects on plants are given in Table 2.

Fig 3: SuDhan brand bioslurry based organic products for their use in agriculture

PRODUCT DEMONSTRATIONS

The efficacy of the products was tested by their utilization for the demonstration purpose on Farmers' fields. In all 17 farmers were randomly selected from 10 representative villages of Anand district.Farmers were given information on the SuDhan products and the products were used in farmers' fields during the year2019-20 seasons (*Kharif* and *Rabi*) on various crops (Rice, Wheat, Chilli, Brinjal, Tomato, Banana, Papaya, Cotton, Castor) at different locations.

The texture of the soils varied from Loamy sand to Sandy loam, Medium black clay loam; the soil reaction was slightly alkaline with low to medium level of salt accumulation; and low organic carbon status. Nitrogen, low to medium P, high K while micronutrients (Fe, Mn, Zn) availability was marginal to deficient and Cu was in sufficient range *(Kumar et. al. 2019).*

The information on baseline survey of the selected farmers who are members of Milk Cooperative Societies of different villages of Anand district indicated that most of the farmers are marginal with reasonably good socio-economic status; and found interested to adopt newer technologies of agriculture, especially for the crops grown in their areas.

Table 2: SuDhan Products, Contents and Actions

SuDhanProduct	Content	Action
1. SuDhanPhosphateRich Organic Manure(PROM)	BioslurrysolidsandRockPhosphate(3:1)fermentedtogetherwithbeneficialmicrobes	SolubilizePwhichcanreplacePcontainingchemicalfertilizers
2.SuDhanMicronutrientsGradeIll	Microbialculture,salts,beneficialmicrobesandenrichedwithmicronutrientsasperGoGnotified GradeIll	Increasesavailabilityofmicronutrientsandprovidesvigourtoplants
3.SuDhanRootGuard	Modifiedchitosan,lacticacid, aceticacidandtraceelements	Organicliquidwhichprotectsroots from infectionand improvesitsgrowth
4.SuDhaoWonder	Marinealgaeextract,tracesofmicronutrients	Organicliquidwhichpromotesoverall plantgrowthand improvesphotosynthesis
5. SuDhanLux1Grow	Chito-oligosaccharides,saltsandtracesofmicronutrients	Organicliquidwhichprotectsplantandpromotesitsgrowth
6.SuDhanICON-4	Humate,fattyacidsandtracesofmicronutrients	Organicliquid,enrichedwithbeneficialorganiccompoundswhichpromotesplantgrowthandgivesprotectionfrom nematodes
7.SuDhanChitoGuard	Modified Chitosan,lacticacidandderivativesof salicylate	Organicliquidwhichpromotesgrowthofbeneficial microbesandprotectsfromentryof

The demonstration was conductedand monitored keeping both SuDhanTreated and Un-treated (Control) plots (about 200-250 m^2 size each). The treatments included soil application of SuDhan PROM, 25-50 kg / Acre (depending upon duration of crop) as basal at the time of sowing / transplanting of the crop; SuDhanGrade III was applied @ 1% solution as foliar spray after specified period during the growth of crops and dilute form of SuDhanroot enhancer (SuDhan Root Gourd) was applied after establishment of plants as drenching application @ 10 % solution in root zone of the crops. The growth of the crop was monitored and other package and practices for crop protection as per standard recommendations were followed. The crop was further nourished with the foliar application of SuDhanGrade III (1% solution) for supplementation of essential micronutrients to boost the growth after about 25-40 days of sowing / transplanting. The second spray of SuDhan Grade III was made after 45-60 days of sowing / transplanting. Various growth parameters and yield data were recorded during the growth period and at harvesting of the crops, respectively.

RESULTS AND DISCUSSION

During both the seasons, observations were taken on important growth parameters and yield. The results on average values of four to five observations for respective parameters of different crops under both the treatments are presented in Fig 4.The results clearly revealed that the application of bio-gas slurry based SuDhanbiofertiliserincreased the growth of different crops and yield compared to traditional practice of farmers. The microbes and trace elements enriched SuDhanbiofertilisersmust have provided better nutrition to the crops due to favourable action of microbes present in the products besides supplementation of micronutrients which are essentially required for the balanced nutrition of the crops as the soil was nearly deficient for the availability of important micronutrients *(Shukla and Tiwari 2016)*.

Beneficial microorganisms or microbial inoculants are carrier-based ready-to-use live formulations, which on application to plants or soil helps in mobilization of various nutrients by their biological activity. Biological organic fertilizers add nutrients through the natural processes of fixing atmospheric nitrogen, solubilizing phosphorus and stimulating plant growth through the synthesis of growth-promoting substances.

Thus, the enriched SuDhan biogas slurry-based products have played a vital role in enhancing the nutrients availability for better plant growth as well as yield.It is clear that the farmers' practice alone might have not providedbalanced nutrition to the crops and hence the values of growth parameters (nos of tillers, fruits, bolls, effective spikes per plant) of the crops at different stages were comparatively lower than the SuDhantreated plants. The higher growth of the crops must haveresulted into higher economic yield of different crops upon maturity. The overall observation and results clearly showed the superiority of the products to enhance growthandyield of different crops. The increase in crop yield varied from 14.7 (castor) to 36.1 (cotton) per cent with an average of about 28.0 per cent over farmer's practice (Fig 4). The farmers' opinion was also in line with the results obtained under demonstrations trials.

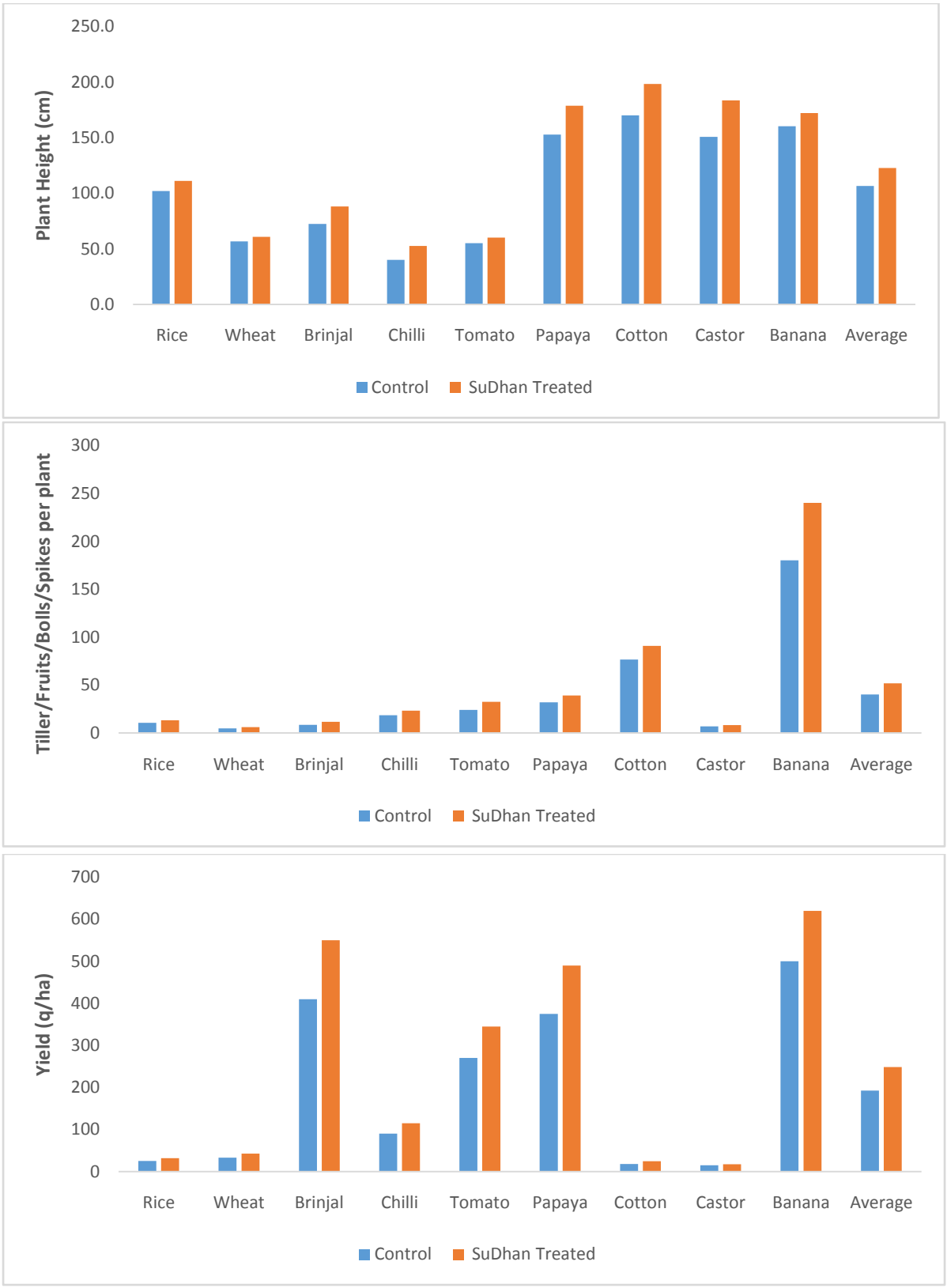

Fig 4: Effect SuDhan organic fertilisers on growth and yield of different crops

SUMMARY AND CONCLUSION

The pilot project model was developed by the NDDB as Manure Value Chain for dairy cooperative farmers in Anand district. Itwas found effective and efficient in terms of

providing green energy (biogas) to farmers for their cooking needs and hygienic environment besides income generation by selling of surplus bio slurry for production of organic products to be utilized as inputs in the agriculture. The collected bio slurrywas processed for the production of SuDhan brand organic products which were utilised in fields of different farmers at different locations under demonstration trials during the year 2019-20.

The application of organic products has shown enhancement in the growth and yield of different crops viz., banana, cotton, rice, wheat, brinjal, chilli, tomato, castor, papayaas compared to traditional practices of farmers. The crops received soil application of PROM as basal, SuDhan (Root Gourd) rootenhancer after establishment of the crop and SuDhanGradeIII application as foliar during the growth period. The beneficial effect of the products was indicative of its utilization to provide balanced nutrition to plants for higher crop growth and yields;and reduce use of chemical fertilizers, thereby possible reduction in the soil-water pollution. The use of various products as a package would likely to be still more effective in enhancing growth and yield of different crops. Thus, field demonstrations of the slurry-basedSuDhanproducts are showing improved growth and yields of all category of crops simultaneously reducing the agriculture input cost.

BENEFITS OF MANURE VALUE CHAIN (MVC) OF NDDB

- Utilization of dung in biogas digester can provide cheap energy (1 cubic meter per 25kg dung); and bioslurry which is a good organic fertilizer for crops.
- Generates energy in terms of biogas fuel and saves about Rs 3000 on fuel together with selling of bioslurry at the average rate of Rs 1 per litre.
- The direct use of bioslurry can meet the requirement of chemical fertilisers by about 4.5% for NPK & 0.4% for micronutrients, made available from 17 million House Holds of Indian Dairy Cooperative farmers.
- The use of bioslurry based enriched SuDhan products in fields can reduce the use of chemical fertilizers (N and K) and replace the application of P and micronutrients.
- The SuDhan organic fertilizers can enhance crop growth, its quality and increase in crop yields.
- The model is environment friendly which improves soil health and the ecosystem.
- Improves sanitation and decreases environmental pollution by controlling emission of GHGs.
- The Model could be useful to provide sustainable solution to the manure management and increases the farmers' income as a step towards doubling the farmers' income by 2022.
- The Model is an interesting solution not only for farming challenges (fertiliser) but also energy challenges, especially for smallholder farmers.

REFERENCES

20th Livestock Census.(2019). Department of Animal Husbandry, Dairying and Fisheries.Government of India.

Behera, Kambaska&Alam, Afroz& Vats, Dr. Sharad & Sharma, Hunuman& Sharma, Vinay.(2011). Organic Farming History and Techniques.10.1007/978-94-007-1905-7_12.

Gagandeep Kaur; Brar, Y.S.; Kothari, D.P. **(2017)** Potential of Livestock Generated Biomass: Untapped Energy Source in India. Energies, 10(7), 847.

Gupta, K.K.; Aneja, K.R. and Rana, D. **(2016)** Current status of cow as a bioresource for sustainable development. *Bioresour.Bioprocess*, *3*.

Karade N.M., Patel K.P., Patel M., Bharti S., Joshi P., Sanghwi M. and Shetkar, B. (2020) Efficient Manure Value Chain- A Step Towards Doubling Farmer's Income. Paper presented in Dairy Industry Conference *on* "Dairying for- Health and Wealth" at Jaipur (Rajasthan), February 20-22,2020.

Kumar, Dileep., Patel, K.P., Ramani, V.P., Shukla, A.K. and Meena, R.S. (2019) Management of micronutrients in soil for the national security, In : Nutrient dynamics for sustainable crop production, Editor: R. S. Meena. Publisher Springer (ISBN: 978-981-13-5869-8).

Kumar,S., Malav L.C., Malav M.K. and Khan S.A. (2015) Biogas Slurry: Source of Nutrients for Eco-friendly Agriculture**.**International J Ext Res. 2:42-46.

Rao, P.V.; Baral, S.S.; Day, R.; Mutnuri, S. **(2010)** Biogas generation potential by anerobic digestion for sustainable energy development in India. *Renew. Sustain. Energy Rev., 14*, 2086–2094.

Shukla, A.K. and Tiwari, P.K. (2016) Progress report of AICRP on Micro and Secondary Nutrients and Pollutant Elements in Soils and Plants, IISS, Bhopal.

The Pandemic COVID19: Impact on Farming and Food Supply

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Across the world, an outbreak of infectious disease COVID19 caused by SARS-CoV-2 has spread rapidly since late 2019 and early 2020, profoundly devastating the lives and fundamental activities of livelihood. WHO (World Health Organization) reported a continued steep rise in the number of cases and deaths worldwide, as the pandemic spreading to at least 240 countries and territories. Countries like India, China, New Zealand, France, Poland and UK have implemented the world's largest and most restrictive mass quarantines. As we speaks about India, early actions were taken to limit the spread the pandemic by ordering a 21 – day lockdown starting from March 25 (Phase I), March 25 to May 3 (Phase II) and further up to May 3 to May 18 (Phase III) for a 1.3 billion population.

1. AGRICULTURE AND FOOD SUPPLY:

As the spread of the virus continues to evolve differently by continents and by countries, the full impact of the virus on food security and agricultural food systems is not yet known, nor will likely be known, for months to come. Something is clear that it will have and almost having a negative impact on people along with food supply chains i.e., from farmers to middle men, transporters, markets and consumers. According to a report from FAO (Food and Agriculture Organization of the United Nations), it is concerned about the impacts of the virus on food and livelihoods of people who are already experiencing food crises.

1.1 LESSONS LEARNT FROM PREVIOUS CATASTROPHE:

We have to acquire a fair amount of lessons from previous catastrophe, from Ebola virus disease outbreak in West Africa in 2014, cholera outbreak in Haiti in 2010, global crises (Food prices crisis of 2008). According to reports from FAO on Ebola and Cholera outbreak, the Ebola outbreak does not represent a food related risk, but it shown a great impact on market chains and production (rice, cassava, palm oil, animal products, horticultural product, cocoa and bushmeat) in Guinea, Sierra Leone and Liberia (47% of farmers were unable to cultivate farmland due to outbreak) of West Africa. Haiti's cholera outbreak, which was magnified by hurricane Tomas (November floods) did a

huge damage of 200,000 acres crops. Many farmers avoided the harvest, fearing that the water in the rivers and canals that irrigate their paddies and other fields might be infected by cholera. This outbreak affected the agricultural commerce in the area as the consumers were not willing to buy any produce from the regions which were affected by cholera.

There was a prominent impact of these two outbreaks as market supply chains and most of the farmers were unable to cultivate or sell crops due to lack of inputs, labor and suspended trade flow of agri-commodities to national and international market. This resulted in higher food prices, and the reduction in economic activity both at the regional and national levels. Learning from these, it was crystalline we have to safe guard our livelihoods and food production and access at the every onset of the crisis will be critical to mitigate the secondary impacts of the COVID-19 pandemic and related containment efforts.

For any nation, health and food security objectives are closely intertwined. We have to be proactive in anticipating COVID19 collateral effects by protecting the livelihoods and food access of the most vulnerable people, besides supporting public health actor's efforts to contain the spread of the disease. Investing in local food systems provides people with a means to continue surviving in the midst of disaster.

1.2 IMMEDIATE CHALLENGES:

Food is the basic need to stay alive for the human no matter rich or poor, living in county side or in metropolitan cities. Supplying basic food for all the communities of people is a great task in this time of crisis. According to a report from World Economic Forum, in developing nations government schools closing means no more school meals, which is an end to the only hot meal anyone among the family members would get in a day.The only way to reinforce the poor children with a meal is by providing rice, eggs and other rations through the nutrition programs like Mid-day meals, Integrated child development services (ICDS) and Anganwadis. Kerala government is setting examples by helping the weaker sections of communities by providing meals at the doorsteps of households; such innovative programs should be taken up by all state governments to aid informal workers and poor. In order to avoid exclusion errors, it better government should distribute 71 million tons of rice and wheat to the needy people that are overflowing in the government warehouses.

Farming and food are two sides of a same coin. As we speak about farming in India, lockdown coincides with rabi harvesting season of crops like wheat, mustard, gram, lentil. Farmers across the country looking up to the government to ensure the uninterrupted harvesting of the crops and transporting them to the mandis. There is a shortage in the supply of fruits, vegetable, poultry, fish and dairy products to urban and pre urban areas. It's fetching more difficulties to the government for untroubled supply of food grains and other essential items to the consumers during this time of crisis. The migration workers who plays a prominent role in harvesting, post harvest handling and transporting flew back to their native places, thus creating a panic button in supply. Farming sector in India depends on migrant laborers, among 140 million of India's

population nearly 50 million migrant laborers have returned to their native place due to lockdown in the entire nation. The migration of laborers to rural areas from cities provides an opportunity to develop agriculture potential by engaging them in livestock, food processing, farming, water management, godowns and fisheries sectors, as these sectors were neglected over the years.

In this time of catastrophe we have to sustain the agricultural demand commodities by investing in the key logistics. There a demand to encourage e-commerce, delivery companies, **Farmer Producer Organizations (FPOs) or custom hiring centers (CHCs),** small and medium enterprises running with raw material of agriculture and allied sectors and start ups with suitable policies, so that the rural economy doesn't collapse. The Union Minister of Agriculture & Farmers' Welfare, Rural Development and Panchayati Raj, Shri Narendra Singh Tomar launched new features of **National Agriculture Market (e-NAM)** platform to strengthen agriculture marketing by farmers, which will reduce their need to come wholesale mandis. These software modules are (i) Warehouse based trading module in e-NAM software to facilitate trade from warehouses based on e-NWR (Telangana - 14 warehouses & Andhra Pradesh -23 warehouses), (ii) FPO trading module in e-NAM whereby FPOs can trade their produce from their collection center, (iii) Launch of Logistic Module will promote inter-State trade under e-NAM by providing online transport facilities for distant buyers. These programs will help farmers to sell their produce at remunerative prices near to their farm gate without coming to mandis. He further added that Mandis have been advised to adopt utmost sanitary and social distancing measures for the safety of farmers and other stakeholders. States are also being encouraged to facilitate direct buying by bulk buyers/processors and big retailers without having to go through mandis to decongest them. The Bengal famine (1943) leads to 2 - 3 million deaths, which were due to food supply chains disruptions not a lack of food availability. From the experience gained keeping food supply chains functional in these hard times is most important to food security.

1.3 APPROACH OF KHARIF SEASON:

The kharif season varies by crop and region; in India the season starts in June and ends by October with advent of the south – west monsoon. April and may are the pivotal months for preparation of the kharif season but this pandemic has put a spanner in those preparations, especially for the seeds and agri chemicals sectors. We depend on agriculture for our survival and quality of seeds depends on seed sectors (public & private). India needs 250 lakh quintals of seeds for the kharif season and the seed production system is complex which requires help of allied sectors such as transport, testing labs and packaging industry. According to International Seed Federation (ISF) there is no evidence found to say that food including seeds are route for virus transmission. Due to current battle Indian seed companies, distributor and retailer networks are reporting low pre – booking. Finest seeds and farm inputs must reach the farmers in time for the kharif season, as many climate models predict a favorable monsoon in the 2020 (India Meteorological Department). Automated machines should

be introduced for the planting of seeds which need only a machine driver for sowing and harvesting. Agricultural loans to farmers should be expanded towards the proceed of kharif season. Private sector can play a significant role with necessary policy support in this calamity.

3. ROLE OF GOVERNMENT:

Nearly 700 million people of the country's 1.3 billion rely directly or indirectly on an agriculture-derived livelihood. Agriculture and allied sectors sector contribute 16.5 percent to the country's $2.6 trillion GDP, according to the Indian government's Economic Survey in 2019-20. To protect the most vulnerable sections (including farmers) from the adverse impact of pandemic, Indian government declared a package of INR 1.7 trillion as the nation was under complete lockdown. Under PM – KISAN scheme the government released advance amount of INR 2000 to the farmers as income support. The government supporting the poor and vulnerable people by various scheme like NREGS, Pradhan Mantri Garib Kalyan Yojana and PM – CARES along with grain allotments to registered beneficiaries. To address the "burden of debt servicing" due to the pandemic Reserve Bank of India (RBI) has announced the crop loans have been granted a moratorium of three months (till May 31) by banking institutions with 3 percent concession on the interest rate of crop loans up to INR 300,000 for borrowers with good repayment. In the second tranche of Covid-19 special package, Union Finance Minister Nirmala Sitharaman addressed that over three crore farmers (marginal farmers) have benefitted from loans worth Rs 4.22 lakh crore and they don't need to pay premium and 25 lakhs new kisan cards with a loan limit of Rs 25,000 crore have been sanctioned during this period. Besides all these packages and schemes there are sectors which require attentiveness of the ministry. Farm inputs, seeds and fertilizers outlets are imposed to shut by police, the ministry should issue a notice to the police in this situation. All the manufacturing units that are associated with agri – inputs (seed industry depends on the packaging units) must allow to function to terminate the collapse of agri – input ecosystem. Seed industry requires a special package with low interest or interest free loans. Under RKVY, Private Partnership for Integrated Agriculture Development (PPP-IAD) should benefit more farmers as it enhances productivity, earn benefits and sustain economically and socially. Across the country the obstacles like collection of rabi harvest from farmers, movement of food grains to mandis, restriction in the movement of vehicles by road and shortages of operators need to be address soon by the government. The government should vigilance while moving the food commodities to the vulnerable people of communities through rail and road, while following the prescribed guidelines. Back in 2000, the government in Maharashtra state created smaller weekly markets in urban areas where growers can sell their produce, rather than huge whole scale markets. In Maharastra the Paani foundation is collecting surplus produce from farmers and doing door to door delivery to reduce crowds at local markets. Such innovative programs should be taken more by both public and private sectors for the even food supply.

5. DEMAND AND LOSS:

In India agriculture and its allied sectors is the largest source of livelihood. There is a huge demand for durable goods and discretionary services during the lockdown times. People around the globe reports panic buying and food hoarding have proliferated since the pandemic. According to World Economic Forum "on the supply side, global grain stockpiles are healthy but could quickly be depleted as the virus disrupts food production and distribution. It also voice that COVID-19 is amplifying the risk of a worldwide food-price spike, which would trigger crises in many developing countries. In the poorest of these, food accounts for 40-60% of the consumption basket, about 5-6 times its share in advanced economies." Both local and international markets need more stockpile to meet the demand of human in times to come. There is so much of demand and fall in prices of the agricultural commodities at local and global level. As we scrutinize the local markets of India, tomato growers in Maharastra selling tomato Rs 2 per kg on contrast in summer season tomatoes prices will consistently be at it's vertex (Rs 40-50 per kg). Grapes growers facing an aggregate loss of Rs 1000 crore as demand has fallen due to crisis. Vegetables in Punjab were being sold at Rs 1/kg where the actual price is Rs 15/kg. Due to misinformation, that chicken are the carriers of COVID19 poultry industry hit badly. The prices of broiler has fallen from Rs 55/kg in January to Rs 24/kg in March 2020 in Delhi elsewhere in Tamil Nadu egg prices fallen from Rs 4 per egg to Rs 1.95 per. If this is the dejected state of local market on the other hand international export is being hit badly due to lockdown.

India is the second largest producer of agricultural commodities like rice, wheat, cotton, sugarcane, groundnut, fruits and vegetables in the world. In 2018-2019 India's exports are valued at 38 billion US Dollars but this year India can't make it as most of the importing markets are shut down because of the pandemic. Banana business hit hard in Europe Union, West Asia and South East Asia due pandemic. There was a fall in banana prices by 30% within two weeks in Maharastra and Andhra Pradesh. In Iran, Iraq and Pakistan, Nowruz festival was called off and this has been a big blow to Indian Basmati exporters. On contrary, Germany and Poland imports Indian Basmati rice by increasing in the rice consumption. Ground nut importers from China and Vietnam standstill due to pandemic. While the bright side is Europe Union relaxes for the import of fruits and vegetables from India but there no import orders from USA. Indian mangoes fetching a huge opportunity in Korean markets as Korean prefers Indian mangoes over Cambodia mangoes. Across the globe beside India other countries facing the hard times when it comes to export of agricultural commodities. Vietnam's rice export reduces to 40% in comparison to the same period in 2019. Nearly half of the world trade in floriculture products and 77% of flower bulbs sold by Netherland. But the revenue has dropped by 85% since last month as the demand for flower is zero. After Netherland, Kenya facing a fall of flower export earnings which has drop by about half to 60 billion shillings ($571 million) or lower this year. The COVID19 pandemic has caused major disruption to food and agricultural products along with world trade. Many countries across the globe carefully strategizing how to ensure their own food supply,

as the production has slowed down, transportation became a challenge as borders have been shut. The vulnerable poor people who spend 60 percent of their daily income on food will agonize food shortages. The only way to get through this pervasive is just letting the food trade flow with ease and all prescribe guidelines of safety. According to FAO economist Maxima Torero "the worst that can happen is that governments restricts the flow of food….Now is the time to protect the flow of food around the world".

6. NARRATIVES FROM FARMER'S EDGE:

Across the globe and around the clock farmers are the most hardworking individuals to feed mankind. India is called as land of farmers, as most of them are involve in farming. Farming and farmer is the most affected tribe in the calamities. In this hour of pandemic there are many narratives from farmers despite of many packages and schemes from the government. In Bihar farmers faced a lot of issues for harvesting the rabi crop as the labours hesitant to venture out to work in the fields, because of getting penalized by virus infection. According to Niraj Yadav, a farmer from Patna, 50 per cent of total vegetables grown were going to waste because of lack of transport facilities. Anil Salunkhe a farmer feeding strawberries to the cattles grown in his two acre farm in Satara district, some 250 km south – east of Mumbai as there are lack of tourists and ice cream producers to purchase the strawberries. He was hoping to make 800, 000 rupees but he has not even recovered the production cost 250,000 rupees. Nearly 15 tonnes of grapes were dumped in a nearby forest after failing to sell them by Munishamappa, a farmer in Bengaluru. DyaneshUgle of Sahyadri Farms, vocalize there was a huge cut down of export for grapes to Europe due to lockdown. A small land holder from Khairpur village of West Greater Noida forced to sell four quital of chilli at Rs 10 per kg against the normal cost of Rs 40. After months of hard work in farms "we were hoping to reap a affluent harvest of rice in rabi season, but God clearly had other plans" were remark by Balbir Singh Rajewal, President of the Bharatiya Kisan Union in Punjab. Three acres land of Ajay Jadhav was cultivated with basil, iceberg lettuce and bok-choy relies on restaurants but was forced to make manure. As the villagers refused to buy exotic vegetables even for free. Rahul Pawar dumped exotic flowers (gerbera, gladioli and bird of paradise) into the compost pit, as the weddings that typically demand more of these flowers were called off due to lockdown.

Another flower grower Sachin Shelar says the bulk of his earnings come from the summer season, but sales have stalled during this crucial period. Many farmers with their own efforts running small mandis in the town of Satna (Madhya Pradesh) to sell pulses, mustard and wheat by following guidelines without the assistance from government. Grain farmers with larger land holdings are experiencing greater struggles as there was severely interrupted agricultural patterns especially harvesting activities in the northwest northern breadbasket states of Uttar Pradesh, Punjab and Haryana where wheat and pulses are grown, mention Rajewal. Pravin Paithankar, president of the Maharashtra Heavy Vehicle and Inter – State Container Operators Association speaks that the farmers who hang on cash crops like cotton, onion and bananas from southern Tamil Nadu and Maharashtra observe issues with transportation. As the truck

drivers and container operators prefer to stay in their villages due increasing cases in urban. An umbrella organization All India Kisan Sangharsh Coordination committee of over 250 farmer unions across the country, urged Prime Minister Narendra Modi to procure the entire wheat produced in the country to protect farmers. Without food the world would slowly die, and farmers work hard day to day to stock the markets with food crops. In these pandemic times farmer's suicides will break our heart. A farmer from Karnataka committed suicide weeks ago as he was unable to sell his harvest because of lockdown. Rambhavan Shukla, another farmer from Jari village in Uttar Pradesh hanged himself because of non-availability of workers for harvesting his wheat crop. Despite the turbulence within the rural economy, however, there's optimism that India's food security won't suffer. The country maintains substantive buffer stocks of wheat and rice and its granaries are overflowing with nearly 60 million tons of food grain, according to the Food Corporation of India.

7. INITIATIVES FROM OVERSEAS

In United Kingdom, around 70,000 – 80, 000 seasonal pickers are needed, as the ongoing lockdown can't fill the vacancies of migrant workers. The government has launched a **"Pick for Britain"** scheme to redeploy students and furloughed workers on farms across the country. Spain is the biggest exporter of fruit and vegetables in the Europe Union faces similar shortages of migrant workers. The government declares that it will allow illegal immigrants to take farm jobs alongside the unemployment. A website called **"The Land Helps"** was initiated by the German government to link farmers with the millions of people whose work places have closed, and with students whose exams have been postponed due the pandemic. In US through **"Farm to table"** many farmers selling their products directly to consumers, "a lot of new people into local food that have never tried buying from their local farmers before" was stated by founder of Harvie. Many others are adopting a community supported agriculture programme. In France a television service **"Cultivons Nous.tv"** on Netflix for farming broad casting documentaries and clips filmed by farmers for the city dwellers who have been locked down, to show true hard work of the farmers that goes into feeding a nation.

The impact of COVID-19 on farming and farmers is profound and the full impact on the economy is still unknown. The substantial challenge during this time is to protect the most vulnerable section of society and to make out the safest way for farming and food supply. The focus of government should be to protect the lives of every citizen with basic food supply. People who rely on agriculture and allied sectors of agriculture are most likely to suffer because of pandemic, until the economy bounce back government has to see the alternate channels to improve the standards of living for these people.

REFERENCES

FAO (Food and Agriculture Organization of United Nations) – Addressing the impacts of Covid19 in the food crises.

World Economic Forum – How can we prevent a Covid19 food crisis?

World Economic Forum – Coronavirus could worsen the hunger in the developing world.

APEDA – Covid19 Global Coverage: Opportunities versus threat for Indian Agro exports.

APEDA - Union Agriculture Minister launches new features of e-NAM platform

India Today.

The Hindu Business, Agri business.

Dr Arabinda Kumar Padhee, Director, Country Relations and Business Affairs - New Delhi, ICRISAT; and Dr Peter Carberry, Director General, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) Business standard.

Social distancing in the local markets.

Livestock's Contribution to Indian Economy

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Livestock plays an important role in Indian economy. India is the fastest growing country and more than 70 percent population of India is earning from agricultural and animal husbandry sector. The contribution of agriculture and animal husbandry in national GDP is equal. Also, India is the leading country in total milk production. About 30.5 million people depend upon livestock for their livelihood. Livestock contributes26% to the income of small farm households as against an average of 24% for all rural households. Livestock provides livelihood to two-third of rural community. It also provides employment to about 18.8 % of the population in India. India has vast livestock resources. Livestock sector contributes 4.11% to the GDP and 25.6% to total Agriculture GDP. Together with its allied activities, livestock provides milk and milk products, meat and meat products, and also constitutes a major supplier of food and food articles, raw materials, and finished products. Livestock sector includes animal husbandry, dairy and fisheries sector. Therefore, the livestock sector plays a vital role in national economy and in the socio-economic development of the country. It also plays an important role in the rural economy by supplementing family incomes and generating gainful employment in the rural sector, particularly among the landless labourers, small and marginal farmers and women.

Since India's independence, it has experienced considerable economic growth and structural change; a trend accelerated by its structural reforms which began in 1991. These changes are also reflected in trends in its livestock sector which has shown considerable growth in recent decades especially since the late 1990s. There have also been major changes in the production of the Indian livestock sector.

LIVESTOCK SECTOR CONTRIBUTION:

India is

- **First** in the total buffalo and cattle population in the world.
- **Second** in the population of goats.
- **Third** in the population of sheep (72 million).
- **Fourth**in the population of ducks and chicken.
- **Ninth**in camel population in the world.

(Source: GOI, 20th livestock census)

THE LIVESTOCK PROVIDES FOOD AND NON-FOOD ITEMS TO THE HUMAN POPULATION:

1. Food: The livestock provides food items such as milk, meat and eggs for human consumption. India is the leading milk producer and buffalo meat exporter in the world. It is producing about 187.7 million tonnes of milk, about100 billion eggs, 8.89 million tonnes of meat in a year.

2. Fibre and skins: The livestock also contributes to theproduction of wool, hair, hides, and pelts. Leather is the mostimportant product which has a very high export potential. India is producing about 41.9 million kg of wool per annum.

3. Draft: Bullocks are the back bone of Indian agriculture. Despite many advancementsmade in the use of mechanical power in Indian agricultural operations, the Indian farmers especially in rural and hilly areas (where landholdings are very small) still depend upon bullocks for various agricultural operations. The bullocks are saving a lot of fuel which is a necessary input for using mechanical power like tractors, combine harvesters etc. Pack animals like camels, horses, donkeys, ponies, mules etc. are being extensively used to transport goods in different parts of the country in addition to bullocks. Inhilly terrains, mules and ponies serve as the only alternative to transport goods. Similarly, the army has to depend upon these animals to transport various items in the areas of high altitude.

4. Dung and other animal waste materials: Dung and other animal wastes serve as very good farm yard manure (FYM) and worth several crores of rupees. In addition, it is also used as fuel (bio gas, dung cakes), and for construction as poor man's cement (dung).

5. Storage: Livestock are considered as “moving banks” because of their potentiality to dispose off during emergencies. They serve as capital and in case of landless agricultural labourers many times, it is the only capital resource they possess. Livestock serve as an asset and in case of emergencies they serve as guarantee for availing loans from the local sources such as money lenders in the villages.

6. Weed control: Livestock are also used for biological control of bush, plants and weeds, hence increasing the agricultural production and contributing to the economy indirectly.

7. Cultural: Livestock offer security to the owners and also add to their self esteem especially when they own prized animals such as pedigreed bulls, dogs and high yielding cows/ buffaloes etc.

8. Companion animals: Dogs are known for their faithfulness and are being used as companions since time immemorial. While the nuclear families are increasing in number and the old parents are forced to lead a solitary life, pet animals like dogs and cats are providing the needed company to the latter thus making them to lead a comfortable life.

The livestock plays an important role in the economy of farmers. The farmers in India maintain mixed farming system i.e. a combination of crop and livestock where

the output of one enterprise becomes the input for another enterprise thereby realizing the resource efficiency.

THE LIVESTOCK SERVE THE FARMERS IN DIFFERENT WAYS:

1. Income:

There's a saying, "Calf is the fixed deposit to the farmer" as after calf matures, if female, it can contribute to the income of the family by the sale of milk and production of replacement stock. Also, bullocks can be used for transportation purpose. After the productive life is over, it can be slaughtered for meat purpose. Livestock is a source of subsidiary income for many families in India especially the resource poor who maintain few heads of animals. Cows and buffaloes during theirlactationperiod will provide regular income to the livestock farmers through sale of milk. Animals like sheep and goat serve as sources of income during emergencies to meet exigencies like marriages, treatment of sick persons, children education, repair of houses etc. The animals also serve as moving banks and assets which provide economic security to the owners.

2. Employment

A large number of people in India being less literate and unskilled depend upon agriculture for their livelihoods. But agriculture being seasonal in nature could provide employment for a maximum of 180 days in a year. The landless and small landholders depend upon livestock for utilizing their labour during lean agricultural season.

3. Food

The livestock products such as milk, meat and eggs are an important source of animal protein to the members of the livestock owners.

4. Social security

The animals offer social security to the owners in terms of their status in the society. The families especially the landless which own animals are better placed than those who do not. Gifting of animals during marriages is a very common phenomenon in different parts of the country. Rearing of animals is a part of the Indian culture. Animals are used for various socio-religious functions. Cows for housewarming ceremonies; rams, bucks and chicken for sacrifice during festive seasons; bulls andcows are worshipped during various religious functions. Many owners develop attachment to their animals.

5.Draft

The bullocks are the back bone of Indian agriculture. The farmers especially the marginal and small depend upon bullocks for ploughing, carting and transport of both inputs and outputs.

6. Dung

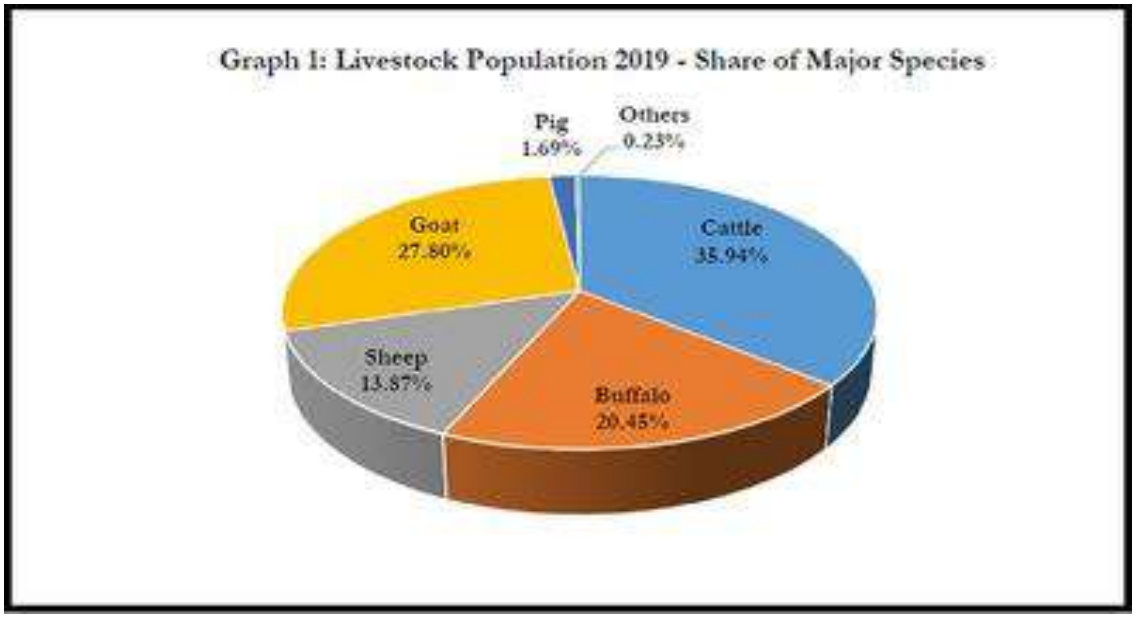
In rural areas,dung is used for several purposes which include fuel (dung cakes), fertilizer (farm yard manure), and plastering material (poor man's cement).

Table No. 1: Livestock Population - Major Species During 2007 to 2019

Species	Population in millions		
	2007	2012	2019
Cattle	199.08	190.9	192.49
Buffaloes	105.34	108.34	109.85
Sheep	71.56	65.07	74.26
Goats	14.054	135.17	148.88
Pigs	11.13	10.29	9.06
Yaks	0.08	0.08	0.06
Mithun	0.26	0.30	0.38
Horses &Ponies	0.61	0.63	0.3
Mules	0.14	0.20	0.08
Donkeys	0.44	0.32	0.12
Camels	0.52	0.40	0.25
Total	529.70	512.06	535.78

BENEFITS OF LIVESTOCK SECTOR DEVELOPMENTS IN INDIA

Animal Husbandry sector provides large self-employment opportunities. Presuming that one family member is employed in looking after the livestock, 25 million people are estimated to be employed with the livestock rearing activity. This sector is playing very



important role in the rural economy as support sector of the economy. Especially 70 million rural households primarily, small and marginal farmers and landless labourers in the country are getting employment opportunities in dairy. Dairying has become an important secondary source of income for millions of rural families.Poultry is also

another way of getting food and food security in India. Apart from food security it has provided employment to about 2.5 million people. Livestock sector not only provides essential protein and nutritious human diet throughmilk, eggs, meat etc. but also plays an important role in utilization of non-edible agricultural by-products. Livestock also provides raw material/by products such as hides and skins, blood, bone, fat etc.This provides subsidiary occupation to a large section of the society particularly to the people living in the drought prone, hilly, tribal and other remote areas where crop production on its own may not be capable of engaging them fully. In the adverse climatic conditions and national calamities like drought, flood etc., Animal husbandry practices have proved to be boon for sustaining the livelihood of the landless and marginal farmers in the state.

CONCLUSION

Indian livestock industry makes up for a significant amount of world's livestock resources. Both the national economy as well as the socio-economic growth of the country is backed by the livestock sector. Besides offering great potential and outstanding contribution in the agricultural sector over the past years, the livestock sector is performing well in the manner of production, value addition and export of dairy, fishery, wool, poultry and other products. Apart from its performance there exist some threats also which we need to consider and take the global market opportunities.

Solar Based Irrigation Pump for AgriculturalCrop Production

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Irrigation is essential for the nation's drive to produce more food, yielding several times moreproduction than from per unit of land as rain fed farming. Agriculture is considered as the backbone of Indian economy that contributes a high proportion tothe Gross Domestic Product (GDP) and supports industry as well as trade of the country to a great extent.According to the current estimates, India has 142 million hectares agricultural landand out of which 45% use artificialsources of irrigation, while the rest of agricultural land relies solely on monsoon rain (Indian Policy and Development, 2017). To achieve an increaseof 494 million tonsin food production by 2050, the irrigated area should be increased from 79 million hectares to 146 million hectares (Soman, 2016). Irrigation coverage will continue to increase covering approximately 55% of the total crop area from its present level of 41%, which may be fulfilled either by surface water or groundwater (Amarasinghe et al., 2008). Various devices or pumps have been in use for lifting the water from surface water body or groundwater body since 3000 BC in different parts of the nation. As electrical energy and energy from fossil fuels were unknown, manually operated mechanical devices, or devices driven by natural forces, such as wind, had to be invented. Such water lifting devices have their origin in the prehistoric time.

Early devices, such as Dhekali, Water wheels, Rahatsand Chutes were constructed and used human as well as animal'spower(muscle energy) to provide the energy required to operate the device and for movement of the wheels. Later on, pumps, such as helicoid pumps known as "Archimedean" were invented and they are still in use. Several types of water lifting devices known as "tympana" (drums) were also used widely for irrigation and mining, until the past centuries.In the 19th century, the production of thermal and electric motors started. Rapid development of industries and urban population growth posed problems, the solution of which was impossible without the use of pumps. Nowadays, new water lifting techniques e.g. piston pumps, centrifugal devices, even vacuum pumps, Jet pumps and Submersible pumps have opened new horizons over the traditional and conventional pumping methods used for water application in agriculture farm field. However, all these devices are present in the market and are easily available.Amongst all, thecentrifugal pump is most widely adopted by the Indian farmers. Ituseseitherdiesel or electricity asa source of energy. Agriculture activities includinguse of irrigation pumps accounts for about 25% of India's total electricity use consuming 85 million tons of coal annually, and 12% of India's total diesel consumption,

using more than 4 billion liters of diesel. Currently, India has 26 million groundwater electrical pump sets, which run mainly on coal-fired power plants or by diesel generators (Shim, 2017). Out of a total of 26 million irrigation pumps, almost 9 million are running using diesel engines and the remaining 17 million from the grid electricity. Due to increasingcost of diesel andenvironmentalhazards as a reason of burning of fuel and priming problems, it is replaced by submersible pumps which are operated by electric power source. In this way farmers are facing the problems regarding hike in price of electricity. India is entering a serious situation where without any possibility for increasing energy resources for increased crop production it would become very difficult to achieve food security. To overcome all these problems, we have to move towards renewable energy sources like solar energy, wind energy, hydropower etc.

Renewable energy sources replenish themselves naturally without being depleted in the earth, helps to conserve of environment, reduce CO_2emissionand high benefit cost ratio.In this regard Dr. Rajendra Prasad Central Agricultural University, Pusa developed different types of solar powered irrigation system in which pumps driveusing solar energy to lift the water from the bore well as well as from the water bodies i.e. river, pond etc. Solar energy is the most abundant andenvironment friendly source of energy in the world. It uses the photovoltaic generation approach(i.e. polycrystalline, mono-crystalline, amorphous)which is an efficient and effective method for harnessingthe solar energy. Solar panels (an array of photovoltaic cells) are nowadays extensively used for illuminating street lights, for powering water heaters and to meet domestic loadsas a whole.One of the major applications of this technology is that it canbe used in the operating irrigation pumps in agriculture farming. Solar powered pump can be a suitable alternative in irrigation system for farmers in the present state of energy crisis in India.This green way for energy production needs minimal attendance and maintenance and provides free energy with near-zero operational cost once an initial investment is made.International Renewable Energy Agency (IRENA, 2016) projected a 59% cost reduction for electricity generated by solar PV by 2025 compared to 2015 prices and this may act as a catalyst for wider rural electrification and reducing energy costs for irrigation. Thefollowing are the techniques that can be used as an appropriate option to cope up with high tariffs of electricity and diesel for unfortunatepeople and deprived farmers as a whole:

1. Solar Tree: This system specially developed for Diara lands (i.e. land lying adjacent to or surrounded by the perennial river and formed due to it's meandering and course changing behavior), having characteristics like light textured soil and undulating topography requires frequent watering. Theseregionencounter the major problem of frequent failure of electric power supply due to frequent floods,because of which, the farmers put more emphasis on adopting an expensive alternative to diesel pumping systems for irrigation in their fields.

The system consists of anumber of solar panels, thoseare installed on the tree-shaped structure to harness sun’s energy and provide it to drive the submersible pump. It also enhances the efficiency of pumping as well as efficiency of irrigation. According to the article (Jain, 2017), a solar tree capable of operating a 5 horse power submersible pump is suitable for irrigation of 15 acres land using conventional irrigation system. The command area can be increased by about 40 percent by adopting an advanced irrigation system like drip and sprinkler irrigation system.The cost of irrigation also came down, i.e. almost to one-third of the cost of irrigation from a normal diesel engine.

Technical Specification of Solar tree

- **Installation area covers (m^2)** : 10
- **Solar modules capacity (kw)** :5
- **Submersible pump power rating (hp)** : 5
- **Irrigation potential (acre)** : 15
- **Cost of Solar Tree (lakh) (without pump &tubewell)** :5.50 - 6.00

Source: (DRPCAU, 2017-18)

2. Boat Mounted Solar Energy Based irrigation System: This system is generally useful for irrigation in Tal and Diararegions. It consists of a submersible pump, which isoperatedby solar panels placed on a normal boat. The pump lifts water from the river can be used forirrigation in the vicinity of the river with this system. The boat is taken ashore during the flood.

Technical Specification of Boat Mounted Solar Energy Based irrigation System

- **Solar modules capacity (W_P)** : 1800
- **Submersible pump power rating (hp)** : 2
- **Discharge Recorded (lps)** :Upto 5.75 at the head of about 15m
- **Daily out put** : 1 lakh litres
- **Cost of System (lakh)** :Approx. 6.00-7.00

Source: (DRPCAU, 2018-19)

3. Tractor trailer based solar powered submersible pump: It operates a 2 horsepower pump by placing solar panels on a normal trailer. The system has also been installed with easily foldable solar panel to move it from one place to another. This system is useful for irrigation in Diara, Tal and Chair areas.

Technical Specification of Tractor trailer based solar powered submersible pump

- **Solar modules capacity (W_P)** : 1800
- **Submersible pump power rating (hp)** : 2
- **Discharge Recorded (lps)** :Upto 5.75 at the head of about 15m
- **Daily out put** : 1 lakh litres
- **Irrigation Potential (acre)** : 5-6 acre
- **Cost of System (lakh)** : Approx. 4.0

Source: (DRPCAU, 2018-19)

CONCLUSION

Solar based irrigation pump is a requirement for irrigation in agriculture field which is a way of improving human development leading to economic growth and productivity. Therefore, Implementation of the above developed techniques is beneficial to farmers under the Diara land areas to achieve the goal of beneficial development which is considered affordable, reliable, and sustainable for all. These techniques brought to light the opportunities in irrigation associated with renewable energy sources, which are beneficial for energy security, energy access, social and economic development and climate change mitigation and reduction of environmental hazard.

REFERENCE

Amarasinghe, U. A., Shah, T., and Anand, B. K. (2008). India's water supply and demand from 2025-2050: business-as-usual scenario and issues (No. 614-2016-40820).

DRPCAU, 2017-18. Annual Report, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar.

DRPCAU, 2018-19. Annual Report, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar.

International Renewable Energy Agency (IRENA). Solar pumping for irrigation: Improving livelihoods and sustainability. Abu Dhabi: IRENA, 2016. Retrieved from http://www. irena.org/menu/index.aspx?mnu=Subcat&PriMenuID=36&CatID=141&SubcatID=2736.

Jain,S.K. (2017). RAU develops solar tree for irrigation in areas sans power, Times of India, Retived from https://timesofindia.indiatimes.com/city/patna/rau-develops-solar-tree-for-irrigation-in-areas-sans-power/articleshow/61535756.cms.

Mohan, S. (2017).Indian Policy and Development.McGraw-Hill Education.

Shim, H. (2017). Solar-powered irrigation pumps in India-capital subsidy policies and the waterenergy efficiency nexus. Jung-gu, Seoul: Global Green Growth Institute.

Soman, P. (2016).Hightech Interventions in Horticulture Crops [Blog].Retrieved from http://blog.jains.com/Hightech_Interventions_in_Horticulture_Crops.htm.

Employing Natural enemies for eco-friendly pest management in hill agriculture in Indian Himalayas

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ABSTRACT

Natural enemies or biocontrol agents include those organisms that are capable and helpful in managing and suppressing the insect pests infecting field crops and causing economic damage. The natural enemies have a major key role to play in controlling insect pests attacking hill crops. The hill agriculture is the cultivation of field crops in distributed patches of land in the vast matrix of forest. The crops are grown in small patches and there is vast diversity in the type of field crops cultivated. The insect pests are the major biotic stress causing agents in the present scenario of climate change in hill farming and many insect pests have gained the status of major insect pest recently. The first and foremost step taken by farmers to manage these insect pests in hill agriculture is to allow for natural control or take up insecticide spray with locally available, low grade insecticides. But, natural control along with human intervention to artificially release natural enemies would be the best strategy to manage pests at lower cost with higher effectivity. In this article we will be emphasising on major predators and parasitoids that can be easily identified by the farmers and encourage their population growth in order to exploit their services in pest management.

Key words: Natural enemies, Hill agriculture, Predators and Parasitoids, Pest management, Natural control, Human intervention.

INTRODUCTION

Biological control or biocontrol is an important component of integrated pest management programme, wherein, through human intervention, the population of insect pests, diseases and weeds are suppressed through artificial release or landscape manipulation for encouraging the population of natural enemies of the pests. Natural enemies or biocontrol agents include those organisms that are helpful and capable in suppressing the pest population or debilitating the hosts that they infect, for example,

insect predators, parasitoids, weed killing herbivorous insects, spiders and disease causing pathogens like fungi, bacteria, virus, nematodes and protozoa.

Hill agriculture is cultivation of field crops in distributed patches in the matrix of forest. It includes the most traditional form of subsistence farming. Wherein, crop–livestock mixed farming is mainly practiced by the farmers to earn their livelihood and it is the backbone of rural economy of Indian Himalayas (Rao and Saxena, 1996; Tripathi and Sah, 2001). This form of subsistence farming is supporting 115 million people in the mountains with less than 10% of net sown area of total area under Indian Himalayas (Semwal *et al.,* 2004). The crop production and productivity are very low when compared to national averages because of low input use efficiency, smaller land holdings, non-availability of plain and fertile lands, non-availability of novel group of safer and effective crop protection chemicals, large area under rain fed conditions, several biotic and abiotic stresses leading to crop loss and lower economic yields.

Among all the lacunae faced in hill agriculture, the present article focuses on biotic stress imposed by insect pests on field crops due to changing climatic conditions and their management through use of natural enemies like predators and parasitoids that can be easily identified by farmers and encourage their population build up in order to effectively manage the insect pests.

IMPORTANT PREDATORS:

Predators are those insects which can catch hold of and feed on large number of insect preys in their entire life time. They can be either prey specific or general feeders. Few important predators are listed below.

1. **Tiger beetles**: they are cylindrical shaped, greenish elongated beetles with sharply pointed mandibles. The body is covered with whitish to yellowish spots and stripes.
2. **Ground beetles**: the beetles are shiny black in colour with yellow or white spots over the body. The grubs of both tiger beetles and ground beetles make vertical pits in the soil to trap the prey and both are active at night (nocturnal).
3. **Lady bird beetles or lady bugs or lady beetles**: they are tiny, hemispherical shaped beetles. The body colouration varies from light yellowish to dark reddish colour and with varyingly designed with spots and lines. The grubs are blackish in colour with spiny structures over the body. They are voracious predators on aphids, whiteflies, mealy bugs and other soft bodied insects.

Tiger beetle

Ground beetle

Ladybird beetle adults and grubs

4. **Fireflies or glow worms**: they are medium sized beetles with specialised light emitting organs. Both adults and grubs predate on soft bodied insects.
5. **Dragonflies and damselflies**: these are general predators and known for their aerial predation. Dragonflies are robust and active fliers, while damselflies are fragile and weak fliers. They predate on soft bodied insects and larvae.


Male Firefly


Dragonfly


Damselfly

6. **Aphid lions or green lace wings**: they are pale greenish coloured flies with characteristic golden coloured eyes and netted wings. They lay whitish stalked eggs and grubs are whitish, creamish or light greenish in colour and mostly covered under debris (camouflage). They are active predators of aphids.
7. **Preying mantids**: these are large and active predators with varying body colouration. They usually mimic the flowers or the background where they are resting. They catch hold of moving insects with their snapping or raptorial forelegs. The mantids being general predators predate on large variety of insect pests.
8. **Cone nose bugs or reduviid bugs or kissing bugs**: they are usually blacking or reddish in colour with narrow head and elongate body. The abdominal region is laterally extended beyond the wings. They suck the body sap from soft bodied caterpillars and are active predators.


Green lacewing


Preying mantid


Cone nose bug / Reduvid bug

9. **Robber flies**: they are elongate flies with very prominent compound eyes. The body is covered with long bristles. The legs are stout, hairy and suited for capturing the prey. They are very active aerial predators feeding mainly on soft bodied insects.
10. **Flower flies or hover flies or syrphid flies**: they are actively flying, brightly coloured flies hovering over flowers and resembling honey bees. They lay whitish, cylindrical eggs near aphid colonies. The maggots with whitish to transparent body prey on aphids and adults feed on nectar and pollen. They are

seen in large numbers during bright sunny days and adults aggregate in large numbers on Juniper plants.

11. **Spiders**: there are two types of spiders, hunters and web spinners. Both are active predators and feed on large number of insect pests and help in reducing the pest population.


Robber fly


Syrphid fly


Hunter spider


Web spinning spider

IMPORTANT PARASITOIDS:

Parasitoids are those insects which insert their eggs into body of an insect host with the help of specialized ovipositor and the larvae or grubs which emerge from the eggs, feed on host tissue and cause death of host insect. Usually one parasitoid requires one host for completion of its life cycle. Mostly the parasitoids are host specific. Few important parasitoids are listed below.

1. **Trichogramma wasps**: these are very tiny insects and rarely visible to naked eyes. They are egg parasitoids. The adult female inserts eggs into the eggs of other host insect and the grubs emerging feed on egg contents and cause mortality of the host eggs even before hatching. They mainly parasitize on the eggs of lepidopteran insects (Moths and Butterfly eggs)
2. **Ichneumon wasps**: they are slender wasps with elongated body and ovipositor. The ovipositor is protruded outside and sometimes as long as the body. They are diurnal (active during day time) in behaviour and adults visit flowers and feed on pollen and nectar. The eggs are laid inside larval body of host insects; the grubs feed on body tissues and pupate inside or on the body of host insect and thus cause mortality.
3. **Braconid wasps**: these are small, stout bodied insects with long slender abdomen which is longer than head and thorax. The ovipositor is very prominent and used in piercing the body of host insect. The grubs feed on host tissues by staying inside the host body, but pupation occurs in silken cocoons on the body surface of host insect. They are usually gregarious (feed in groups) parasitoids and polyembryony (large number of grubs emerging from single egg) is the common phenomenon.




Trichogramma wasp Ichneuomen wasp Braconid wasp Pupa of Braconid wasps

4. **Chalcid wasps**: these are tiny wasps with well developed hind femur and coxa. The ovipositor is usually smaller in size and the body colour varies from shiny metallic black to light greenish black colour. Most of them are either larval or pupal parasitoids of lepidopteran insects.
5. **Bethylid wasps**: they are ant like tiny wasps, black in colour and the females are wingless. They are host specific larval parasitoids of lepidopteran insects.



Chalcid wasp Female Bethylid wasp Male Bethylid wasp

6. **Yellow jacketed wasps or Hornets:** they are medium to large sized insects with yellow and black markings on the body. They construct papery nests with chewed wood and saliva. They capture and paralyse the caterpillars and deposit them in each cell in their nest and lay eggs over it. The grubs feed on paralysed eggs and pupate within the cell. They are diurnal in behaviour and very active during sunny days.
7. **Mud wasps or thread waisted wasps**: they are medium sized wasps with elongate and slender waist. The body colour varies from reddish to dark black colour. They construct earthen nests in the soil with saliva and red soil. The adults capture and paralyse the prey and provision it to grubs for feeding in the nests.
8. **Tachinid flies or bristle flies**: they are small, brownish to blackish flies resembling house flies. The body is covered with long bristles. Adults pierce the body of host insect and lay their eggs. Maggots feed on host insect and pupate inside. They mainly parasitise on larvae and pupae of Lepidopteran and Coleopteran insects.




Yellow jacketed wasp Mud wasp or thread waisted wasp Bristle flies / Tachinid fly

SCOPE FOR EMPLOYING NATURAL ENEMIES IN HILL AGRICULTURE:

The hill agriculture is practiced mainly in small distributed patches among the vast forest area. The crops cultivated are very diverse and cover very small area. Due to non-availability of plant protection chemicals, farmers rely on use of plant extracts or cheaply available local insecticides which are broad spectrum in their action and less effective against insect pests but harmful to natural enemies. Instead of these low quality plant protection chemicals, farmers can resort their interest on landscape modification and encouraging population of natural enemies through artificial release. The reasons, why biological control would be successful in hill agriculture are:

a. Highly diverse cropping system that is capable of supplying insect predators and parasitoids with vast variety of insect hosts or preys along with pollen and nectar.
b. The forest trees and hedges along the fields act as beetle banks and resting and nesting sites for natural enemies during adverse climatic conditions.
c. The forest trees also provide alternate food source to natural enemies during off seasons.
d. The microclimatic conditions are very favourable for natural enemies to feed, breed and reproduce in large numbers and perpetuate to other adjacent fields.
e. The farmers mostly rely on natural pest control allowing some yield loss without much of chemical intervention. So, one or two artificial release of natural enemies would serve their purpose of insect pest management.
f. The diverse flora can support and build up the faunal diversity without much of human intervention after artificial release.
g. The pest population density is low and rarely reaches alarming stages because of both biotic and abiotic control over pest populations. So, biological control would be the best management method that can be employed for managing insect pests in hill agriculture.

REFERENCES

Greathead, D. J and Greathead, A. H. 1992. Biological control of insect pests by insect parasitoids and predators: the BIOCAT database. *Biocontrol news and information*. 13(4): 61-68.

Rao, K.S., Saxena, K.G., 1996. Minor forest products' management: problems and prospects in high altitude villages of central Himalaya. *Int. J. Sustain. Dev*. *World Ecol*. 3, 60–70.

Semwala, R.L., S. Nautiyal., K.K. Sen,, U. Ranaa., R.K. Maikhuri., K.S. Rao and K.G. Saxena. 2004. Patterns and ecological implications of agricultural land-use changes: a case study from central Himalaya, India. *Agriculture, Ecosystems and Environment*. 102 (2004) 81–92.

Tripathi, R.S., Sah, V.K., 2001. Material and energy flows in high-hill, mid-hill and valley farming systems of Garhwal Himalaya. *Agric. Ecosyst. Environ*. 86, 75–91.

Waterhouse, D. F. 1998, Biological Control of Insect Pests: Southeast Asian Prospects. ACIAR Monograph Series.

Tapeworm - A Deadly Brainworm

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Cabbage and green vegetables are the major part of our diet. These are consumed in our daily diet as they are beneficial for our health because of their high nutritional value. However, these vegetables also contains lot of insect pests and other organisms which could be harmful for our health.One of the most harmful organisms is "Tapeworm"which is generally present on theunderside of the green vegetable leaves that could cause serious damage to our brain and in case of late detection, even lead to death.

Pic 1. Cabbage leaves (left) and tapeworm seen inside human gut (right)

Raw cabbage safety hazards have been a debated issue for quite a long time. Theyserve as breeding nest to the deadly parasite known as tapeworm.Very few of us is aware of the fact that green-leafy vegetables are a perfect abode for the worms and parasites. Some of these worms and parasites are so small that they cannot be seen by our naked eyes (See Pic 2).

Pic 2. Tapeworm in the cabbage leaf

According to several researches, eating rawveggies are one of the biggest causes of tapeworm infection.While most veggies have them, cabbage and cauliflower are specially notorious of harbouringthem. These worms are so small that they easily remain hidden inside the layers of cabbage or cauliflower. They even survive on high temperatures because eggs of these worms are hard-shelled and whatreally scary is that, they not only multiply in the human body gut, but a tiny spore can even go to the brain through the blood stream!. The most common form of brain tapeworm is the pork tapeworm known as *Taenisolium*. It is a common pest feed on vegetables like cabbage, kale, cauliflower and broccoli. It is a ribbon-like worm, which when ingested, attaches itself to the walls of the intestines and hatches eggs and becomes larva. After hatching eggs, it enters the blood stream and travels to the brain causing "**Cysticecrosis**" and it spread to various parts of body including liver and muscles. In some cases, "**Cysticerci"** may be found in the human eyeball (see Pic 3), extraocular muscles, and under the conjunctiva (sub-conjunctiva). Depending on the location, they may cause visual difficulties that fluctuate with eye position, and can also results in decreased vision or even a visual loss.

Pic 3.Tapeworm enters into the human eye

Whenitgetsinsidethebrain,thelarvastartsirritatingthesurroundingareaandresultsinsymptomslike:

- Headaches
- Paralysis
- Seizures
- Vomiting
- Loss of vision

"Cerebral cysticercosis" also known as parasitic infection can occur in three stages:

- In the initial stage, it can cause swelling of the brain followed by severe headache.
- In the second stage, the patient suffers from epileptic attacks.
- In the third stage, eggs get lodged in different tissues of the body forming cysts and cause a disease called **"Neurocysticercosis"**. Patient goes unconsciousness and needs intensive therapy in this stage. It can also cause death in some cases. This stage is known as **"Cysticircle granuloma"**. There are several drugs and surgical approaches to fight neurocysticercosis and fortunately, it is a curable diseases if detected on time.

It is very difficult to wash off these worms and their spores from the veggies. In fact they do not even go away after boiling. **"Potassium permanganate"** is the best natural way to get rid of cabbage worms. Add a few crystals of potassium permanganate to a bowl full of water and soak your veggies in this solution. After 3-5 minutes, wash them thoroughly under running water. It is most effective way for removing bacteria, parasites and chemical pesticide residues.

MYTH ABOUT THE TAPEWORM :

It is a myth spread by quacks. By a trick of their hand, they show people that they have taken out a tapeworm from the brain, which was caused by eating cabbage. It is a misconception. It is a prolonged treatment in which epilepsy, headaches and seizures can be controlled through proper timely medication.In rare cases, surgery is done.One should thoroughly wash leafy vegetables before cooking and one's hands before eating. The tapeworm is, also, caused by sanitation issues, lack of toilets and pig meat (pork), if inspection is not done. The waste that is thrown and the waste generated by defecation in the open is eaten by pigs. When the meat of that pig is eaten, without proper inspection, it causes **"Neurocysticercosis".**

CASE STUDIES ABOUT THE WORM :

In a study of Dr. Theodre Nash (2012) who works at the National Institute of Health, Bethesda, Maryland, U.S.A. She observed some of the patients fall into comas while some are paralyzed down one side of their body; Some were partially blind. The similarity among them was captured in the brain MRI scans that was each brain contains one or more whitish blobs. She came to know the blobs are not made of patients own cells and the blobs are tapeworms. The tapeworms are best known in their adult stage but before theybecame adult, they live in the form of large cysts either in brain or any another body part. These cysts were whitish blobs and caused disease **"Neurocysticercosis"**. She told that the symptoms of tapeworm are usually mistaken for variety of brain disorders. The clearest way to detect is from the image of cysts in the brain scan[1].

In another case study of Gurugram (Haryana), the doctors found that the brain of eight year old girl named 'Trushika' was infected with tapeworm eggs in 2018. Shewas admitted in the city hospital as she was suffering from severe headaches and epileptic

seizures for the past six months. She was put on steroids and because of that at this tender age, she gained 20 kgsbodyweight. Despite such heavy medications her elipletic seizures and headaches remain persistent. This lead the doctors to conduct another CT scan which showed the presence of 100 tapeworm eggs in her brain which reached her brain through the bloodstream from the stomach. She was diagnosed with **"Neurocysticercosis"** due to which her brain swelled. This was caused by accidently eating food infested by tapeworms. Her treatment began by reducing her swelling with decongestants and gradually the cysts were treated by starting anthelmintic therapy followed by steroids [2].

TO AVOID INGESTING THESE WORMS, DO THE FOLLOWING PRACTICES :

- Wash all greens in strong jets of running water, so that the worms get rinsed off due to the force of water.
- Cook the greens thoroughly at high temperature.
- Don't eat these vegetables as raw at anytime and especially in restaurants / outside (avoid chinese food containing raw cabbage altogether).
- Try and avoid consuming these vegetables during monsoon season when these worms multiply at high rates.
- Take a deworming tablet every six months as directed by physician.

REFERENCES:

https://www.discovermagazine.com/health/hidden-epidemic-tapeworms-living-inside-peoples-brains

https://m.timesofindia.com/city/gurgaon/doctors-find-100-tapeworm-eggs-in-girls-brain/amp_articleshow/65096110.cms

Human-wild animal conflict: A threat

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Human-wildlife conflict (HWC) is critical threats of globally endangered species, such as the Sumatran tiger (*Pantheratigris sumatrae*) and the Asian lion (*Panthera leo persica*), but some species such as snow leopard (Uncia uncia) and the Red colobus monkey (Procolocus kirkii) which is less endangered. Sanctuary and National parks are the important for the conservation of such types of endangered species (Bruner *et al*., 2001). Equally, protected areas often only protect a part of an ecosystem or species range, and wildlife dispersal from such areas may increase conflict with man (Woodroffe and Ginsberg, 1998). Even as alternative forms of land use, such as wildlife tourism, are implemented in an attempt to derive sustainable benefits from wildlife, conflict may remain (Roe *et al*., 1997; Goodwin *et al*., 1998).

Major species of wild animals exposed to conflict, lead to be more prone to extinction (Ogada *et al*., 2003) because of injury and death caused by humans, also by road accident and railways accident. Some wild animals falling into well during capture, and also by shooting and poison. These human activities not only reduced the population of endangered species but it also negative impact on environmental condition especially disturbance of ecosystem and biodiversity preservation. Human-wildlife conflicts affect the human welfare, health, safety, economic and social costs. It also increases the chance of zoonotic disease by injury and contact.

DEFINITION

Human–wildlife conflict is defined by the World Wide Fund for Nature (WWF) as "any interaction between humans and wildlife that results in negative impacts on human social, economic or cultural life, on the conservation of wildlife populations, or on the environment.

Human - Wildlife Conflict (HWC) is defined as 'interaction between humans and wildlife where negative consequences, whether perceived or real, exists for one or both the

parties when action of one has an adverse effect on the other party'. It has been in existence for as long as wild animals and humans have co-existed and shared the same resources.

BRIEF HISTORY ABOUT HUMAN-WILDLIFE CONFLICT

Crocodiles have an ancient lineage dating back to the Mesozoic era, and have remained functionally unchanged for longer than the human species has been in existence. It is likely that crocodiles have attacked and eaten humans and their predecessors in Africa over the last four million years. Human-elephant conflict is as old as agriculture in Africa (Treves and Naughton-Treves, 1999). San or Bushman rock art in Africa frequently portrays people fleeing from predators or other large animals. Pre-colonial and early nineteenth century historians describe areas in Africa and other parts of the world where elephants invaded human cultivations, causing food shortages and leading to the displacement of settlements (Barnes, 1996). Some authors blame colonialism for ruining traditionally harmonious relations between wildlife and local people (Adams and McShane, 1992).

CAUSES OF HUMAN-WILD ANIMAL CONFLICTS:

- Habitat fragmentation: on the fragment of habitat cause to shrinkage of wildlife area lead to wild animal migrate from own habitat to human habitat because of searching of space, food and shelter. As result, increases the chance of human wild animals conflict.
- Encroachment in the forest lands by local people has resulted in shrinkage of wildlife habitats especially on the fringes which has increased the pressure on the limited natural resources in the forest areas.
- The incidences of man- wild animal conflict also increase by the disturbance of wild animals its own habitat during collection of fuel wood, fodder. Also increased the chances of conflict by increasing the cultivation area in wildlife habitat.
- It is observed that the local people have to go deeper and deeper, year by year for fetching firewood and other forest produce for their bonafide use, because of degradation of forests in the fringes. This has increased the number of incidences of man-animal conflict.
- Infestation of wildlife habitat by the invasive exotic weeds like Lantana, Eupatorium and Parthenium have resulted in decreased availability of edible grasses for the wild herbivores. As a result, herbivores come out of forest area and cause depredation of agricultural crops on the fringes.
- Most incidences of man-animal conflicts are noticed during summer when water becomes scarce. The livestock and wild animals have to share the limited water sources on the fringes or inside forest. Human interference with the natural drainage system in forest areas and diversion of water towards habitation has further complicated the issue.
- Decreased prey base caused by poaching of herbivores has resulted in carnivores moving out of forest in search of prey and indulge in cattle lifting.

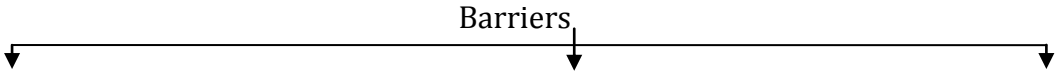
Some incidents of human wild life conflict

Conflict	Wild animals	Losses
Lion and Other Carnivore Conflict in Zimbabwe	Lion and baboons	Baboons killing more number of small animals, lions caused the greatest economic loss because of the high value of cattle (Butler, 2000).
Wildlife Conflict in Uganda	Olive baboons (Papio cynocephalus), bush pigs (Potamochoerus sp.) and elephants (Loxodonta africana).	Maize and sweet potato crop could have been destroyed (Naughton-Treves, 1997).
Wildlife Conflict in Cameroon	Elephant, baboons (Papio anubis), green parrots (Poicephalus senegalus) and warthog (Phacochoerus aethiopicus).	Maize (Zea mays), millet (Sorghum spp.), yam (Dioscorea rotundata) and cotton (Gossipium spp.), (Weladji and Tchamba, 2003).
Asian Elephant Conflict in China	Asian elephant	Wheat, rice, banana and bamboo (Zang and Wang, 2003)
Lion and Leopard Conflict in India	Asian lion (Panthera leo persica) and leopard (Panthera pardus)	Sugarcane and mango and to hunt prey such as buffaloes, cows, pigs and dogs.
Tiger and Asian elephant Conflict in India	Tiger and elephant	for an average loss of 14% of the total annual crop production (0.82 tonnes per family), in monetary Losses 30% of the average annual household income in the region (Madhusudan, 2003)
Wolf Conflict in Italy	Wolf (Canis lupus)	Sheep and goats, horse and cattle

PREVENTIVE STRATEGIES

Artificial and Natural Barriers:

Barriers have main function of preventing spatial overlapping among wild animals and local people or communities. Barriers are two types natural and artificial.



Natural

Rivers, coasts or mountain ranges fencing (Vijayan and Pati, 2002).

Artificial

Rubble walls and barbed wire

Fladry barrier is a technique traditionally used in Eastern Europe and Russia to hunt wolves. It consists of hanging flags from ropes, placed a short distance above the ground and spaced 0.5m apart; nowadays it is employed to protect domestic animals from wolf attacks (Musiani *et al*., 2003).

Alternative barriers have been sought, for instance planted hedgerows of various spiny cacti and moat. Plant hedges have the positive aspects of being a low cost solution and are effective with both carnivores and ungulates. On the other hand, they are very slow to establish, do not deter baboons and elephants and are often made of exotic species, which can spread uncontrollably, (Hoare, 1992). It is clear that physical barriers are not always an economical management practice. They frequently require additional labour from farmers and their family members and never ensure complete protection. The reason for this failure can be explained by the behaviour of different animal species. Burrowing animals for instance, breach the barrier and permit access to other species, as Hoare (1992) mentions, lions can use holes that have been dug by warthogs (Phacochoerus spp.). In Rajasthan, India, where stonewall,mud and brushwood fences were constructed, farmers claimed that nilgai (Boselaphus tragocamelus) could easily jump over the fence of 1.5 m in height and wild boar (Sus scrofa) were able to dig beneath them to get into fields (Sekhar,1998).

Guarding

Monitoring herds and active defense are essential features of animal husbandry in East Africa, where human herders are effective and fearless in warding off predators. In this region, herders are reported to challenge and scare away dangerous carnivores such as lions, hyenas and cheetahs with nothing more than simple weapons like spears, knifes or firearms (Patterson et al., 2004). Northern Kenya, the presence of human guards, dogs and human activity were associated with lower rates of livestock attacks by large predators (Ogada *et al*., 2003). Guarding is also a popular preventative strategy in some parts of India. In this region, the majority of the farmers ranked guarding as the most efficient and common measure to protect their crops, despite requiring additional labour at night (Sekhar, 1998). According to Treves and Karanth (2003b), the utilization of domestic guard dogs appear to be a successful strategy for managing predation risk from coyotes, black bears (Ursus maritimus) and even cheetahs, but less effective with wolves and grizzly bears (Ursus arctos). Although the effectiveness of this defence practice is dependent on humans also being present to ensure that the dogs remain with the livestock. In North America dogs are often left alone to safeguard domestic animals and are not as effective as in Europe and North Asia where shepherds and ranchers work directly with their dogs (Musiani *et al*., 2003).

Relocation

Voluntary Human Population Resettlement Where alternative land and incentives are available, relocation of local communities to areas offering better access to natural resources and socio-economic opportunities can be an adequate solution to HWC (Madhusudan, 2003). In fact, resettlement scheme aiming to prevent the overlap

between wildlife and people, can be successful in the long run if some essential assumptions are met: firstly, the villagers should gain substantial benefits, such as better access to resources, secondly, they should be relocated to an area where the risk of losing property is lower and thirdly, they should not face any political, social and cultural opposition (Treves and Karanth, 2003b).

Waste Management Systems that Restrict Wildlife Access to Refuse: Good standards of waste management are important to avoid attracting wild animals to human settlements and to prevent wild populations being augmented and artificially sustained by human induced food availability. Each stage of waste handling should be addressed, from collection to transportation to disposal.

MITIGATIVE STRATEGIES

Compensation Systems: HWC carries significant economic costs to humans and compensation is a measure which aims to alleviate conflict by reimbursing people for their losses. Compensation systems rely on giving out monetary payments or licenses to exploit natural resources, allowing the hunting of game or the collection of fuel wood, timber and fodder from inside protected areas. Of the two methods, financial compensation is a very contentious issue and the least popular due to its inefficiency and low rate of reimbursement. This is a reality in many developing countries, which face budget constraints and usually pay on an irregular basis and to a limited extent. The second compensation scheme, also known as the "settlement of rights" to use natural resources, appears to be a more practical solution, as the following case studies demonstrate.

An alternative approach, the "settlement of rights", appears to be a better strategy. It fixes a quota of commodities that can be exploited, it clearly demarcates reserve zones that are accessible to local villagers and it legitimizes their rights to those resources. Indeed, the benefits derived from the legitimate collection of natural resources influence the attitudes and perceptions of rural residents towards wildlife and conservation, while promoting responsibility and awareness (Sekhar, 1998).

Insurance Programme: Livestock and crop insurance is often proposed as an innovative solution to mitigating the impact of HWC, but it is yet to be experimented broadly. It covers crops and livestock from the risk of wildlife attacks and involves the villagers and local governing bodies paying a premium share of the insurance and allows rural inhabitants to make a minimum annual cost and to be refunded in the event of crop or livestock losses. In addition, the local governing bodies or the forest department are relieved of significant financial expenses, from not having to administer compensation schemes (Madhusudan, 2003).

Incentive Programmes: Incentive programmes are based on subsidies. They offset the cost of conservation and demand the adoption of conservation-friendly practices, creating tolerance towards wildlife through the exchange of benefits. Two interesting incentive programmes have been developed in India and Mongolia, where agro pastoralists and pastoralists live within the snow leopard's territory (Mishra *et al*., 2003).In India in the state of Himachal Pradesh, the programme succeeded in reducing

the forage overlap among wild herbivores and livestock through the clearance of an area of 500 ha from livestock grazing and other human use. The villagers received financial benefits for their loss of herding land and the money was used for collective work. As a consequence, wild herbivore densities increased, resulting in more naturally available prey for predators and thus reducing the pressure of carnivores on livestock (Mishra *et al*., 2003). In Mongolia, the programme did not permit pastoralists to poach the snow leopard and its prey. The programme itself is expected to grow rapidly, also because marketing opportunities for the handicrafts are opening. However one weakness of the incentives programme is the need for subsidies from external sources, from either conservation funds or governments (Mishra *et al*., 2003).

COMMUNITY BASED NATURAL RESOURCE MANAGEMENT SCHEMES (CBNRMS)

A CBNRMS has been established in the Caprivi region of Namibia, where the eco-tourism industry and hunting concessions are potentially valuable for developing a local economy based on wildlife related revenues. This scheme entails a system of returning benefits to rural communities in order to motivate them to protect wildlife outside protected areas and to discourage poaching; it is still at an early stage, but it is expected to have a real potential in mitigating the conflict (Rodwell *et al*., 2000).

Regulated Harvest: in many regions, HWC is managed by hunting. This is a low cost technique and has the potential to raise public tolerance towards wildlife. The money raised from the sale of licenses can fund conservation activities and the protection of human settlement (Treves and Karanth, 2003b). To be viewed as a legitimate management practice, hunting needs to be based on scientific monitoring that ensures sustainable harvests and it needs to be regulated by policies that address the timing, location and methods of hunting, as well as the distribution of benefits to all stakeholders. In reality, lethal control is considered to be an expedient to satisfy the aggrieved party and reasons for scientific skepticism are due to the lack of selection of target animals to be eliminated. As a result the individual animals killed are often not responsible for depredation and after their removal other individuals can cause trouble in the same location. It is assumed that regulated harvest is not effective in reducing crop and livestock losses and it is also likely to increase the risk of further losses when dangerous carnivores are wounded instead of being killed (Treves and Karanth, 2003).

Wildlife Translocation: Translocation consists of moving a certain number of animals from a problematic zone to a new site. In spite of seeming to be the least sensible of the solutions listed above and the risk of exporting the problem to another site, it may be a practical and acceptable approach in some cases and where there is the availability of a suitable habitat with territorial vacancies. Translocation works well when isolated individuals are unable to survive or reproduce because they are too distant from the main population and need to be moved back to their own group; or when a high density population needs to be reduced through the relocation of individuals (Treves and Karanth, 2003). In most cases the conflict cannot be avoided and translocation does not seem to be an immediate and straightforward solution. However, it is encouraging that the conflict can be minimized through good management practices and housekeeping

principles, such as livestock protection at night, property guarding or avoidance of a predator's home territory. It is also reassuring that some of the successful measures involve low technology tools and low cost approaches such as pens with chain link ceilings, man-made salt ponds, fladry barriers and insurance programmes.

To control poaching: restrict the illegal hunting of wild animals should be stop to maintain the equilibrium of ecosystem.

To stop monoculture and increase number of edibles miscellaneous species: Plant monoculture of species like teak should be avoided. Instead mixed plantations of miscellaneous, bamboo and fruit species can be considered. This will provide more food for animals in the forest, hiding shelter to animals as well as provide food for most herbivores.

Prohibition of fragmentation of wildlife habitat: for construction of dams, long canals for irrigation and Highways through the forest areas, then the prohibit fragmentation of wildlife habitat with proper care should be taken. The connectivity of wild animals should not be disturbed. As results, animals cannot pass these canals and roads easily and they are localized and their natural balance is disturbed.

Providing LPG to villagers: LPG should be provided to those villagers who frequently go to the forest areas specially wildlife habitats to search fuel wood for their chullahs as results to stop the human wildlife conflicts.

Awareness Raising: People should be made more and more aware through meetings and pamphlets etc. They should not go deep into the forest areas. If they have to go then they should go in groups and they should keep talking to each other to detract the wild animals. School children in vulnerable villages should be educated about the importance of wildlife and human conflicts.

CONCLUSION

It is concluded that the human wild animal conflict very critical threat to wild animals as well as human. It causes more economically loss in term of crop and treatment of human and animals. They are also responsible for extinction of species. The proper preventive strategy and mitigation are adopted to control human wild animal conflict.

REFERENCES:

Adams, J.S. and McShane, T.O. 1992.The Myth of Wild Africa: Conservation without Illusion. New York, USA, W.W. Norton & Co.

Bruner, A.G., Gullison, R.E., Rice, R.E. & da Fonseca, G.A.B. 2001.Effectiveness of Parks in Protecting Tropical Biodiversity. Science, 291, 125-128.

Butler, J.R.A. 2000.The Economic Costs of Wildlife Predation on Livestock in Gokwe Communal Land, Zimbabwe. African Journal of Ecology, 38(1): 23–30.

Goodwin, H., Kent, I.J., Parker, K.T., & Walpole, M.J. 1998. Tourism, Conservation and Sustainable Development; Case Studies from Asia and Africa. Wildlife and Development Series, No. 12.IIED, London.

Hoare R.E. 1992.The Present and Future use of Fencing in the Management of Larger African Mammals. Environmental Conservation, 19(2):160-164. .

Madhusudan, M.D. 2003.Living amidst Large Wildlife: Livestock and Crop Depredation by Large Mammals in the Interior Villages of Bhadra Tiger Reserve, South India. Environmental Management, 31(4): 466–475.

Mishra, C., Allen, P., McCarthy, T., Madhusudan, M., Bayarjarkal, A. & Prins, H. 2003.The Role of Incentive Programs in Conserving the Snow Leopard.Conservation Biology, 17(6): 1512–1520.

Musiani, M., Mamo, C., Boitani, L., Callaghan, C., Gates, C., Mattei, L., Visalberghi, E., Breck, S. & Volpi, G. 2003.Wolf Depredation Trends and the use of Fladry Barriers to Protect Livestock in Western North America. Conservation Biology, 17(6): 1538–1547.

Rodwell, O., C.E., Rodwell, T., Rice, M. & Hart, L.A. 2000. Living with the Modern Conservation Paradigm: can Agricultural Communities Co-exist with Elephants? A Five Year Case Study in East Caprivi, Namibia. Biological Conse rvation, 93(3): 381–391.

Ogada, M., Woodroffe, R., Oguge, N. and Frank, G. 2003. Limiting Depredation by African Carnivores: the Role of Livestock Husbandry. Conservation Biology 17(6):15211530.

Roe, D., Leader-Williams, N. and Dalal-Clayton, B. 1997.Take only Photographs, Leave only Footprints: the Environmental Impacts of Wildlife Tourism. Wildlife & Development Series, No.10, IIED, London.

Sekhar, N.U. 1998. Crop and Livestock Depredation caused by Wild Animals in Protected Areas: the case of Sariska Tiger Reserve, Rajasthan, India. Environmental Conservation, 25(2): 160–171.

Treves, A. and Karanth, K.U. 2003b. Human Carnivore Conflict and Perspectives on Carnivore Management Worldwide. Conservation Biology, 17(6): 1491–1499.

Treves, A. and Naughton-Treves, L. 1999. Risk and Opportunity for Humans Coexisting with Large Carnivores. Journal of Human Evolution, 36: 275–282.

Weladji, R.B. and Tchamba, M.N. 2003. Conflict between People and Protected Areas within the Bénoué Wildlife Conservation Area, North Cameroon. Oryx, 37(1): 72–79.

Woodroffe, R. and Grinberg, J.R. 1998. Edge Effects and the Extinction of Populations inside Protected Areas. Science 280(5372):2126-2128

Zang, L. and Wang, N. 2003. An Initial Study on Habitat Conservation of Asian Elephant (Elephas maximus), with a Focus on Human Elephant Conflict in Simao, China. Biological Conservation, 112(3): 453–459.

The Future Farming: Rooftop Gardening

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Rooftop gardens are man-made green spaces on the topmost levels of residential, commercial or industrial structures. The practiceto grow vegetables, flowers or medicinal & aromatic plants on the rooftop of buildings is referred as rooftop gardening, rooftop kitchen garden or rooftop farming. It is generally done using the green roof, hydroponics, or container gardens. In hydroponic farming techniques, crops are grown in water not in soil, which allows farming in a land that is not appropriate for traditional farming or the use of spaces that were otherwise not utilized. Rooftop farming provides families with the exclusive opportunity to use their obtainable spaces to gain additional income. The hot areas in India have scarce water and agricultural land to provide sufficient food to the increasing population hence traditional farms will no longer be an option. It's the time that we have to move from traditional cultivation practices to rooftop gardening to grow vegetables organically for financial and health betterment of the families.

THE KEY ELEMENTS FOR SETTING ROOFTOP GARDEN:

Location

The place could be a corridor, backyard, balcony, or along the walls. For selecting a location, the primary factor is sunlight. The rooftop garden should receive at least four to six hours of direct sunlightfor the growth of the plant, but if the sunlight is too harsh, you can use a net for shade to prevent the plants from getting scorched.

Roof surface

In case you are covering the surface of the terrace with soil, make sure you water proof the surface to avoid any leakage into the home. If you are going for a regular terrace garden with pots, there are no extra efforts required.

Suitable plants

The plant should be suitable for the soil, climatic conditions, season you get in your area and what would be beneficial for your home. Among vegetables, tomato, chili and leafy vegetables are the easiest to grow, while Spider plant and Anthuriumare ideal ornamental plants that act like indoor air purifiers as well.

Ideal containers/beds

The plants can be grown in cement &clay pots, metal paint containers, huge drums and even large jute or plastic sacks. Shallow cement pots are ideal for herbs like coriander, mint, etc., while plastic ones are becoming popular since we continue to use them for a long duration. Great emphasis should be placed on developing lightweight systems for rooftop applications, a rooftop bed or container of 9-12 inches depth would be about ideal.

Growing medium

The growing medium should contain sufficient organic matter to ensure proper growth. Several growing materials like vermiculite, sphagnum moss, sand, wood chips, household compost, coconut husks, and perlite can be used to make up the medium. Ground paste of chilies and garlic are an effective bio-pesticide. It is equally important to maintain a neat garden for proper growth of plants.

Irrigation

In summers, garden requires watering twice a day but in winters you have to apply water according to the availability of moisture.It's advised that don't irrigate the garden in rains and even one day after the rain as excess water drains all the nutrition away from the soil. It's good if we go for Rain Water Harvesting against portable water source.

VEGETABLES PRODUCTION ON ROOFTOP:

- Crops should be durable and capable of resisting wind and other hard climatic conditions are ideal for rooftop gardening but thin, crisp stems plants should be avoided.
- Vegetables like French beans, chillies, tomatoes, brinjal, okra and lime are easier to grow.
- You can also try different cucurbits like cucumber, ridge gourd and bottle gourd.
- Vegetables like onion, radish, and carrots can also be grown but they require a larger area.
- Low growing greens, including lettuce and spinach, are also well-suited to rooftop growing, as some varieties of climbing beans which can withstand consistent exposure to wind.
- For best results, vegetables grown on rooftops should be started in flats or similar containers under screens that will prevent soil from drying out.
- Amend growing medium with plenty of water high-quality organic constituents, such as compost; and spread a thin layer of mulch around plants upon transplanting.

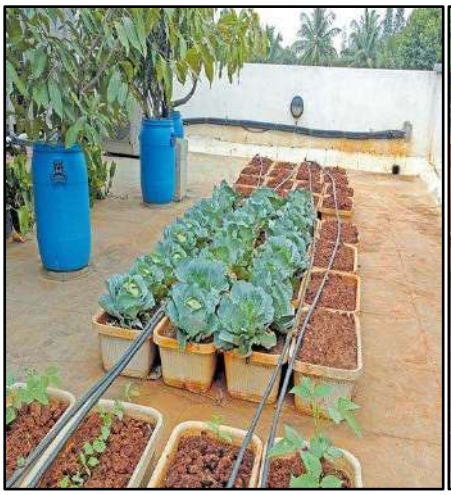
ADVANTAGES OF ROOFTOP GARDENING:

Rooftop gardening is your personal space where you can harvest any produce vegetables and herbs when required. It provides cooling effect to your building due to shady green plants. Growing plants on terrace may reduce carbon monoxide and good

for the environment as well. Rooftop gardening requires less maintenance. If needed, shade net can be used for shade loving plants. Your building looks beautiful with terrace gardening and provides an amazing view for others. You can use rainwater for growing plants. Rooftop gardening is a stress buster and can also reduce daily spending cost on vegetables, fruits or herbs. Your relatives can also enjoy the vegetables or fruits from your terrace gardening.

CONCLUSION:

As population of Indian cities is increasing at faster rate, demand for food and expenditure on food are also increasing. But the resource is scarce as agricultural land is converting to residential, commercial or industrial land uses. Thus it decreases the possibility to grow more and different agricultural food products. Further, food contamination with the use of harmful chemical and inorganic fertilizer is increasing at an alarming rate. In this circumstance, to solve these problems and find a way out, initiation of growing vegetable on roof top can be a possible and potential solution. Rooftop vegetable farming can help to meet food demand by supplying fresh and hygienic vegetables, reducing household expenditure for buying vegetable, create healthy atmosphere by improving air quality and absorbing carbon from air and lessening the impact of climate change.



If you are new to gardening, then start with a small pot & single vegetable thenprogressively grow other vegetables. Plants like tomatoes, chillies and leafy veggies are easier to grow and do not require much care, so you can start with those.

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An Overview on Ecological Perspectives of Aquaculture Systems

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Abstract

Aquaculture is the farming of aquatic organism Nutrient build-up happens when there is a high density of fish in one area. Fish produce waste, and their waste has the potential to build up in the surrounding area. It refers to deplete the water of oxygen, creating algal blooms and dead zones. Environmental impact is essential tool in environmental management is a relatively new and growing technology where problems are constantly encountered and pragmatic solutions are sought for predicting and mitigating factors. In this conceptual paper the various impacts caused by environment and also the parameters has been determined in various aspects.

Keywords: Mitigating, Management, Technology, Organism

INTRODUCTION

Aquaculture is the farming of aquatic organisms such as fish, shellfish and even plants. The term aquaculture refers to the cultivation of both marine and freshwater species and can range from land – based to open – ocean production. The influence of aquaculture on water quality is to increase the suspended substances and the nutritional salts in waters. Cages used an aquaculture can also reduce the dissolved oxygen in the water. The wastes of cage aquaculture increased the total concentration of water nutrient and increased the turbidity of the waters.

Aquaculture system

The Creation of ponds for marine aquaculture has led to the destruction of thousands of hectares of mangroves and coastal wetlands. Mangroves provide nursery grounds for many species, including commercially important fish, and their destruction may lead to substantial losses for commercial fisheries. Aquaculture of some species

relies on juvenile fish or shellfish being caught from the wild to supply stock, rather than using hatcheries to rear them. Shrimp farms in many areas rely on wild caught juveniles. This has led to over exploitation and shortages of wild stocks. The main environmental impact of crab culture is the procurement of larvae from wild brood stock, and the on - growing of wild crablets.

Pumping of groundwater to supply freshwater to marine shrimp farms has resulted in depletion and, sometimes, salinization of local water supplies, causing water shortages for coastal communities. There have also been many reports of crop losses after agricultural land has become salinized by effluent water pumped out from shrimp farms into land.

ENVIRONMENTAL IMPACTS OF AQUACULTURE

Environmental Impacts in the last three decades has created negative environmental impacts, such as extensive mangrove conversion to ponds, changes in hydrologic regimes in enclosed waters due to proliferation of aquaculture structures, and discharge of high levels of organic matter into coastal waters. Similarly, the increasing deterioration of coastal water quality resulting from the discharge of domestic, agricultural and industrial wastes into coastal waters has affected aquaculture production and profitability.

Novel fish diseases cannot be treated, and diagnosis of aquatic diseases in the third world involves undeveloped instruments and weak technical power. Hence inability to distinguish bacterial and nutritional diseases, which directly influence correct medication. Once the diseases comes on, the abuse of medicines is imminent.

Various high – yielding aquaculture methods such as industrial fish farming, cage fish culture, and raceway culture are developed to some extent. Fishing and environment protection consciousness are still deficient, and the random discharge of aquaculture waste waters without any treatment has deteriorated the whole aquaculture environment, and blocked the sustainable development. Feeds are the basic material of aquaculture, and the source of main nutritional matters. Most feeds of aquaculture are outside source foods and given to aquatic animals directly.

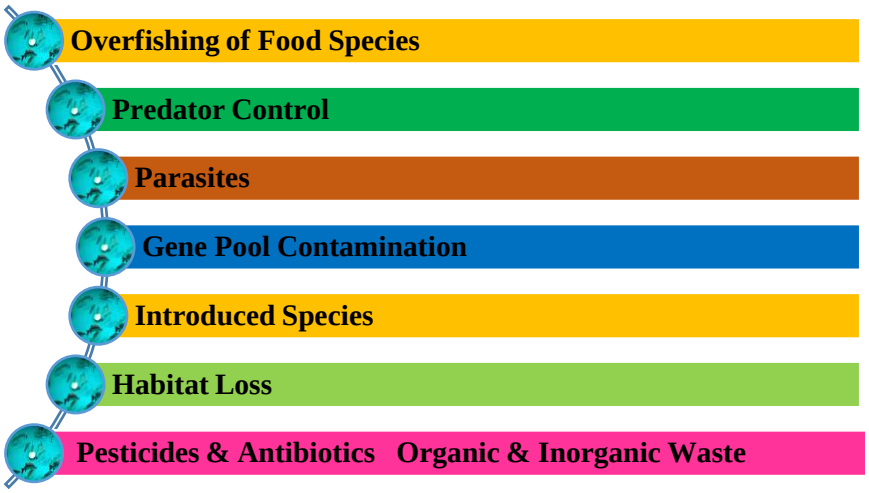

Fig.1. Various Parameters which cause environmental Effects

DESTRUCTION OF HABITAT OF AQUACULTURE ACTIVITIES

The different habitat source materials and organic matters can increase the productivity of the planktons. Feeds make the nutrient matters in waters to gradually increase, and the phytoplankton propagated largely at the beginning, but as time goes on and the continual expansion matters input increases to a point the water quality deteriorates, so the amount of phytoplankton will begin to reduce.

The influence of aquaculture on aquatic biology is that the escaping fishes would impact their wild neighbours in biology. Small – Scale scenarios and unreported escape cases seem to make up a large proportion of the escaped farmed fish. The escaping fishes in the aquaculture may spread diseases and change the inheritance composition of genes of wild swarm, and infect local epidemics to wild swarms.

In the recent years, because of the development of aquaculture, the seductive profit of aquaculture has raised an aquatic tide in the world, most lakes, rivers, swamps, coastal lowlands and mudflats are changed into shrimp culture ponds and fish culture ponds. These lowlands were mangroves, saline soils and agricultural lands, and some of them were inhabiting spawning and refuge places for many fishes and shellfishes. Unreasonable development will destroy the ecological environment of shells, and the natural resource.

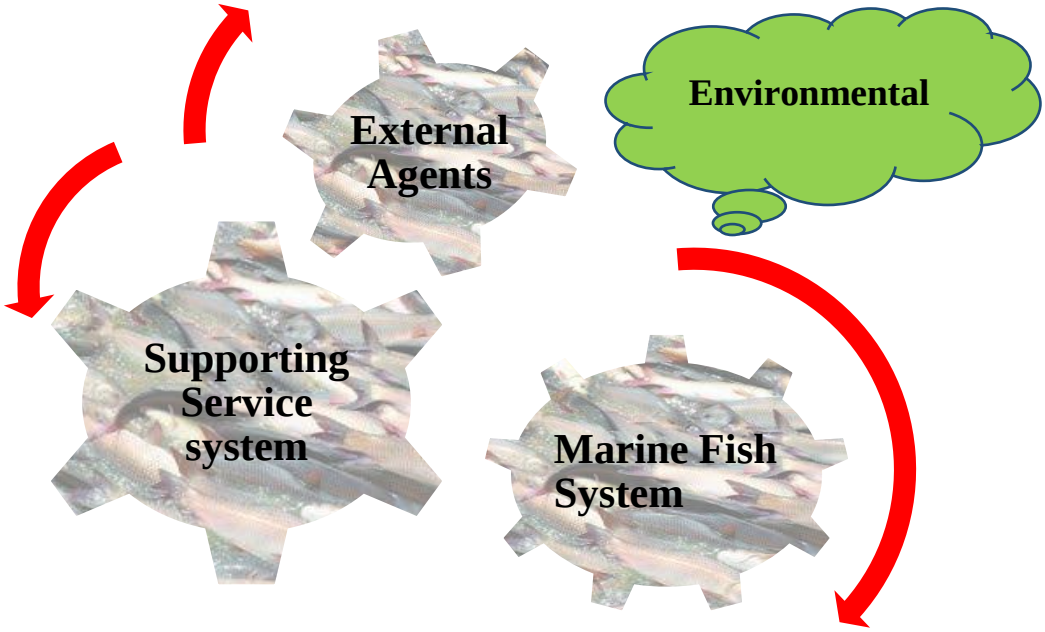

Fig. 2. Aquaculture Activities

PHYSIOCHEMICAL PARAMETERS

The farms has to be based primarily on access to surface or underground sources of water, the choice often falls on wetlands with a high water table, or on the flood land areas. Coastal wetlands are considered to be among the most productive natural systems known, and the sources of nutrients for organisms living in marshy areas as well as the water bodies into which they drain. The commercial species of fish and

shellfish has been well described in fisheries areas. The impact on the environment is more direct in cage culture with large numbers of water exchange, the environmental impact of farming has been increased. The demising of the aquatic recreational facilities are of special importance because of their social implications influence on variousattitudes.

SUSTAINABLE AQUACULTURE SYSTEMS

Production systems also represent a unique investment opportunity because of the long-term demand for seafood products and the value inherent in owning a real asset. And while investing in production does carry risks, experience with other emerging technologies such as wind, solar and battery storage has taught us lessons about the optimal way to structure capital for these projects. With all this in mind, we have identified three attractive opportunities for impact investment.

Seaweed and bivalves a category of shellfish that includes oysters, clams and scallops are an easy sell. Not only do they require few inputs, but each has been shown to have restorative effects on degraded habitats by improving water quality, providing habitat for other species and reducing excess nutrients from their immediate environment. The ecological incentives, combined with a growing interest in both species groups for food and non-food uses, create an opportunity to expand production both in scale and geographic scope.

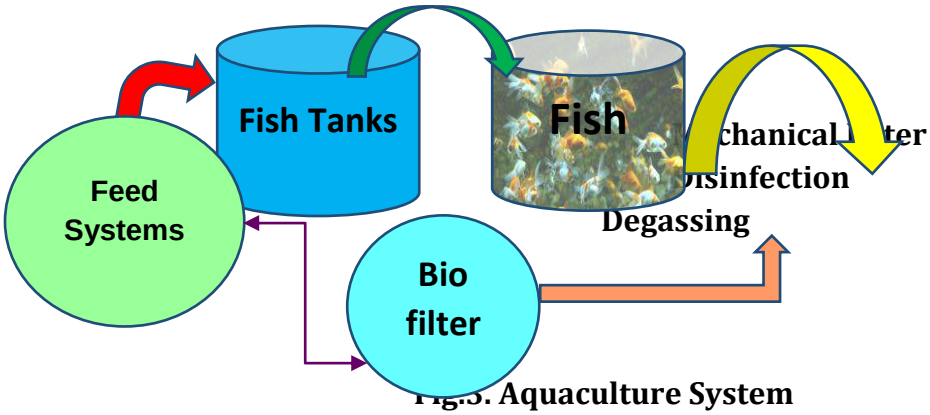

Fig.3. Aquaculture System

USE OF ANIMAL WASTES

Animal waste are used to fertilize pond farms in many countries of the world and are considered superior to inorganic fertilizers in producing and maintaining desirable species of planktonic and other organisms in fresh and water ponds. In integrated livestock – cum- fish farming, the animals are raised near on fish ponds so that the manure and other waste materials can be discharged directly into the ponds. The number of animals regulates to ensure that the wastes discharged into the ponds do not exceed the quantities that the biological process can handle without creating adverse environmental effects within the ponds. The number of animals raised in association with fish farms is generally based on the extent to which the pond waters decompose and mineralize these solids and use the nutrients for plankton production.

CONCLUSION

1. **Mitigate Nutrient Pollution**
2. **Provide habitats**
3. **Support fish stocks**
4. **Reduce local climate change impacts**

Most aquatic wastes come from feeds, to reduce the wastes, and also it limit the percentage of unconsumed feed in the culture facility. To reduce nutrient wastes the effluents be monitored and managed to reduce the negative environmental impacts, by feeding proper feed quantity is confirmed to reduce the amount of feeds scattered and feed loss. The chemical dosage must the strictly controlled to maintain the performance of fishery chemical administration.

Enhancing management level of aquaculture to implement the resource development and it will be utilised to regulate the fishery resource management. In this review it concluded that a member of promising technical, social and institutional approaches with potential to contribute to low impacts in aquaculture and the strategies are required to promote and support their uptake and necessary adaptation. Awareness has been increased to prompt the target institutions including national and local government authorities, extension agents and educational establishments that stand to benefit to overcome the diffulties carried by various sources.

REFERENCE

Murphy, A.M. et al., 1979. An Australia-wide outbreak of gastroenteritis from osyters caused by Norwalk virus. Med.J.Aust., 2:329-33.

Nishimura, A., 1982. Effects of organic matters produced in fish farms. On the growth of red tide algae Gymnodinium type 65 and Chatonellaandqua. Bull.Plankt.Soc.Japan, 29(1):1-7.

Richard, Y.,1984. Aspects pratiques de la desinfection des eaux par 1'ozone, p. 1-11. In Ozone etBiologie. Paris, Association Internationale de 1'ozone

Pike, E.B. and J.W. Ridgway, 1985. The microbiological implications in European Community Directives related to the water cycle. J.Appl.Bacteriol., 59:105-26.

Welcomme, R. (comp.), 1988a. International introductions of inland aquatic species. FAO Fish.Tech.Pap., (294):318p.

Effect of climate on Livestock Performance

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Despite the spectacular success of the green revolution and achieving self-sufficiency in food production, there are increasing concerns on sustaining the pace of agricultural growth to feed the large population of our country. The impacts of climate change on agriculture are being witnessed globally, but countries such as India are especially vulnerable in view of high population depending on agriculture, there is excessive pressure on natural resources and coping capabilities to climate change (Venkateswarlu, 2017). Climate change will affect livestock production through competition for natural resources, quantity and quality of feeds, livestock diseases, heat stress and biodiversity loss while the demand for livestock products is expected to increase by 100% by mid of the 21st century (Garnett, 2009). The challenge is to maintain a balance between productivity, household food security, and environmental preservation (Wright *et al.,* 2012). The situation in India is more alarming as rural economy is primarily dependant on crop - livestock production systems. Almost 70 per cent of livestock in India is owned by small-marginal farmers and landless labourers (NAAS, 2016). The animals of these poor livestock owners are most vulnerable to climate change and are at greater risk since they do not possess necessary means for adaptation and mitigation. Presently there exists very few strategies for promoting sustainable agriculture and livestock related practices that explicitly include measures to support poor or local communities to mitigate the effects of climate change (IPCC, 2013). This has led to food insecurity, hunger and suicide of farmer as well as livestock keepers in India.

However this can be mitigated by selection and rearing of those livestock which respond to changing conditions that includes climate change and disease outbreak (Gornall *et al*., 2010). The vast animal genetic diversity is critical for ensuring food security and overall development of the country (Sunderland, 2011).The animal genetic

resources of India if taken care of have the potentiality to the future demand of growing population (FAO, 1995; Hammond & Leitch, 1995). Climate resilient livestock production system is the answer to the changing global climate. Selection and management of those climate resilient livestock which have the ability to produce and endure drastic climatic conditions will promote food systems to ensure food security and better livelihood of the people (Thornton *et al.*, 2014).

EFFECT OF CLIMATE CHANGE ON LIVESTOCK

The effect of climate change on livestock can be direct or indirect which leads to marked differences in productivity as well as health of the animal (Thornton, 2010; Nardone *et al*., 2010) Climate change directly affects the health, reproduction, nutrition and overall body metabolism of the animal resulting in poor performance, inferior product quality and outbreak of novel diseases (Hayhoe *et al*., 2007; Frumhoff *et al*., 2006). Indirect effects are slow but long lasting which includes change in habitat and feeding systems, alteration of fodder quality and quantity, change in yields, quantity and type of product, increased competition for resources and modifications in ecosystem (Howden,2008; Ghahramani and Moore, 2013; Kebede,2016). As milk yield in dairy cattle has risen, and growth rates and leanness in pigs and poultry have increased, the animal's metabolic heat production has increased and their capacity to tolerate high temperatures and climate change has declined (Zumbach *et al*., 2008).

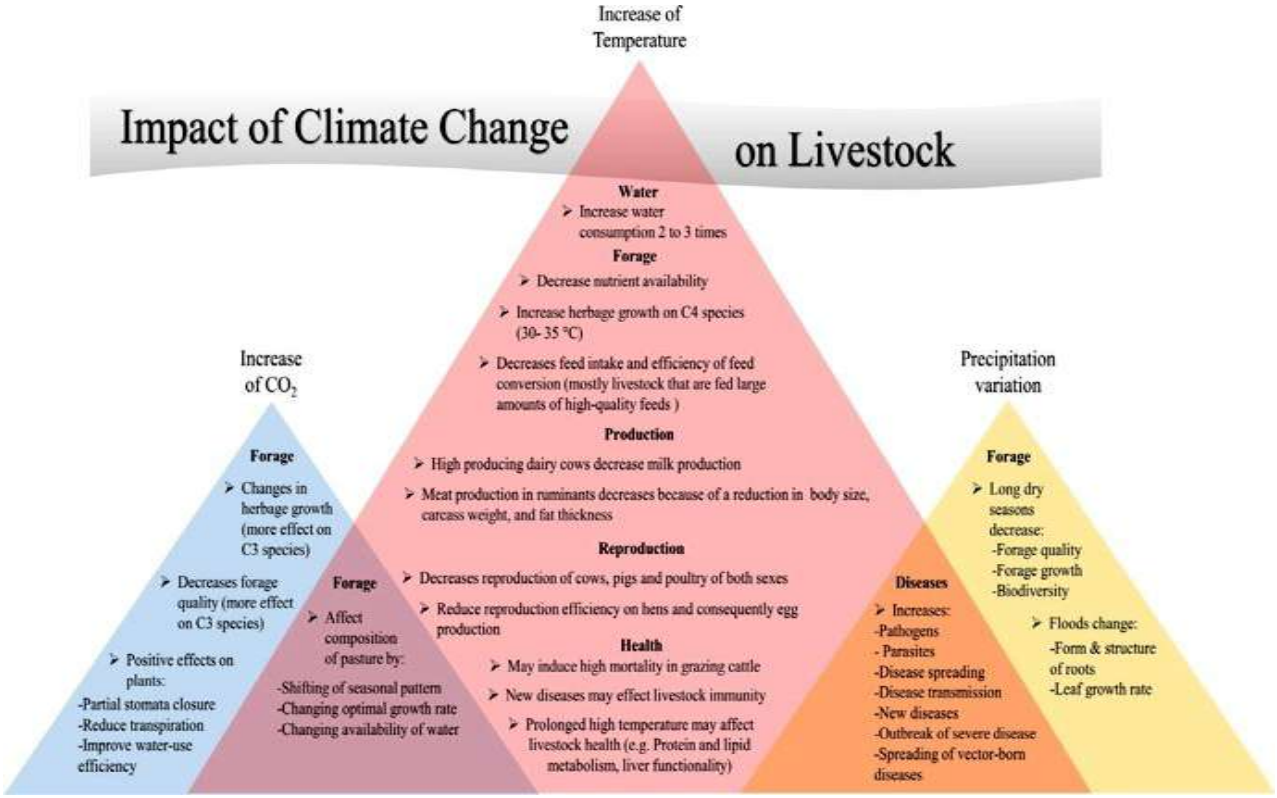

Fig. 1: Impacts of Climate Change on Livestock (M.M. Rojas-Downing *et al.*, 2017)

PHYSIOLOGICAL STRESS

Climate change or mostly heat stress alters the physiology of livestock leading to endocrine imbalance, reduced reproduction rate increased mortality (Dash *et al*., 2016). With increasing milk yield in dairy cattle, growth rates and leanness in pigs and poultry, metabolic heat production has increased and the capacity to tolerate elevated temperatures has declined (Hoffman, 2010). High temperatures also increase animals' water requirements and reduce their appetites and feed intakes (NRC, 1981). Extreme heat waves already kill many feedlot animals in countries such as the United States of America (Hatfield *et al*., 2008). With added climate change the animals mostly enters negative energy balance, reduction in blood glucose level, decreased nutrient absorption and ends up using 40% of the energy for maintenance alone. In dairy cattle there is reduction in milk production and quantity of milk protein and solid not fat (SNF) decreases (Fenwick *et al*., 2008).

Animals direct their energy toward milk production, making them vulnerable to extremely high temperatures (Dikmen *et al*., 2013).It has also led to decreased conception rates, low intensity and duration of oestrus, reduced libido and lower concentration of semen. There also occurs increased potassium loss through skin, increased sweating and increased urinary sodium excretion (Marai *et al*., 2009). Reproduction efficiency of both livestock sexes may be affected by heat stress. It affects oocyte growth and quality (Barati *et al*., 2008; Ronchi *et al*., 2001), impairment of embryo development, and pregnancy rate (Hansen, 2007; Nardone *et al*., 2010; Wolfenson *et al*., 2000). Cow fertility may be compromised by increased energy deficits and heat stress (De Rensis and Scaramuzzi, 2003; King *et al*., 2006). Heat stress has also been associated with lower sperm concentration and quality in bulls, pigs, and poultry (Karaca *et al*., 2002; Kunavongkrita *et al*., 2005; Mathevon *et al*., 1998).

NUTRITIONAL STRESS

Increased ambient temperature or climate change affects feed intake in livestock. Thermal stress has direct effect on appetite, there is decreased rumen motility and increased water intake resulting in gut fill, lower volume of saliva and impaired buffering action leading to acidosis (Wilson *et al*.,1998; West, 2002; Nardone, 2010; Kumar *et al*., 2011). Stress affects carbohydrate and lipid metabolism and thus partitioning of nutrients towards the mammary gland, under the influence of endogenous somatotropin, which is naturally increased during periods of negative energy balance (Bauman and Currie, 1980). This response alters post-absorptive carbohydrate, lipid and protein metabolism, independently of reduced feed intake through coordinated changes in fuel supply and utilization by multiple tissues (Baumgard *et al*., 2014). As climate is drastically changing and has become more variable, the feeding habit of different species has altered. Indirect effects of climate change that includes change in feed resources linked to the carrying capacity of rangelands and buffering abilities of ecosystems with competitive demands of food, feed and fuel will result in modifying animal diets and compromise the ability of small holders to manage feed deficits (Renaudeau *et al*., 2012).

DISEASE STRESS

Climate not only affects livestock and human beings but also vectors, pathogens, hosts and host pathogen interactions. It also affects the spatial distribution of disease outbreaks, their timings and intensity (Gallana *et al*., 2013). Small spatial or seasonal changes in disease distribution may lead to rapid spread of pathogens or even may expose naive livestock population to new diseases (Patz *et al*., 2003). Such livestock population lack resistance or acquired immunity to new diseases or pathogens resulting in more serious clinical diseases. Climate affects pathogen development time and survival. Long summer increases number of pathogens life cycle and ability to mutate (NRC, 2004). Climate change has thus resulted in increased disease susceptibility in livestock. Temperature increases could accelerate the growth of pathogens and/or parasites that live part of their life cycle outside of their host, which negatively affects livestock (Harvell *et al*., 2002; Karl *et al*., 2009; Patz *et al*., 2000). Climate change may induce shifts in disease spreading, outbreaks of severe disease or even introduce new diseases, which may affect livestock that are not usually exposed to these types of diseases (Thornton *et al*., 2010). So evaluating disease dynamics and livestock adaptation will be important to maintain their resilience.

CONTRIBUTION OF LIVESTOCK TO FOOD SECURITY

Livestock plays an important role in Indian economy over years. About 20.5 million people depend upon livestock for their livelihood now. Livestock contributed 18% to the income of small farm households as against an average of 14% for all rural households (BAHS, 2016). Livestock provides livelihood to two-third of rural community. It also provides direct employment to about 8.8% of the population in India (DAHD, 2015). Livestock is a source of subsidiary income for many families in India especially the resource poor persons who maintain few heads of animals (FAO, 2010). Cows and buffaloes if in milk will provide regular income to the livestock farmers through sale of milk and also food security. Small ruminants like sheep and goat serve as sources of income during emergencies to meet exigencies like marriages, treatment of sick persons, children education, and repair of houses and also serve like mobile banks and assets which provide economic security to the owners(FAO, 2006).Agriculture being seasonal in nature could provide employment for maximum of 180 days in a year, but the landless and less land people depend upon livestock for utilizing their labour during lean agricultural season(FAO, 2009a).Livestock systems are also credited with providing environment services that includes promoting soil health and thereby helping to capture atmospheric carbon and mitigate climate change (FAO, 2009b).

EFFECT OF CLIMATE CHANGE ON LIVESTOCK PRODUCTIVITY

Livestock products are an important agricultural commodity for global food security because they provide 17% of global kilocalorie consumption and 33% of global protein consumption (Rosegrant *et al*., 2001). The livestock sector contributes to the livelihoods of one billion of the poorest population in the world and employs close to 1.1

billion people (Hurst *et al*., 2005). There is a growing demand for livestock products, and its rapid growth in developing countries has been deemed the ‘‘livestock revolution” (Thornton, 2010; Wright *et al*., 2012).Over 50% of the bovine population is located in the tropics. It has been estimated that heat stress causes severe economic loss in approximately 60% of the dairy farms around the world (Wolfenson *et al*., 2000). The magnitude of the effect of heat stress on reproduction in dairy cattle is increasing as higher milk yield leaves the animals more susceptible to the deleterious effects of heat stress (Al-Katanani *et al*., 1999, Gaughan, 2002). Significant negative impacts have been implied with medium-term to long term effects on livestock population due to change in climatic conditions. It is predicted to reduce yields by 4.5 to 9%, depending on the magnitude and distribution of global warming (FAO, 2013). Since agriculture makes up roughly 16% of India’s GDP, A 4.5 to 9% negative impact on production implies cost to be roughly up to 1.5% of GDP per year. It is also estimated that annual loss in milk production due to heat stress is nearly 2 % of the total milk production in India (Chauhan & Ghosh, 2015). The negative impact of temperature rise on total milk production for India has been estimated about 1.6 million tonnes by 2020 and more than 15 million tonnes by 2050 (Srivastava, 2010). The impact will be more on high producing animals. Hence there is an urgent need to identify the resilient breeds of livestock to fulfill the demand of milk and milk products for ever growing human population in changing scenario of climate change or global warming.

RESILIENCE OF INDIAN LIVESTOCK TO CLIMATE CHANGE

Different species and breeds differ greatly in the extent to which they can tolerate climatic extremes. For instance, a number of studies (Burns *et al*., 1997; Goddard, 2009) have revealed differences in heat tolerance among cattle breeds and cross-breeds. Tropical breeds tend to have better heat tolerance than breeds from temperate zones (Aggarwal and Upadhyay, 1997; Patel, 1997; Upadhyay *et al.*, 2008a). Indian livestock are adapted to climate by morphological, physiological, vegetation and environment. There is wide variation in adaptability between breeds and between animals within the same breed (Singh and Bhattacharya, 1990; Singh *et al*., 1992; Singh and Saxena, 1995).They have the desired traits to adapt to stressful environment conditions as well as stressors and thus maintain substantial level of production.

MORPHOLOGICAL AND PHYSIOLOGICAL ADAPTATIONS

Indian livestock breeds are well adapted to soil, plant and climatic conditions that prevail in different agro climatic zones. Zebu breeds having small size and low body weight, small barrel shaped body and slender legs, with a hump and dewlap. Most of the breeds developed for draught purpose long legs with articulate joint provide ample capacity to run and swiftly move even under moist soils (Upadhyay *et al*., 1992). The non-descript cattle of India have adapted to thermally stressful conditions by reducing metabolic rate, heart rate and high sweating capacity due to their genotype environment interaction (Upadhyay *et al*., 2008b).

The better adaptation to these environments by *Bos indicus* cattle is primarily related to the greater sweating rates due to higher density and larger perimeter of sweat glands, quick transfer of metabolic heat to the skin and due to a less tissue resistance and less hair coat resistance to heat loss (Dikmen *et al*., 2008). These characteristics permit these cattle to maintain body temperature more efficiently than *Bos taurus* breeds. At increased core body temperatures; there is increase in glucose and amino acid oxidation, decrease in fatty acid metabolism, alteration in endocrine system and activation of the stress response genes to environmental heat loads (Upadhyay *et al*., 2008b). As compared to temperate cattle breeds *(Bos taurus),* zebu cattle breeds *(Bos indicus)* including Indian breeds can better withstand high temperatures (Seif *et al*., 1979; Srivastva and Sidhu, 1979; Singh and Mishra, 1980; Lemerle and Goddard, 1986; Khan, 1986; Meirelles *et al*., 1999). They experience less severe reduction in feed intake (Allen *et al*., 1963; Johnston *et al*.,1958; Seif *et al*., 1979), growth rate (Rajaratne *et al*., 1983), milk yield (Johnson, 1965; DeVillalobos *et al*.,1975), work capacity (Upadhyay and Madan,1987; Carvalho *et al*., 1995) and reproductive function (Johnston *et al*., 1963;Skinner and Louw,1966; Rocha *et al*.1998; Barros 2002;Eberhardt, 2005)in response to heat stress.

Studies conducted by Kumar *et al*. (2009) on Sahiwal and Sahiwal-Holstein cross cattle have revealed that during hot dry summer and under direct sun exposure, Sahiwal cattle are able to withstand extra environmental heat loads due to their capacity to increase skin evaporative losses (Mandal *et al*., 2002). The crossbreds exhibit more distress symptoms like open mouth panting, tongue protrusion, profuse salivation and restlessness compare to indigenous cattle. The ability of Sahiwal cattle to increase evaporative cooling at higher temperatures without increasing their respiratory frequency much is an important factor in establishing compared with the heat tolerance of Sahiwal-Holstein crossbreds (Singh and Upadhyay, 2009). Indigenous cattle breeds of India having special adaptive mechanisms to deal with extra heat loads of tropical climate, it facilitate easy transfer of heat from body without much loss of moisture are unique in Zebu and other livestock species in addition to mechanism, that conserve energy for body maintenance at high temperatures(Singh and Upadhyay, 2009). The ability of the animals to maintain normal body temperatures by cutaneous and respiratory heat dissipation plays a predominant role in adaptation of cattle in hot climate (Gebremedhin and Wu, 2001). They are able to maintain body core temperature until skin surface temperature exceeds 35°C (Pollard *et al*., 2005).

The water recycling and economy in these animals is much more that give them higher capacity to dehydrate and withstand higher thermal stress. Some of the Zebu breeds like Tharparkar, Nagori and Sahiwal well adopted to hot dry desert conditions are able to reduce their metabolic requirements to minimum and conserve energy for diversion to products (milk/work) without extra energy expenditure (Upadhyay *et al*., 2008b). Taking advantage of heat adapting abilities of cattle breeds from our country, like Kankrej, Krishna Valley, Nellore, Ongole and Gir, have been used extensively in breeding programmes designed to evolve cattle suited for tropical areas in North and

South American countries besides Australia since 18th century (Johnston *et al*., 1958, Bhushan 2006).

ADAPTATION TO THE VEGETATION AND ENVIRONMENT

Zebu cattle are superior to European cattle in their capacity to digest food because of differences in the rates of fermentation in the rumen. Zebu had higher fermentation rates and could utilize the low protein coarse feeds and fodders that are available under tropical conditions (Upadhyay *et al*., 2008b). Indian zebu breeds are tolerant to foot rot and mastitis than European breeds and are also resistant to many parasitic and viral diseases that affect Taurus cattle, as their skin thickness is more and capacity to invade through by many parasites is reduced it makes them more resistant to vector borne diseases (Dowling, 1955). Tropical buffalo skin surface attain high temperature during direct solar radiation in summer and rainy season, their long wallowing hours to alleviate thermal loads, in water and mud kill many ectoparasites (Upadhyay *et al*., 2007b). Analysis of Temperature Humidity Index (THI) in relation to habitat of cattle breeds indicate that indigenous or non-descriptive animals, due to their better adaptive capacity and ability to cop up with feed scarcity or harsh environmental conditions, predominantly are distributed in high THI zones (Bahanova *et al*., 2007).

SELECTION OF LIVESTOCK FOR CLIMATE RESILIENCE

Animal genetic resources (AnGr) are critical for ensuring global food security. Two-third of India's population directly or indirectly depends on livestock for their livelihood, energy protein and critical energy requirements (DAHD, 2012). With increasing demand and competition for animal products, diversity of animal genetic resources is necessary to ensure adaptation potential in times of uncertainty. Climate change is drastic and is expected to be a major force testing residence of global food production systems. India being a country with varied climatic condition and agro climatic zones has a wide animal genetic resource which can survive and flourish in changing climate (FAO, 2007, 2009, 2011).

Having diverse animal genetic resources will allow for more opportunities to match breeds to a changing climate or to replace populations hit by severe climatic events such as droughts or floods. Preparation for these transformations will require a significant research commitment and genomics will play a role in the genetic measures taken for adaptation of livestock to climate change (Hansen, 2007; Groeneveld *et al*., 2010; Marai and Habeeb, 2010) Adaptation to climate change is unlikely to be achieved with a single strategy (Hoffmann, 2010). Many local breeds adapt well to harsh climatic conditions but lack of technology, unscientific selection and breeding for more productivity has led to decline in indigenous breeds of livestock. Breeding for climate change adaptation or mitigation will not be that much fundamentally different from existing breeding policy but problems related to measuring the actual genetic worth of indigenous must be overcome by new technologies (Hoffmann, 2013; Fourcada and Hoffman, 2014).Selection for breeds with effective thermoregulatory control will be

needed. This includes inclusion of traits associated with thermal tolerance, body coat, colour, hardiness and feeding efficiency (Gibbs *et al*., 2009).

The use of multi-species and multi-breed herds is one strategy that many traditional livestock farmers use to maintain high diversity in on-farm niches and to buffer against climatic and economic adversities (Hoffmann, 2003; FAO, 2009b). Such traditional diversification practices are useful for adaptation to climate change. Seo & Mendelsohn (2007, 2008) modeled that small farms in developing countries were found more climate change resilient due to their more diverse species portfolios. In the last few decades the selection and breeding policy is more oriented towards production and yield ignoring key traits for resilience and longetivity but now the obvious option is to breed for traits associated with superior productivity and resilience in conditions expected to occur as a result of climate change such as drought and heat tolerance.

The best method of reducing the impact of stressful climatic condition is to improve productivity and animal welfare is by breeding animals that are productive in the presence of that stressful condition without any managerial interventions (Barker, 2009; FAO, 2009b). The rapid development of genomic tools now allows analysis of functional genomic regions with potential associations with adaptation (Qian *et al*., 2013) Genomic selection has the potential to expedite both pure and crossbreeding programmes for adaptation, assuming phenotypes are available (Hayes *et al*., 2009b;Hayes *et al*., 2012); programs for performance recording in developing countries are thus needed. Realistic approach to improve the Indian livestock breeds is through selection and it may start with single nucleus herd. Genetic improvement programmes targeting adaptive traits in high output and performance traits in locally adapted breeds should be considered (West, 2002). Selection for heat tolerance in high output breeds based on rectal temperature measurements and inclusion of temperature humidity index shows promising results (Finocchiaro *et al*. 2005; Bohmanova *et al*.2007; Dikmen & Hansen 2009). Use of reproductive technologies, improved characterization of adaptive traits and strategic crossbreeding and upgrading with indigenous breeds could be incorporated into the breeding policy for better results and to create climate resilient herd. Sires whose daughters shows better productivity potential in changing climatic conditions can be used for further breeding programmes. Possible synergies between plant and animal breeding need to be better developed (Mulder *et al*., 2006; Hayes *et al*., 2009a). However speed of artificial selection depends on genetic factors, selection procedures and accuracy of phenotyping. Breeding for improved climate resilience requires technology, skills, conservation and exchange of animal genetic resources (Hoffmann, 2013).

ADOPTION OF GOOD ANIMAL HUSBANDRY PRACTICES

In tropical and subtropical regions, heat stress, if not properly managed, can have a significant deteriorating impact on the production and health of dairy cattle and buffaloes. Due to the increased heat production along with accumulation, cooling capability of the animal are compromised because of environmental conditions thus add heat load in the animals even to the extent that body temperature rises, intake declines

and ultimately the productivity decreases(Singh and Upadhyay, 2009;Upadhyay and Madan,1987;Upadhyay *et al*.,2008b).

FEEDING STRATEGIES UNDER CLIMATE CHANGE

Heat stressed cattle eat less frequently during hotter hours so feeding during cooler times of the day is one option. Water intake is vital for milk production, but it is also essential for thermal homeostasis. Cold drinking water in rumen increases feed intake by 24% in indigenous cattle, it also helps in lowering both rectal and tympanic membrane temperatures (Bianca, 1964; Harris and Barney, 1992; Dracley, 1999). Drinking water has pronounced effect on animal comfort by direct cooling in the reticulo-rumen and by serving as the primary vehicle for heat transfer and dissipation through sweating and panting. The heat-stressed cow is prone to rumen acidosis and many of the lasting effects of warm weather which can probably be traced back to low rumen pH (Niles *et al*., 1980; Schneider *et al*., 1986) during the summer months in which high energy feeds i.e. fats are to be increased and fibre which is culprit for increasing heat increment has to be restricted.

Nutritional technologies such as formation of calcium soaps of fat via bypass fat helps in maintaining the level of milk production in lactating cows and buffaloes during hot and humid season(Kundu *et al*., 2010), when the animals are unable to consume enough energy which leads to drastic reduction in milk yield. In milk production system where considerable forage is incorporated into diets, addition of lipids might be one of the ameliorative measures to maintain production by maintaining the energy levels of animals during heat stress. Feeding forages in a Total Mixed Ration (TMR) is recommended during heat stress, so that livestock consume sufficient forage intake relative to grain and concentrates when given a choice (Shojaeian *et al*., 2007). Hot weather also increases the need for certain minerals (Harris, 1992). Animals reduce their voluntary feed intake during thermal stress and therefore the mineral intake may be less than optimum required for productivity. Also, associated nutritional-physiological ramifications may affect macro mineral needs (Schneider *et al*., 1986). Jenkinson and Mabon (1973) noted marked increases in rates of loss of Na, Mg, Ca and C1, but not P and significant correlations of these losses with sweating rate. However to alter the microclimate of an animal effectively through housing or environmental modification, we must consider altering one or more of the following factors: temperature or emissivity of the surrounding; air temperature; air velocity; air vapour pressure; radiation or shade factors; and conductivity of surfaces that animals might contact.

SITE SELECTION AND HOUSING

In tropical and sub-tropical climate animal shelters are designed to curtail the heat load on animals from external macro-environment and providing congenial micro-environment in animal houses. Design, height and orientation of shelters, choice of roofing material, provision of open space for ventilation and space per animal are some of the important aspects to attain cooler microenvironment (IPCC, 2014). Structures or

trees can markedly reduce wind-speed, and can be beneficial to the survival of exposed animals (especially newborn) however wind breaks have an importance much beyond these benefits, especially in the tropical and subtropical areas.

Windbreak acts as a barrier lowering the wind speed near the ground surface, deviating and splitting the air stream, the protection achieved is determined by the configuration, height, density and thickness of the trees in a belt Open or partially open ventilated shelters (Ward, 2012) Enclosed shelters are not recommended for tropical climates because the decreased natural air velocity and sanitation. In temperature, partially enclosed shelter can reduce the thermal radiation received by animals during hot weather (IPCC, 2014).

CHALLENGES AND INITIATIVES

The livestock sector has been blamed for contributing more to global climate change than the automobile industry (FAO, 2006).India has one of the highest livestock population in the world and being a country with large population and most of them being poor and illiterate, it is difficult to implement uniform plan for better productivity under changing climatic conditions. Farmers with small land holdings and low income form a major obstacle in front of the government to implement new programmes and initiatives. However the government is trying its best to improve production The Global Plan of Action for Animal Genetic Resources (FAO, 2007b), adopted by the Interlaken International Technical Conference and endorsed by the FAO Conference in 2007, is the first internationally agreed framework specifically for the management of livestock biodiversity in the era of climate change. Indian government has taken several steps to ameliorate climate change which includes National Initiative on Climate Resilient Agriculture (NICRA) during 2010-2011 for the twelve year plan with the objectives to enhance the resilience of Indian Agriculture covering crops, livestock and fisheries to climatic variability through development and application of improved production and risk management technologies under ICAR (DAHD, 2012).National Agricultural Innovation Project (NAIP) funded by World Bank under the umbrella of ICAR, New Delhi initiated the activities for capacity building to undertake basic and strategic research in the frontier areas of agriculture and allied sciences to meet challenges in technology development in the immediate and predictable future.

To sum up, generation of new technologies, policies that support rational use of natural resources, sharing of global best practices and capacity building of farmers will go a long way towards making agriculture climate smart. The XIII Agricultural Science Congress with focus on Climate Smart Agriculture, jointly organized by the National Academy of Agricultural Sciences, New Delhi and the University of Agricultural Sciences, from 21 to 24 February 2017 at Bengaluru is a testimony, both, to the gravity of the impact of climate change on agriculture and, the concerted action deployed by governments and institutions in addressing these challenges (Venkateswarlu, 2017). But this is just the beginning and if India wants to reach its production goals for sustainable food systems in a changing climate scenario more work needs to be done

especially in the livestock sector by promoting climate resilient breeds production systems to endure the vagaries of climate.

REFERENCES

Aggarwal A. and Upadhyay RC. 1997. Pulmonary and cutaneous evaporative water losses in Sahiwal and Sahiwal X Holstein cattle during solar exposure. Asian Australasian Jounal of Animal Science 10: 318-323.

Allen TE, Pan YS and Hayman R. 1963.The effect of feeding on the evaporative heat loss and body temperature in Zebu and Jersey heifers. Australian Journal of Agricultural Research 14: 580-593.

Annual Report (2015), Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India, New Delhi.

Al-Katanani YM, Webb DW and Hansen PJ. (1999). Factors affecting seasonal variation in 90-day non return rate to first service in lactating Holstein cows in a hot climate. Journal of Dairy Science 82(12): 2611-2616.

Basic Animal Husbandry Statistics. (2016). Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India.

Bohmanova J, Misztal I and Cole JB. (2007). Temperature-Humidity Indices as Indicators of milk production losses due to heat stress. Journal of Dairy Science 90: 1947-1956.

Barati F, Agung B, Wongsrikeao P, Taniguchi M, Nagai T and Otoi T. (2008). Meiotic competence and DNA damage of porcine oocytes exposed to an elevated temperature. Theriogenology 69: 767–772.

Barker JSF. (2009). Defining fitness in natural and domesticated populations. In: Adaptation and Fitness in Animal Populations: Evolutionary and Breeding Perspectives on Genetic Resource Management (Ed. by J. Van der Werf, H.-U. Graser, R. Frankham & C. Gondro), Springer, New York. pp. 3–14.

Bianca W. (1964). Thermoregulatory responses of the dehydrated ox to drinking cold and warm water in a warm environment. Research in Veterinary Science 5: 75.

Bauman DE and Currie WB. (1980). Partitioning of nutrients during pregnancy and lactation: a review of mechanisms involving homeostasis and homeorhesis. Journal of Dairy Science 63: 1514- 1529.

Baumgard LH, Abuajamieh MK, Stoakes SK, Sanz-Fernandez MV, Johnson JS and Rhoads RP. (2014). Feeding and managing cows to minimize heat stress. in Proceedings of Tri-State Dairy Nutrition Conference, Fort Wayne, Indiana. pp. 61-74.

Barros CM, Monteiro FM, Mello DS, Carvalho LM, Teixeira AB and Trinca L A. (2002). Resistance of *Bos indicus* to heat shock, compared to crossbred or *Bos taurus*, at early stages of in vitro embryo development. Proceedings of the international symposium on reproduction in domestic ruminants 6: A4.

Burns BM, Reid DJ and Taylor JF. (1997). An evaluation of growth and adaptive traits of different cattle genotypes in a subtropical environment. Australian Journal of Experimental Agriculture 37, 399-405.

Carvalho FA, Lammoglia MA, Simoes MJ and Randel RD. (1995). Breed affects thermoregulation and epithelial morphology in imported and native cattle subjected to heat stress. Journal of Animal Science 73: 3570–3573.

Chauhan DS and Ghosh N. (2014). Impact of Climate Change on Livestock Production: A Review. Journal of Animal Research 4(2): 223-229.

DAHD-GOI. 2012. 19th Livestock Census. Department of Animal Husbandry.

Dash S, Chakravarty AK, Singh A, Upadhyay A, Singh M and Yousuf S. (2016). Effect of heat stress on reproductive performances of dairy cattle and buffaloes: A review. Veterinary World 9(3): 235–244.

De Rensis F and Scaramuzzi RJ. (2003). Heat stress and seasonal effects on reproduction in the dairy cow: a review. Theriogenology 60, 1139–1151.

DeVillalobos M, Suniaga J and Pulido F. (1975). Tolerance to heat and atmospheric humidity of Holstein-Friesian and Swiss Brown/zebu crossbred cows at Jusepin, Monagas State,Venezuela. Agronomia Tropical 25: 243–257.

Dikmen S and Hansen PJ. (2009). Is the temperature-humidity index the best indicator of heat stress in lactating dairy cows in a subtropical environment? Journal of Dairy Science 92: 109–116.

Dikmen S, Alava E, Pontes E, Fear JM, Dikmen BY, Olson TA and Hansen PJ. (2008) Differences in thermoregulatory ability between slick-haired and wild-type lactating Holstein cows in response to acute heat stress. Journal of Dairy Science 91: 3395-3402.

Dikmen S, Cole JB, Null DJ and Hansen PJ. (2013). Genome wide association mapping for identification of quantitative trait loci for rectal temperature during heat stress in holstein cattle. PLOS ONE. 8(7):e69202.

Dowling DF. (1955). The thickness of cattle skin. Australian Journal of Agricultural Research. 6: 776-785.

Drackley JK. (1999). Biology of dairy cows during the transition period: the final frontier? Journal of Dairy Science. 82: 2259-2273.

FAO. (1995). World watch list for domestic animal diversity. 2nd ed. Edited by Scherf B. Rome, FAO and the United Nations Environment Programme (UNEP).

FAO. (2006). World agriculture: towards 2030/2050. Interim report, Global Perspective Studies Unit. Rome, Italy: Food and Agriculture Organization of the United Nations.

FAO. (2007). Global plan of action for animal genetic resources and the Interlaken Declaration. Int. technical conf. on animal genetic resources for food and agriculture, Interlaken, Switzerland, 3–7 September 2007.

FAO. (2009a). Format and content of future status and trends reports on animal genetic resources. Intergovernmental Technical Working Group on Animal Genetic Resources for Food and Agriculture, Fifth Session, Rome, 28–30 January 2009.

FAO (2009a). Global agriculture towards 2050. High Level Expert Forum Issues Paper. FAO, Rome.

FAO. (2009b). Status and trends of animal genetic resources – 2008. Intergovernmental Technical Working Group on Animal Genetic Resources for Food and Agriculture, Fifth Session, Rome, 28–30 January 2009.

FAO. (2009c). Report of the Fifth Session of the Intergovernmental Technical Working Group on Animal Genetic Resources for Food and Agriculture, Rome, Italy, 28–30 January 2009.

FAO. (2011). World livestock 2011: Livestock in food security. FAO, Rome

FAO. (2013). Climate-smart agriculture: Sourcebook. FAO, Rome.

Fenwick MA, Llewellyn S, Fitzpatrick R, Kenny DA, Murphy JJ, Patton J, & Wathes DC. (2008). Negative energy balance in dairy cows is associated with specific changes in IGF-binding protein expression in the oviduct. Reproduction (Cambridge, England) 135(1): 63–75.

Finocchiaro R, van Kaam JBCHM, Portolano B and Misztal I. (2005). Effect of heat stress on production of Mediterranean dairy sheep. Journal of Dairy Science 88: 1855–64.

Fourcada J and Hoffman JI. (2014).Climate change selects for heterozygosity in a declining fur seal population. Nature 511: 462–465.

Frumhoff PC, McCarthy JJ, Melillo JM, Moser SC and Wuebbles DJ. (2007). Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions. Synthesis report of the Northeast Climate Impacts Assessment (NECIA). Cambridge, MA: Union of Concerned Scientists (UCS).

Medicinal Rice: Nutritional Quality and Its Properties

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Rice (*Oryza sativa* L.) belonging to the family Poaceae and subfamily Oryzoides. Its chromosome number is 2n = 24. Rice is the second most important cereal crop in the developing world after wheat crop. It is main staple food of half world's population. It belongs to the grass family. About 20 species of rice were identified but only two species are mostly cultivated i.e. *Oryza sativa* L. and *Oryza glaberrima* L. these both species are native to tropical and subtropical southeastern Asia and Africa. *Oryza sativa* is more tolerance and high adaptability than the other species because it grown in different types of climatic condition, soil, in submerged condition as well as in dry hilly slopes (Lu and chang, 1980).

Rice is also known as grain of life and it is consumed by 90 % of Asians. It plays an important role in National food security. Instead of staple of food, rice is an essential part of social rites, rituals and festivals in almost all Asian countries. Rice has also medicinal properties which were clearly recognized by the medicinal system of ancients. India is rich in medicinal plants and different types of medicinal plants were found with different medicinal properties. These medicinal plants have been used in Ayurveda, Unani systems of medicines. According to the Indian literature every plant on the earth is useful for human being and animals in many ways i.e. as food purpose or medicinal purpose (Oudhia, 1999). Rice provides the good human health and nutrition to the consumers. In Ayurveda, the medicinal properties of rice described as oleaginous, biliousness, diuretic, fattening, acrid, aphrodisiac and also used as tonic (Caius, 1986).

In last 20 decades, the disease pattern is changing in India. In ancient time only communicable diseases were saw but now a days, these communicable diseases shift to the lifestyle-related diseases such as heart attack, diabetes, and cancer. This is only due to the faulty diets, sloppy lifestyle as well as high stress levels. The panic thing is that these diseases not only seen in urban India but also in rural India too.

In India, peoples have been attracted towards the junk food but this junk food is responsible for the life-style related diseases. The alarm bells have already begin ringing for heart problems, cancerous as wells as diabetes problems. Now, so many medicines are available for these diseases but these newly developed medicines have many side effects and too expensive. The expenditure of the medicines are also become a burden on the common man.

Indian nutritionists have been constantly recommending the use of green, healthy and functional food. Now a day, a number of healthy food are available in market such as wheat flour (*atta*) noodles, brown bread and one of the most important brown rice. Many studies prove that these types of foods are very helpful to reduce the incidence of the life-style related disease. The focus is on mineral contents, antioxidants properties and the glycemic index is great issue in the world. Some people think that rice consumption is related to the higher risk of diabetes mellitus (McKeown et al., 2002). But some studies showed that rice have greater variability of the glycemic index depending upon the type of method of cooking. Rice holds promise as a medicinal and health food.

The major rice growing Asian countries such as Thailand, Myanmar, China, Malaysia, Indonesia, and India have attributed some medicinal properties to rice. In ancient time, whole brown rice was declared as perfect food. In China, the medicinal value of rice was known as far back as in 2800 BC, when it was used by royal Chinese physicians for health purposes. The Chinese believe that the rice have too medicinal properties which helps to expel gas from the stomach and intestine, increase appetite as well as cures indigestion. They use weedy/red rice yeast for various ailments such as heart related diseases.

RICE BY-PRODUCTS

1. **Rice Starch:** Starch is a natural polymeric carbohydrates and main component of rice. Starch mainly used in custard powder, distillation of potable alcohol, gel and ice cream, etc.

Pic 1. Rice Starch; Source: www.eceurope.com

2. **Rice Husk:** It is mainly used in paper making, packing, building materials and also to making compost. Instead of these, it is used as insulator.

Pic 2. Rice Husk; Source: http://www.knowledgebank.irri.org

3. **Rice Bran:** It is used in confectionery products like snacks, cookies, biscuits and bread. The bran is used as a cattle feed, compost and mechanical purpose.
4. **Rice Bran Oil:** It is used in synthetic fibers, detergents, cosmetics and emulsifiers. It is also used as edible oil because this oil is rich nutrition and provides protection from heart related diseases.
5. **Broken Rice:** It is mainly used as poultry feed. Instead of this, it is also used to making baby food, noodles, rice cakes and rice flour etc.
6. **Parched Rice:** Parched rice is made from parboiled rice and it is easily digestible.

Pic 3. Parched Rice; Source: http://www.organicfoodsbd.com

7. **Flaked Rice:** It is also made from parboiled rice. It is used to making poha and used in many preparations.
8. **Rice Flour:** It is made from rice grain after fine grinding. It is mainly used to make chapatti.
9. **Rice Milk:** Rice milk is made from brown rice. Basically, brown rice syrup and sugar mixed together to make this milk. This milk is nutritionally superior.
10. **Rice Straw:** It is mainly used as animal feed, mushroom bed, fuel, for mulching in field crops.
11. **Rice Glue:** It is made from white rice. Basically, it is used to paste paper material.
12. **Red Yeast Rice:** It is substance that's extracted from rice that's been fermented with type of yeast called Monscus purpureus. It contains monacolin K, which is mainly used as drug in lowering the Cholesterol levels.

Pic 4. Red Yeast Rice; Source: www.consumerreports.org

NUTRITIONAL QUALITY OF RICE

- **Rich in Protein:** Rice is good source of protein. It contains about 8 per cent protein in 100g serve. The lysine protein is present in high proportion and very high digestibility. It provides eight essential amino acids to the human body. These amino acids help to build resilient muscles which come back to its original form after stretching and bending, healthy skin, hair, clearer eyesight and nourish the heart and lungs, brain, nervous system (Chaudhari et al., 2018).
- **Rich in Carbohydrates:** Rice is main source of carbohydrates. It work as carrier of protein and other micronutrients. Carbohydrates are broken down into the glucose then this glucose used as energy during exercise and work as slow starch digestion. The patient of Type-II diabetes would be eating slowly digestible rice such as brown rice. Because, brown rice has slow starch digestible and some sugar never convert into sugar (Dolson et al., 2009). Brown rice is also responsible for lower risk of diabetes than the white rice (Qi et al., 2010). The patient of Type-II diabetes should avoid more consumption of carbohydrate (Frei and Becker, 2004). It becomes more nutritious when rice is consumed with other food such as green vegetables and fruits etc.
- **Rich in Vitamins:** The vitamins B-complex also present in rice especially thiamin, riboflavin and niacin. These also help to provide the energy, nourishment to skin and blood vessels. Instead of these, rice bran also contain tocopherols and tocotrienols. According to researchers, tocopherols is anti-cancerous and tocotrienols also helps to reduces the cholesterol levels in the human body and prevents the blood clots (Lloyd et al., 2000). In addition, the bran of red and purple rice is good source of anthocyanins and tannins which possess antioxidants and anti-inflammatory properties.
- **Rich in Minerals:** Iron (Fe) and Zinc (Zn) and other minerals have been found in rice varieties i.e. Red and Black rice. Iron and Zinc both are essential for enzymatic and haemoglobin production. The deficiency of zinc in the human body causes weight loss, diarrhoea. Similarly, iron deficiency cause anaemia and fatigue. Instead of these, rice als contains manganese (Mn) and copper (Cu) which are more important for the proper functioning of brain and nerves and enzymes production which helps in normal body functioning. Rice is also good source of phosphorus and potassium to maintain internal water balance and for normal metabolism, cell, tissue, muscle growth and normal activity of the heart.

Table 1: Vitamin and mineral content of cereal and tuber staple food (per 100g)

Food	Carotene (mg)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Ascorbic acid (mg)	Vitamin E (mg)	Iron (mg%)	Zinc (mg%)
Brown rice	0	0.29	0.04	4.0	0	0.8	3	2
Wheat	0.02	0.45	0.10	3.7	0	1.4	4	3
Maize	0.37	0.32	0.10	1.9	0	1.9	3	3

Millet	0	0.63	0.33	2.0	0	0.07	7	3
Sorghum	10.0	0.33	0.13	3.4	0	0.17	9	2
Rye	0	0.66	0.25	1.3	0	1.9	9	3
Oats	0	0.60	0.14	1.3	0	0.84	4	3
Potato	0.01	0.11	0.05	1.2	17	0.06	0.8	0.3
Cassava	0.03	0.06	0.03	0.6	30	0	1.2	0.5
Yam	0.01	0.09	0.03	0.6	10	0	0.9	0.7

Source: Souci et al., 1986; Eggum 1969, 1977, 1979

- **No Cholesterol, Low fat and Salt Concentration:** Rice has low fat and alt concentration and cholesterol is not present. The unsaturated fatty acids are present in rice bran which is removed at the time of milling. Rice bran contains upto 80 per cent of fatty acids (Frei and Becker, 2004). These are essential to maintaining the function of cell membrane and the nervous system.
- **No Gluten:** Rice is always gluten free food. All varieties of rice are gluten free. Some people are suffering from gluten allergy. These types of patient can take gluten free diet by consuming rice.

MEDICINAL PROPERTIES

- **Prevent High Blood Pressure:** Rice has no cholesterols, low fat as well as low salt concentration. It is best diet for the patient of hypertension because these patient demands salt restricted diet. According to researchers, rice is very beneficial for the patient of high blood pressure. Calcium is also present in brown rice in appropriate amount. This is helpful to provide relaxes to the nervous system and reduce the symptoms of high blood pressure.
- **Helps in Body Balance:** The rice diet in combination with the milk is very nutritious and balance body. The natural brown rice is used as the only solid food throughout the day. Fresh milk is taken with each of the rice meals give beneficial results. The rice may be cooked in any manner but no salt should be used. The milk should be comfortably cool. The nutrients in the rice form a unique balance with those in the milk. The two notable amino acids, isoleucine and lysine in the milk are greatly strengthened by rice protein, thereby enabling them to form stronger body building blocks: The naturally lactic acid in milk works with rice protein to aid in the absorption of iron.
- **Cancer Prevention:** The rice has anti-cancerous properties. Brown rice contains many insoluble fibers which provide the protection against various types of cancer diseases. According to researchers, the insoluble fiber in brown rice plays an important role in protecting the body from cancer.
- **Treatment of Dysentery:** The rice husk not only used in paper making, packing, building materials but also has medicinal properties. It helps in the dysentery treatment. A three month old rice husk contains diuretic properties. Mostly people believe that rice is very helpful to increase appetite, stomach ailments and indigestion problems.

- **Prevent Alzheimer's Disease:** It is a progressive disease that destroy memory and other important mental function. Brown rice also cures of this disease. Because, brown rice are contain more quantity of neurotransmitter nutrients which is helpful to prevent Alzheimer's disease.
- **Helps to Prevent Diarrhea:** Rice is very useful in treating diarrhea in children. According to researchers, a teaspoonful powder of parboiled rice with glassful of butter milk after every half an hour provides excellent results.
- **Prevent Heart disease:** Red yeast rice contains monacolin K, which is mainly used as drug in lowering the cholesterol levels. Instead of these, rice bran oil has antioxidant properties that stimulate cardiovascular strength by reducing cholesterol level in the body.
- **Skin Care:** Medical experts say that powdered rice can be applied to cure some forms of skin ailments (Umadevi et al., 2012).

CONCLUSION

In India different types rice varieties are available in abundant quantity with so many medicinal properties. But the problem is that people have not aware related to medicinal properties of rice. So there is need to aware the people regarding medicinal properties of rice so that they can eat healthy and nutritious food to protect against the lifestyle-related diseases such as heart attack, diabetes, skin problem, cancerous problems etc. The promotion and conservation of this national heritage as a health food is critical in order to stem the attack of lifestyle-related diseases.

REFERENCES

Caius, J.F. (1986). The medicinal and poisonous plants of India Reprint. Pbl. Scientific Publishers, Jodhpur, India.

Chaudhari, P. R., Tamrakar, N., Singh, L., Tandon, A. and Sharma, D. (2018). Rice nutritional and medicinal properties: A review. Journal of Pharmacognosy and Phytochemitry. **7**(2): 150-156.

Dolson, L. (2009). What you need to know about complex carbohydrates. http://lowcarbdiets.about.com/od/nutrition/a/starch.htm.

Eggum, B.O. (1969). Evaluation of protein quality and the development of screening technique. In New approaches to breeding for improved Plant protein, (pp. 125-135),Vienna IAEA.

Eggum, B.O. (1977). Nutritional aspects of cereal protein. In A. Muhammad R. Aksel & R.C. Von Boustel, (Eds), (pp. 349-369), Genetic diversity in plants. New York, Plenum press.

Eggum, B.O. (1979). The nutritional value of rice in comparison with other cereals. In proceedings, workshop on chemical aspects of Rice grain quality, (Eds), (pp. 91-111), Los Bunos, Laguna, The Philippines IRRI.

Frei, M., Becker, K. (2004). On rice, biodiversity and nutrients. Institute of Animal Production in the Tropics and Subtropics. University of Hohenheim, Stuttgart.

Lloyd, B.J., Siebenmorgen, T.J. and Beers, K.W. (2000). Effects of commercial processing on antioxidants in rice bran. Cereal Chem. **75**(5): 551-555.

Lu, J.J. and Chang, T.T. **(**1980). Rice in its temporal and spatial perspective. In B.S. Luh, (Eds.), Rice: production and utilization, p. 1-74. Westport, CT, USA, AVI Publishing Co.

McKeown, N. M., Meigs, J. B., Liu, S., Wilson, P. W. and Jacques, P. F. (2002). Whole-grain intake is favorably associated with metabolic risk factors for type 2 diabetes and cardiovascular disease in the Framingham Offspring Study. American Journal of Clinical Nutrition. **76**(2): 390 - 398.

Oudhia, P. (1999). Medicinal weeds in rice fields of Chattisgarh, India. International Rice Research Notes. **24**(1):40.

Souci, S.W., Fuchmann, W. and Kraut, H. (1986). Food composition and nutrition tables, 3rd revised (Eds.), Stuttgarti, Wissen Schaftloche Verlagsgeseil schaft.

Sun, Qi. (2010). White Rice, Brown Rice, and Risk of Type 2 Diabetes in US Men and Women. Arch Intern Med. **170**(11): 961-969.

Umadevi, M., Pushpa, R., Sampathkumar, K.P. and Bhowmik, D. (2012). Rice-traditional medicinal plant in India. Journal of Pharmacognosy and Phytochemistry. **1**(1): 6-12.

Feeding of dairy cows for optimum milk composition

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In India, current milk pricing to the dairy farmers is based on Fat and SNF content of milk. Hence, to maximize the profit in dairy farming, more emphasis is given to increasing fat and protein content of milk. There are many factors that can affect milk composition which includes genetics, stage of lactation, level of milk production, age of cow, environment, season, disease and nutrition. Fifty-five percent of the variation in milk composition is due to heredity, while 45 percent is due to environmental factors such as feeding management and climatic conditions. Hence, nutrition stands as the primary means of manipulating milk constituents. Milk contains 87.7 % water and the solid components include fat, protein, lactose, minerals and vitamins. Among these fat and protein are most subjected to changes due to dietary manipulation. The other solid constituents of milk such as lactose, minerals and vitamins generally do not respond to dietary manipulation. Optimizing the rumen function is the key to maintain milk yield and its composition. Hence, feeding programs with adequate protein and energy, rapidly fermentable carbohydrate, effective fiber, fat and supplementation of feed additives are keys to increase milk composition.

SOURCE OF MILK COMPONENTS

Feed consumed by cows fermented in the rumen with the help of billons of microbes. The different fermentation products from those microbes determine the composition of the milk, including milk protein and milk fat. Fermentation process in the rumen produces volatile fatty acids (VFA) like Acetic acid (65-70%), Propionic acid (18-20%), Butyric acid (8-10%). Milk fat is synthesized in the udder from acetic acid and butyric acid. Propionic acid is precursor for the milk lactose content. About half of the fat in milk (Short chain fatty acids) is synthesized de novo by the mammary gland from precursors such as acetate and butyrate. The other half of milk fat (Long chain fatty acids) is transported from volatile fatty acids of the digestive tract, free non-esterified fatty acids from body fat degradation or from fat metabolized in the liver. Both milk fat content and composition are therefore influenced by the feedstuffs. Milk protein in the mammary gland is synthesized mainly from amino acids in blood and are the primary precursors used to synthesize milk protein. Rumen microbes convert

dietary protein in to amino acids and these amino acids are used by the mammary gland to synthesize milk proteins.

FEEDING STRATEGIES TO MAXIMIZE MILK COMPOSITION

Dietary fiber

Fiber is an important nutrient for rumen health and for increasing or maintaining milk fat percentage. Digestion of fiber in the rumen results in the production of volatile fatty acids like acetic acid and butyric acid which are the precursor for milk fat synthesis in the udder. The level of fiber feeding and the physical size of fiber particles contribute to the effectiveness of a fiber source for stimulating rumination, buffer production and maintenance of normal milk fat and protein composition. Hence, for optimum rumen function the diet should contain 28-30% neutral detergent fiber (NDF) and 19-21 percent acid detergent fiber (ADF). Feeding finely chopped forages give less time in chewing, cause less saliva production, ruminal pH comes down, activity of cellulolytic bacteria will be reduced, hence negative influence on milk fat percentage. The physical size of fiber particles should be 2-5 cm long to promote cud chewing and rumination.

Roughage: Concentrate ratio

In high roughage diet, acetate production will be increased results in high milk fat production. High concentrate diet results more propionic acid production, milk fat will be decreased. For optimum milk fat production roughage: concentrate ratio of the ruminants diet should be around 60:40 or 70:30.

Carbohydrates

Feeding proper non-fiber carbohydrates (NFC) like starch, sugar and pectin can influence both milk fat and milk protein content. Excessive amounts of NFC increases milk protein yield because of high propionate production but depress fiber digestibility, which reduces the production of acetate and leads to low milk fat. Hence, an NFC of 32 to 38% of ration dry matter is recommended to optimize production of milk fat and protein.

Protein

The best way to increase milk protein is to increase the amount of microbial protein and bypass protein available to the cow. Rumen microbes convert dietary protein into microbial protein, which is a primary source of essential amino acids for the cow. Microbial protein is considered as a consistent source of high quality protein. Hence, balancing the diet for microbial protein rather than crude protein, is important for increasing milk protein content. The second source of amino acids for the cow is bypass protein, which escapes the rumen degradation and is digested in the small intestine and used to make milk protein. Hence, ruminant diet with 17-18 % crude protein in which 33 to 40 of crude protein in the form of rumen undegradable protein is recommended to increase milk protein level.

Supplemental fat

During the early lactation period, the dry matter intake of the cows goes down, hence increasing energy density of the ration is the only available option to improve energy intake, which can be achieved through supplementation of grains or fat. Diets containing high levels of grain may cause rumen acidosis, and may ultimately result in low milk and milk fat production. To avoid these problems, fat can be added to increase the energy density of the diet. 50% of the milk fat synthesized in the mammary gland is derived from fat sources in the diet. Supplemental fat usually increases milk production and slightly increases milk fat percent, makes relatively little change in milk protein percent. However, if fat from natural sources exceeds 5% of ration dry matter will affect rumen microbes, reduce fiber digestibility and potentially reduce milk fat percentage. Hence fat can be added in the form of rumen inert or bypass fat safely up to 6 to 7%. The protected fats are mostly either calcium salts of long-chain fatty acids or saturated fats, so that they pass through the rumen without any degradation, reach the small intestine where they are broken down by enzymes and, subsequently, utilised by the body as an efficient source of energy and increases milk fat percentages. Generally, provide one-third of fat in the ration from normal ration ingredients, one-third from oilseeds (Ex. whole cottonseed) or natural fats and one-third from rumen inert or bypass fat.

Feed additives

Maximizing feed intake is most important for improving the milk protein and fat content. Feed additives are able to support maximum feed intake by increasing the number of beneficial bacteria in the gut. These beneficial bacteria stabilize the rumen environment and improve the digestibility of the ration and fiber fractions, therefore increasing the milk yield, milk fat, and milk protein content.

Buffers: Buffers help stabilize rumen pH, providing a favorable environment for fiber digesting rumen microbes, thereby preventing potential depression of milk fat percentage. Common buffers recommended for feeding lactating dairy cows are sodium bicarbonate and magnesium oxide. Buffers should be fed at 1-1.5 % of ration DM or 150-200 grams/cow/day.

Sulfur: Sulfur is necessary for the synthesis of essential amino acids by rumen microbes. The recommended level of sulfur is 0.22 to 0.25 percent of the total ration dry matter.

Yeast culture: Yeast culture and their fermentation products stabilize the rumen environment and improve fiber digestion. They increases the lactic acid utilizing bacteria in the rumen thus more milk fat percent. Yeast culture can be fed up to 10 to 120 grams depending on yeast culture concentration.

Niacin: Niacin is produced in sufficient quantities by rumen microbes to meet the requirement of the animal, however in high producing animals it may not be adequately synthesized. In such conditions, niacin can be fed at a level of 6 to 12 grams per day.

Conclusion

Higher milk production with maximum level of milk fat and protein is essential for achieving profitable dairy farming. Feeding strategies that optimize rumen function can improve milk composition and yield. Feeding of dairy cows with optimum level of fiber, protein, fat and feed additives are the key to increase milk composition.

DUS test in potato under PPV & FR Act, 2001

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Potato (*Solanum tuberosum* L.) is the third most important food crop of the world. Till date sixty-two improved potato varieties have been developed and released in India that is suitable for cultivation in different agro-climatic regions of the country. Though introduced in early 17th century, the present statistics of potatoes shows 34 fold rise from mere 1.54 million tonnes in the year 1949-50 to 53 million tonne during 2018-19. At present India is the second largest potato producer in the world. Such a leap in production is due to modern agricultural technologies viz., improved varieties, and better production and protection technologies. Variety development is a continuous process and involves huge investments and time. Varietal characterisation ie identity of the material is prime concern to breeder, researchers and all the other stakeholders of that variety. The identification and uniqueness of a variety can established either morphologically or through DNA based molecular markers. Morphological identity of variety is established by Distinctness, Uniformity and Stability (DUS) test that is mandatory for the protection of any new plant varieties under the Protection of Plant Varieties and Farmers Right Act (PPV&FRA), 2001. This act grants exclusive right to the breeders to protect their new varieties or new parental lines for a specified period of time. India became signatory to the Trade Related Aspects of Intellectual Property Rights Agreement (TRIPs) in 1994. Article 27.3 (b) of TRIPS agreement mandates the member countries to provide for protection of plant varieties either by a patent or by an effective sui generis system or by any combination thereof. The Indian Patents Act of 1970 does not permit patenting of plants or varieties. Patents on plants are available in countries like USA. In developing countries, patents are replaced by PVP (Plant Variety Protection) considering the fact that variety development is improvement of already existing ones and not de novo creation.

Considering this, The Protection of Plant Varieties and Farmers' Rights Act was passed by the Indian Government in 2001. The sui generis system of the act includes the rights of breeders, farmers and farming communities. The purpose of the act is establishment of an effective system for protection of plant varieties (microbes not included in the act), provision of the rights of farmer's and plant breeder's, stimulation

of investment for research and development facilitating development of the seed industry and ensuring availability of high quality seeds and planting materials of improved varieties to farmers. Article 15.3(b) of the PPV&FR Act defines that the new variety must be clearly distinguishable by one or more essential traits from any variety whose existence is a matter of common knowledge at the time of seeking protection. Section 14 of PPV&FRA, 2001 provides opportunity for the registration as New, Extant and Farmers variety provided the genotype should if fulfil the criteria of Novelty, Distinctness, Uniformity and Stability that are elaborated as:

I. Novelty: defines the originality of a variety. The propagating material of the variety, at the date of filing the registration application, must not be commercially cultivated for more than one year in India. The time durations for the material of exotic origin are less than six years for trees and vines and less than four years for other than trees and vines.
II. Distinctness: The variety to be protected must be clearly distinguishable by minimum one essential characteristic from any other variety of common knowledge.
III. Uniformity: The variety must be genetically and physically pure and phenotypically homogeneous. In case of vegetatively propagated crop as potato the uniformity is tested on the basis of number of off types in the variety. Uniformity of traits is recorded on the plot as a whole by visual assessment in a single observation on group of plants or parts of plants with maximum off-types not more than two in potato DUS test experimental plot.
IV. Stability: The essential traits of the variety should be stable across generations, seasons and locations.

POTATO DUS TEST

The Potato National Test Guidelines have been documented in year 2009 that describes the principles and methods on various aspects of DUS testing of potato varieties. This guideline contains details on planting material required, conduct of tests, methods and observations, grouping of varieties, characteristics and symbols, table of characteristics and their explanation and literature. The brief details are as follows:

a) Planting material: In potato the planting material is tubers and three hundred fully matured, skin cured, freshly harvested tubers (not more than 15 days) medium sized (3.5-5 cm diameter) healthy tubers are required for DUS testing trial. The experimental material must be visibly healthy, free of any quarantine pest and pathogens and must not be chemically or bio-physically treated.

b) Location and duration of DUS test: Potato DUS test are conducted in following locations:

Floral characters: Hill location at CPRS, Kufri, Himachal Pradesh

Light spuort, vegetative and tuber characters: Two plain locations at CPRS, Modipuram, Uttar Pradesh and CPRS, Jalandhar, Punjab

The duration of potato DUS test for New variety is two independent similar growing seasons and two test locations. For varieties to be protected in Variety of Common Knowledge one year DUS testing is required. No DUS test is done for varieties notified under Indian Seed Act, 1966 and is registered in Extant category.

c) Test plot design: The potato DUS experimental plot constitutes bed size of 4.8 m2 with 4 rows of 2 m length and 60 cm row to row and 20 cm plant to plant distance per entry/variety. Total replications are three composing of 120 plants each.

d) Methods of observations: The assessment of Distinctiveness and Stability is taken on 30 plants or parts of 30 plants ie 10 plants per replication. Uniformity of characteristics is observed visually on the plot as a whole. In case of sample size of 120 plants, the maximum limit of off-types is two. The leaf traits will be observed on 4th fully developed leaf from the top of the plant. The colour traits to be recorded in Royal Horticultural Society (RHS) colour chart

e) Grouping of varieties: Grouping of varieties facilitates the assessment of distinctiveness. Traits that do not vary, or vary only slightly, within a variety with its various states are fairly evenly distributed across all the varieties in the collection are suitable for grouping. In potato predominant colour of lightsprout, predominant colour of stem, floral corolla colour and predominant colour of tuber skin are the four grouping characters.

f) Reference collection: Reference collection constitutes live material and detailed database. Reference collection is mandatory to maintain for conducting DUS testing of variety submitted for protection. In potatoes the reference collection material/clones are maintained under field conditions under disease free condition. And a contour part of same is also maintained in-vitro. Theoretically, the reference collection constitutes globally known varieties of same species and crop that are used for comparison for any candidate variety. Under practical condition, this number of varieties in reference collection is reduced by selecting varieties from similar environmental locations. Further the selection is narrowed down to only the most closely similar varieties provided by the breeder in Technical Questionnaires.

g) Nature of traits for DUS potato testing: Qualitative traits: The qualitative traits are generally governed by two or many alleles of a single gene with little or no environmental modifications on the gene effects. Such traits have distinct (separate) phenotypic classes and depict discontinuous variations with no arbitrary limit on their number. Examples are lightsprout predominant colour (Fig. 1 depicts states), shape (spherical; conical; cylindrical), intensity of anthocyanins colouration at base and sprout tip (light; medium; dark), pubescence base (absent; weak; strong, foliage structure (compact; semi –compact; open), stem solidity (solid; hollow) and cross section (round; angular), stem predominant colour (green; red-brown; purple; dark purple) and secondary colour ((absent; green; red-brown; purple; dark purple) and its distribution (absent; only at base; only at lower node; throughout lightly scattered; throughout highly scattered), wing (poorly developed; highly developed) and wing type (straight; wavy), leaf structure (open; intermediate; close), anthocyanin colouration of rachis

(Fig. 2 depicts states ie absent; present) and mid rib (absent; present only at the base; present throughout), leaflet (lateral) shape (narrow lanceolate; lanceolate; ovate lanceolate; ovate; oval), waviness of margin (weak; medium; strong), glossiness of upper side of leaflet (weak; medium; strong), pubescence of blade at apical rosette (absent; present), anthocyanin colouration of bud (absent; present), anthocyanin colouration of floral stalk (absent; weak, medium, strong), anthocyanin colouration of pedicel articulation (absent; present), pedicel articulation position (below the middle; at the middle; above the middle), corolla colour (Fig. 3 defines the states), corolla diameter (small; medium; large), inflorescence size (small; medium; large), anthocyanin colouration of outer side in white flowers (absent; present), intensity of anthocyanins colouration of corolla on inner side (absent; weak; medium; strong), anther colour (greenish-yellow, yellow, orange), anther cone type (normal; irregular), pistil type (normal; irregular), stylar length (shorter; equal; longer), stigma shape (round; lobed); stigma lobe (unilobed; bilobed; tri-lobed), premature bud dropping (absent; present), intensity of flowering (Absent; sparse; medium; profuse), tuber predominant colour (whitish cream; yellow; orange; brown; pink; red; reddish purple; purple; dark purple-black), secondary skin colour (absent; whitish cream; russetted; yellow; pink; red; purple; dark purple-black) and its distribution (absent; confined to eyes; present on eyebrow only; spectacled(only around eyes); splashed; stippled), tuber skin type (smooth; rough), and shape (flattened; round; ovoid; oblong; pear shaped; long-oblong; reniform; irregular), eye depth (protruding; shallow; medium deep; deep), tuber flesh predominant (white; cream; yellow; reddish purple; dark purple), and secondary colour (absent; white; cream; yellow; reddish purple; dark purple) and its distribution (outer cortex; inner cortex; outer medulla; inner medulla; vascular ring; mottled).

Quantitative traits: The quantitative or metric traits are generally economically important measurable phenotypic traits. These traits are recorded on a one-dimensional scale and show continuous variation from one extreme to the other. Such traits are highly influenced by the environmental conditions and are governed by many minor genes. Examples are length of apical sprout (small; medium; long), height of main stem (small; medium; tall), leaf length (small; medium; large), leaf width (narrow; medium; broad) and time of maturity (early; medium; late).

h) Stages of observation: Sprout traits are recorded at 30 days after withdrawal from cold storage. The canopy, leaf and stem trait are taken at fifty days after planting while floral traits are recorded when 50% of flowers open. This stage coincides with 65 days after planting. The maturity of the crop is taken at 90 days after planting and tuber parameters are recorded 115 days after planting.

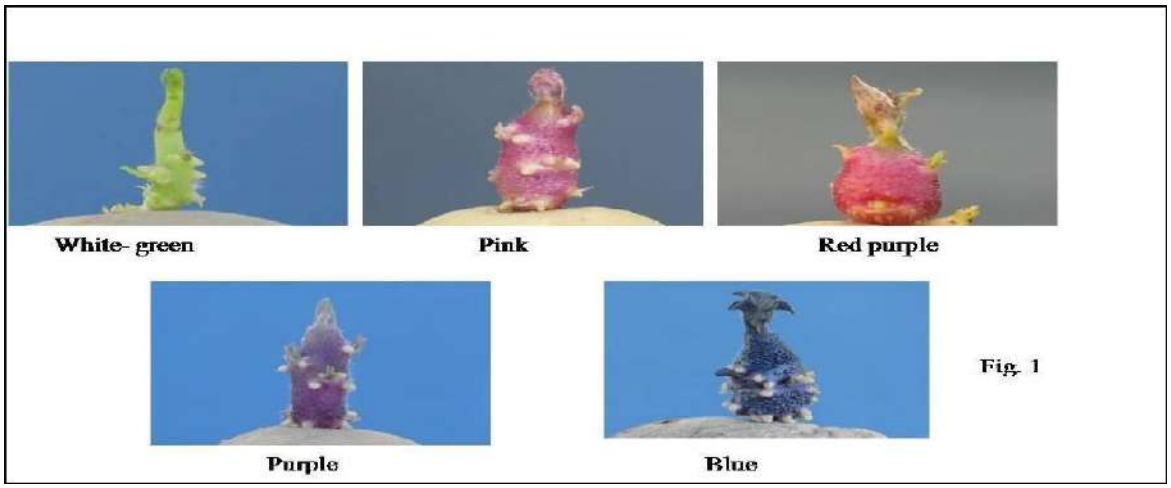

Fig. 1

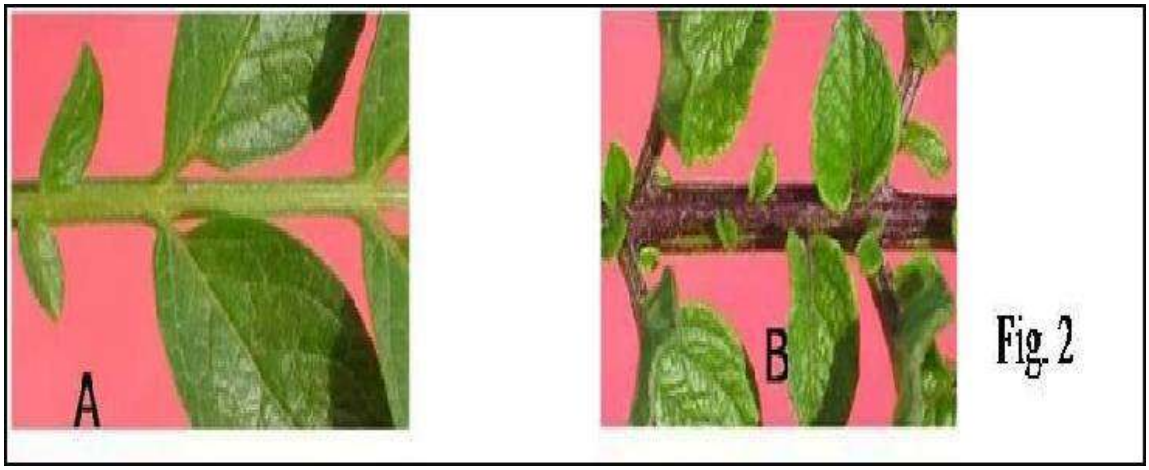

Fig. 2

CONCLUSION

At present the DUS testing is based on phenotypic assessments that are expensive, time consuming and may be often influenced by environmental factors. The efficacy of morphological testing of plant variety registration and protection could be enhanced by

integration of molecular markers based testing. Use of trait specific markers in DUS testing is required for better characterisation of candidate variety as well as the reference collection.

REFERENCES

Guidelines for the conduct of test for Distinctiveness, Uniformity and Stability on Potato (Solanum tuberosum L.) November (2009). Pg. 33.

Farmers' rights under Protection of Plant Varieties & Farmers' Rights Act, 2001 Brochure

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Provisions of Plant Varieties and Farmers' Rights Act. 2001 Brochure Oct 2016.

w ww.plantauthority.gov.in

Mycotoxins and Mycotoxicoses

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ABSTRACT

Mycotoxins are secondary metabolites produced by fungi/ moulds that are capable of causing disease and death in animals and humans.There are thousands of fungal species but relatively few of these grow under favourableconditions on agricultural products and only a fraction produce mycotoxins causing naturally occurring disease.Mycotoxicosis occurs after consumption of mycotoxin contaminated grain or its products.The most important mycotoxinscausing disease in animals and poultry are aflatoxins, ochratoxins, citrinin, ergot alkaloids, zearalenone, deoxynivalenol, fumonisins and T-2 toxin.The detection of mycotoxinsas etiological agents for veterinary or human health is not easy. It is well reported that few mycotoxins with small quantity are sufficient to kill the entire human and animal population. Mycotoxins attract worldwide attention due to its deleterious effect on animal and health. It also produces agricultural losses by damaging the grain products as the climate change also have the impact on mycotoxicosis by altering the environment for mould growth.

Key words: Fungi**,** mycotoxins, mycotoxicosis, livestock, agricultural loss

INTRODUCTION

Mycotoxins are toxic secondary metabolites of fungi/ moulds that are structurally diverse and common contaminants of animal feed. The toxic effect of mycotoxins on animal and human health is referred to as mycotoxicosis. The severity depends on the toxicity of mycotoxin, the extent of exposure, age and nutritional status of the animal and possible synergistic effects of other chemicals to which the individual is exposed. Fungal poisons have been known for many years, but they were not considered a major factor in animal disease until recently. There are thousands of fungal species but relatively few of these grow on agricultural products and only a fraction *i.e* approximately twenty are capable of producing mycotoxins causing mycotoxicoses. They grow under favourable conditions that require 10-33% moisture, 90-95% relative humidity and 24-25°Cambient temperature. The fungi that produce mycotoxins in feed fall broadly into two groups: those that invade before harvest, commonly called field

fungi, and those that occur only after harvest, called storage fungi. A great portion of the mycotoxin problem is associated with stored grains and other concentrate rations, especially high-moisture corn, silage, cottonseed, peanuts and, to some extent, soybeans. The mycotoxins are especially important in intensively raised animals in confinement such as feedlot cattle, dairy cattle, market swine and poultry due to involvement of stored feeds and their heat stability during processing of feed. Unlike bacterial toxins, fungal toxins are not proteins therefore they are non-antigenic, so immunity is not developed against them. The following are some of the important mycotoxins causing some naturally occurring diseases:

1. Aflatoxicosis

In 1960's Turkey X disease killed large number of poultry birds in London. Thecasautive agent was zeroed down to a mycotoxinnamely aflatoxinpresent in groundnut meal feed. Aflatoxins are produced by toxigenic strains of *Aspergillusflavus*and *Aparasiticus*on peanuts, soybeans, corn (maize), and other cereals either in the field or during storage when moisture content and temperatures are sufficiently high for mould growth. Aflatoxicosis affects growing poultry (especially ducklings and turkey poults), young pigs, pregnant sows, calves, and dogs. Adult cattle, sheep, and goats are relatively resistant to the acute form of the disease but are susceptible if toxic diets are fed over long periods. Aflatoxinsact ashepatocarcinogens in both animals and humans.In acute outbreaks, deaths occur after a short period of inappetence. Subacute outbreaks are more usual, and unthriftiness, weakness, anorexia, and sudden deaths can occur. Generally, aflatoxin concentrations in feed are greater than 1,000 ppb are associated with acute aflatoxicosis.

2. OCHRATOXINS

Ochratoxins and citrinin are produced by several species of genera *Aspergillus*and *Penicillium*. The two most common species that produce ochratoxin A (OTA) are *Aspergillusochraceus*and *Penicilliumverrucosum*. *Aspergillus* spp. appears to produce ochratoxins at conditions of high humidity and temperature, whereas some *Penicillium*spp. may produce ochratoxins at temperatures as low as 5 °C. OTA has been found in a variety of food/feed. Unlike OTA, the occurrence of ochratoxin B is rare. Ochratoxin B lacks chlorine and thereby it is less toxic than OTA. OTA occurs naturally with a greater frequency in a variety of cereal grains, peanuts, dried fruits, grapes/raisins, cheese, and other food products. OTA accumulates in the food chain because of its long half-life. Citrinin usually co-occurs with OTA and both are well-known nephrotoxins. OTA is also carcinogenic to rodents and possesses teratogenic, immunotoxic, neurotoxic, mutagenic, and genotoxic properties. Concurrence with OTA of citrinin has been implicated in nephropathy of pigs.

3. ERGOTISM

This worldwide disease of farm animals results from continued ingestion of sclerotia of the parasitic fungus *Clavicepspurpurea*. The hard, black, elongated sclerotia may contain varying quantities of ergot alkaloids, of which ergotamine and ergonovine

(ergometrine) are pharmacologically most important. Cattle, pigs, sheep, and poultry are involved in sporadic outbreaks, and most species are susceptible.Ergot causes vasoconstriction by direct action on the muscles of the arterioles, and repeated dosages injure the vascular endothelium. This may result in reduced blood flow andeventually lead to complete stasis with terminal necrosis of the extremities due to thrombosis. A cold environment predisposes the extremities to gangrene. In addition, ergot has a potent oxytocic action and also causes stimulation of the CNS, followed by depression. Ergot alkaloids inhibit pituitary release of prolactin in many mammalian species, with failure of both mammary development in late gestation and delayed initiation of milk secretion, resulting in agalactia at parturition.

4. ZEARALENOSIS

*Fusarium*spp molds are extremely common and often contaminate growing plants and stored feeds. Maize, wheat, and barley are commonly contaminated. Under humid weather conditions, *F graminearum*may produce zearalenone, the only known mycotoxin with primarily estrogenic effects. Often, zearalenone is produced concurrently with deoxynivalenol. Estrogenism due to zearalenone was first clinically recognized as vulvovaginitis in prepubertal gilts fed moldy corn maize but zearalenone causes sporadic outbreaks in dairy cattle, sheep, chickens, and turkeys. High dietary concentrations are required to produce disease in cattle and sheep, and extremely high dosages are required to affect poultry.

5. FITOMYCOTOXICOSIS

In this mycotoxic disease of grazing livestock, the toxic liver injury commonly results in photodynamic dermatitis. In sheep, the face is the only site of the body that is readily exposed to ultraviolet light, hence the common name. Sporidesmins are secondary metabolites of the saprophytic fungus *Pithomyceschartarum*, which grows on dead pasture litter. The sporidesmins are excreted via the biliary system, in which they produce severe cholangitis and pericholangitis as a result of tissue necrosis. Biliary obstruction may be seen, which restricts excretion of bile pigments and results in jaundice. Similarly, failure to excrete phylloerythrin in bile leads to photosensitization.

6. FUMONISINSTOXICOSIS

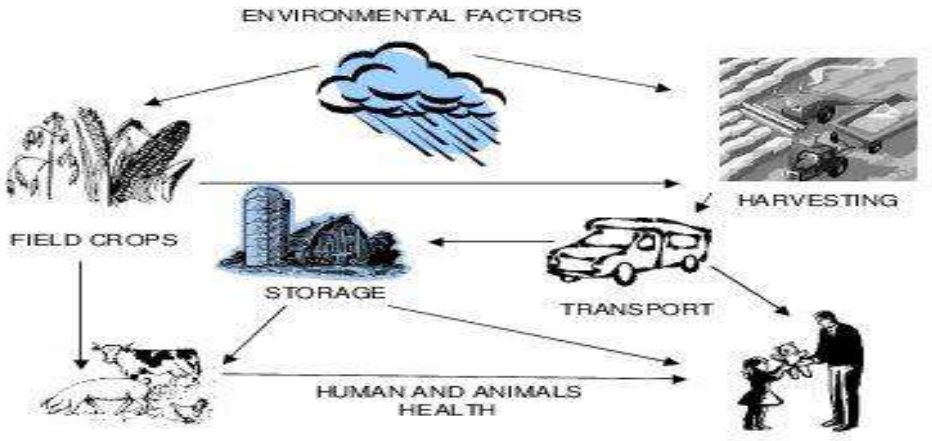
Equine leukoencephalomalacia is a mycotoxic disease of the CNS that affects horses, mules, and donkeys. It is associated with the feeding of moldy corn usually over a period of several weeks. Fumonisins are produced worldwide primarily by *Fusariummoniliforme.* Conditions favoring fumonisin production appear to include a period of drought during the growing season with subsequent cool, moist conditions during pollination and kernel formation. Three toxins produced by the fungi have been classified as fumonisin B1 (FB1), B2 (FB2), and B3 (FB3). Current evidence suggests that FB1 and FB2 are of similar toxicity, whereasFB3 is relatively nontoxic. Major health effects are observed in Equidae and swine causing leukoencephalomalacia and porcine pulmonary edema (PPE) respectively. Acute PPE results after consumption of fumonisins for 3 to 6 days at dietary concentrations greater than 100 ppm.

7. TRICHOTECENOSES

The trichothecenemycotoxins are a group of closely related secondary metabolic products of several families of imperfect, saprophytic, or plant pathogenic fungi such as *Fusarium, Trichothecium, Myrothecium, Cephalosporium, Stachybotrys, Trichodesma, Cylindrocarpon and Verticimonosporium* spp. On the basis of molecular structure, the trichothecenes are classed as nonmacrocyclic (eg, deoxynivalenol [DON] or vomitoxin, T-2 toxin, diacetoxyscirpenol, and others) or macrocyclic (satratoxin, roridin, verrucarin. Trichothecenes are potent immunosuppressive agents that directly affect immune cells and also modify immune responses as a consequence of tissue damage elsewhere. Hemorrhagic diathesis may occur after thrombocytopenia or defective intrinsic or extrinsic coagulation pathways. It appears that hemorrhage results from depression of clotting factors, thrombocytopenia, inhibition of platelet function, or possibly a combination of these. A condition in chickens, referred to as "rickets in broilers," is also thought to be caused by trichothecenes.

CONCLUSION

Fungi cause human illness in different ways. Mycoses are the best-known diseases of fungal etiology, but toxic secondary metabolites produced by saprophytic species are also an important health hazard. Moreover, even when mycotoxins are detected, it is not easy to show that they are the etiological agents in a given veterinary or human health problem. They are important as it causes adverse effect on animal health. Similarly, they produces economic losses of farmers due to spoiling the grains at various point from production to storage. Their heat stability makes them ungradable during the food processing,so in order to avoid this menace, addition of toxin binders is necessary which further increases feed cost. Appropriate feed grains storage is the best preventive measure to avoid the growth of mould. There is no alternate treatment for mycotoxicosis which increase the gravity and severity of disease. Mycotoxins continue to attract worldwide attention because of their impacts on human and animal health, agricultural losses, and the potential effects of climate change.



Food Chain - Mycotoxicos

Artificial Groundwater Recharge Techniques to augment subsurface water

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ABSTRACT

Groundwater has a significant part in meeting the water needs of various sectors, including agriculture. In recent times, due to the occurrence of frequent droughts and increased demand for water among different water user sectors, groundwater tables have been lowering drastically. The cost of pumping has increased due to increased drawdowns, and also water security has become a threat. Population explosion, urbanization, over pumping, and deforestation are a few of the many causes that have been prime increasing this issue. So, this article focuses and discusses various artificial groundwater recharge (AG_wR) techniques to enhance groundwater availability, which is widely accepted and practiced.

Keywords: Groundwater, Water table, Artificial groundwater recharge, Aquifer.

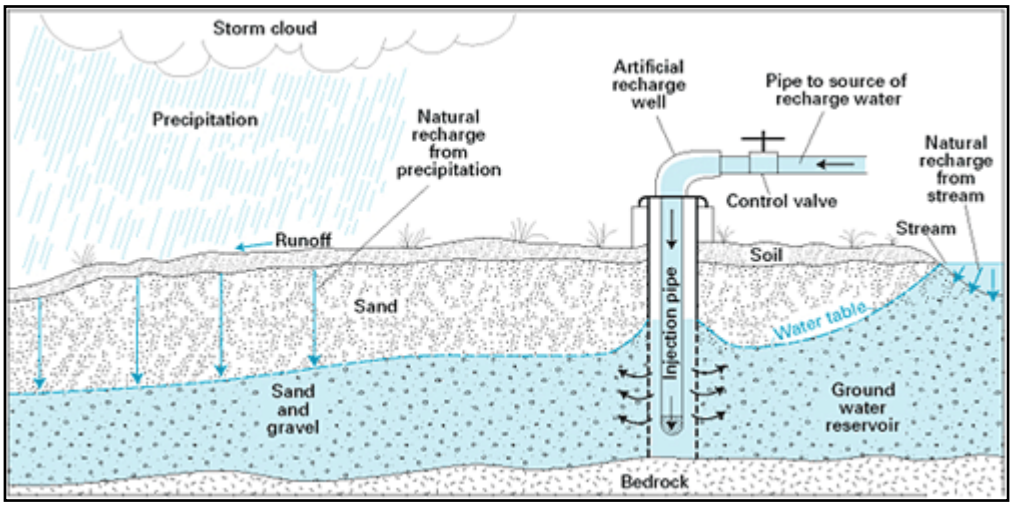
INTRODUCTION:

It is estimated that 11% of the water resources are accessible as open groundwater exists in 800 m profundities, and roughly 1 percent is available as surface water in lakes and streams. Out of the 113,000 BCM of rain and snow got on the earth, evaporation losses represent around 72,000 BCM, leaving an equalization of approximately 41,000 BCM, out of which around 9000-14000 BCM is viewed as utilizable (CGWB 2007). AG_wR is an arranged, structured, and human-made method to augment groundwater aquifers. By bettering its characteristic recharging limits and percolation from surface waters into aquifers, the measure of groundwater accessible for storing is enhanced. This is especially valuable in zones where water and groundwater aquifers are intensely used. Intensive issues with dropping watersheds, soil salinization, saltwater intrusion in coastal regions, or water shortage exist. Subsurface groundwater recharge alludes to the distinctive recharge procedures (by and massive injection or recharge wells) that

discharge treated effluent and additionally gathered stormwater underground and straightforwardly renew groundwater aquifers (without soil percolation). Groundwater recharge is expanding in ubiquity as groundwater resources are being exhausted, and saltwater intrusion is turning into a more noteworthy danger to coastal communities (Tilley et al. 2008).

Artificial recharge (AR) can be possible utilizing any excess surface water. At the point when low-quality water is being used for recharge, the underground formations act as natural filters to expel numerous physical, organic, and concoction toxins from the water as it travels through. Frequently, the quality improvement of water is the fundamental goal of recharge. The system is worked explicitly utilizing the soil and the Aquifer to give additional treatment to the source water. Systems used along these lines are called soil-aquifer treatment (SAT), or geo-purification, systems.

Usual groundwater recharge happens as precipitation falls on the land surface, penetrates soils, and travels through pore spaces down to the water table. Usual recharge additionally can happen as surface-water spillage from waterways, streams, lakes, and wetlands.



Artificial recharge can be possible through the infusion of water through wells. This technique frequently is applied to recharge deep aquifers where the uses of water to the land surface are not powerful at recharging these aquifers.

Why need of AG_wR:

1. To conserve and remove spillover and floodwaters.
2. Supplement to the amount of groundwater accessible.
3. To arrest a decrease in the water level of groundwater repositories.
4. Shrink or balance saltwater intrusion.
5. Store water to lessen the expenses of irrigation systems.
6. Store water in the wet season of the year for use during the crop seasons.
7. Conserve energy in geothermal use.
8. Remove suspended solids by filtration through the ground.

For a recharge project to be successful, field conditions must provide for appropriate storage, movement, and use of recharge water. Following listed physical requirements for recharging:

1. Geology: The basin must be appropriate from the outlook of capacity limit and transmissibility of aquifers.
2. Water: Sufficient recharge water must be accessible.
3. Infiltration: recharge rates must be kept up at satisfactory levels.
4. Drainage: Where a water table is close to the ground surface, adequate capacity limit in the basin for recharging must be given.
5. Water quality: Recharge water must be chemically appropriate with existing groundwater and have a reasonable temperature.
6. Recovery proficiency: Pumping lifts must not be unnecessary, introduced pumping limits must be effectively utilized, and the quality of water recouped must be acceptable.

AR TECHNIQUES

AR is ending up being perhaps the best technique to conserve the groundwater. There are different techniques for this purpose. The AR techniques can be comprehensively classified as follows: -

a. Direct surface methods • Basins or percolation tanks • Stream augmentation • Flooding • Ditch and furrow framework • Over irrigation.

b. Direct subsurface methods • Injection wells or recharge wells • Recharge pits and shafts • Dug well • Borehole flooding • Natural openings, cavity fillings.

c. Combination surface – sub-surface techniques • Basin or percolation tanks with pit shaft or wells.

d. Indirect Techniques • Induced recharge from the surface water source. • Aquifer modification

Leaving the above methods, groundwater conservation can be done by structures like groundwater dams, sub-surface dykes or privately named Bandharas, which are very predominant to capture sub-surface streams. Similarly, in hard rock regions, rock cracking methods, including sectional blasting of boreholes with reasonable strategies, have been applied to interlink the fractures and increment recharge. Senthilkumar et al. 2019 led an experiment in the Amaravathi aquifer system, southern India, utilizing remote sensing and geographic information system (GIS) technique to recognize favorable areas for the development of artificial groundwater recharge.

Concrete sealing of fractures, through uniquely developed bore well, has been used in Maharashtra to save groundwater flow and increase bore well yield. Additionally, recharge through coordinated water resource advancement:

In 2000, the International Water Management Institute (IWMI) completed an experiment (Chawla, 2000) on the Lakhaoti branch canal of Madhya Ganga Canal Project (MGCP) to evaluate the effect of the diversion of surplus Ganga water, during Kharif season, on groundwater levels and patterns of cropping. As

indicated by the investigation, the canal project has assisted with raising the water table from 6.6 m to 12.0 m and cut down the irrigation water pumping cost from Rs 4500/ha to 2700/ha. (Sakthivadivel R. 2007).

AR advantages:

1. The utilization of aquifers for storage and conveyance of water and evacuation of contaminants by a normal cleaning process that happens as polluted /contaminated rain and surface-water enter the soil and percolate below through the different geographical formations.
2. The technique is fitting and, for the most part, surely understood by both the technologists and everyone.
3. Not very many exceptional tools and equipment are expected to dug wells.
4. During the rainy season, water is store by groundwater recharge, and this water use in the dry season.
5. Recharge can altogether expand the sustainable yield of an aquifer.
6. Recharge strategies are ecologically alluring, especially in arid areas.
7. Most aquifer recharge techniques are easy to operate and maintain
8. In numerous stream basins, control of surface-water run-off to give aquifer recharge lessens sedimentation issues.
9. Recharge with low-saline surface waters or a treated effluent betters the quality of saline aquifers, encouraging the utilization of the water for agriculture.

MAINTENANCE OF ARTIFICIAL RECHARGE STRUCTURES:

Intermittent upkeep of artificial recharge structures is fundamental since infiltration capacity lessens quickly because of silting, chemical precipitation, and aggregation of organic matter. If there should arise an occurrence of surface spreading structures, yearly upkeep comprises of scratching the infiltration surfaces to expel accumulated silt and organic matter. On account of infusion wells, occasional support of the system contains pumping and flushing with a somewhat acidic solution to dismiss encrusting chemical precipitates and bacterial developments on the well screens.

CONCLUSION

Several groundwater recharge techniques have been discussed here. Sustainable use of groundwater resources is necessary to eliminate a disastrous impact on the water balance of an ecosystem. Groundwater withdrawals should not exceed the groundwater recharge in a year for a given location. The implication of this article could help in deciding the type of artificial groundwater recharge technique to be adopted at a specific site by considering all the factors which affect the groundwater recharge rate and applicability of a particular technique.

REFERENCES:

CGWB (2007). Manual on artificial recharge of groundwater. Government of India.

Chawla, A.S. (2000). Groundwater recharge studies in Madhya Ganga Canal Project. Consultancy report to IWMI, Colombo, Sri Lanka.

Sakthivadivel R., (2007). The groundwater recharge in India.

Senthilkumar, M., Gnanasundar, D., and Arumugam, R. (2019). Identifying groundwater recharge zones using remote sensing & GIS techniques in the Amaravathi aquifer system, Tamil Nadu, South India. *Sustainable Environment Research,* **29:**15.

Tilley, E. Luethi, C. Morel, A. Zurbruegg, C. Schertenleib, R., (2008). Compendium of Sanitation Systems and Technologies. Duebendorf, Switzerland: Swiss Federal Institute of Aquatic Science and Technology (EAWAG) and Water Supply and Sanitation Collaborative Council (WSSCC).

Causes responsible for abortion in dairy cattle and its management

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Abstract

Abortion in dairy cattle cost to the dairy farmers in terms of loss of newborn, reduced milk yield, uterine infection, andexpenditure on medicines.Abortion due to infectious agents may make the animal infertile permanently. Abortion in dairy cattle caused by infectious and non-infectious agents. Infectious causes of abortion include bacteria, viruses, fungus, and parasites. And, non-infectious causes of abortion include nutritional deficiency, feeding on toxic chemicals and plants, environmental stress, and genetic abnormality in the fetus. Abortion, as such, is not a disease, but more or less a symptom.Good management practicescan help the dairy farmer to prevent and control abortion in dairy cattle.

Keywords: Abortion, Dairy cattle, Infectious agents, Non-infectious agents

INTRODUCTION

In dairy cattle, abortion is commonly defined as a loss of the fetus between the age of 45 days and approximately 270 days. Pregnancies lost before 45 days are usually referred to as early embryonic deaths, whereas a calf that is born dead between 270 days and full-term is defined as a stillbirth (Dinka, 2013). Abortions between 3-5% abortions per year are considered normal, whereas abortion more than 10% is considered as abortion storm. Brucellosis is considered as one of the leading causes of abortion in dairy cattle (Barkallah et al., 2014). Brucellosis is a zoonotic disease, so it is of public health important disease. Abortion in cattle is caused by various infectious and non-infectious agents. Abortions cause significant loss to dairy farmers which include loss of replacement calves, decreased milk production, costs of veterinary aid, feeding of unproductive animals, and infertility.Except in a few cases, it is very difficult to find out the exact cause of abortion because multiple factors are responsible for abortion. Diagnosis of abortion depends upon the collection of the accurate and complete history of animal(like their age, feeding, previous history of abortion, history of animals which are in contact with the aborted animal, and any history of vaccination and treatment given to pregnant animal) and properly collected sample (uterine discharge and blood

sample). Previous available epidemiological data on the incidences of abortion of a particular area may also help to figure outthe causative agent of abortion.Laboratory diagnosis playsa very important role in the diagnosis of an abortion caused by infectious agents. Bovine abortion can also be diagnosed on the basis and collected a sample for analysis.

CAUSES OF ABORTION IN DAIRY CATTLE

Many causes are responsible for abortion in dairy cattle which are classified into two groups; the first group consists of the infectious causes and the second group consists of the non-infectious causes (Hafez and Hafez, 2013).Infectious and non-infectious causes are discussed below under separate heads.

a. Infectious agents causing abortions

Infectious agents that cause abortion in dairy cattle include bacteria, viruses, fungi, and parasites. Some of these are described in detail below-

Bacteria

The bacteria that are responsible for abortion in cattle include *Brucella abortus*, *Leptospirainterrogans*serovarHardjo, *Salmonella enterica*serovarDublin, *Campylobacter foetus* subsp. *venerealis*, *Listeria monocytogenes, Chlamydophilaabortus,*and *Actinomyces pyogenes*. In addition to above bacteria, *Bacillus*spp*., Streptococcus* spp**.,***Haemophilussomnus*, *Coxiellaburnetii*,*Mycoplasma* spp., *Staphylococcus* spp*., Streptococcus* spp. and *E. coli*have also been reported to cause abortion in dairy cattle.

Viruses

Viruses involved in abortion are *Bovine viral diarrhea virus*, *Bovine herpesvirus 1*, *Bovine herpesvirus 4* (BoHV4), *Bluetongue virus*, *Akabane virus,*and more recently the *Schmallenberg virus*.

Fungus

Among the fungi, *Aspergillus fumigatus* is identified as the major cause of mycotic abortion in cattle over 60% of the cases. Other fungi like*Mucor* sp., *Absidia* sp., *Rhizopus* sp., and a few other non-septated fungi are also involved in abortion in cattle.

Parasites

Parasites that are most commonly involved in cattle abortion are *Neosporacaninum* and *Tritrichomonasfoetus*.

b. Non-infectious agents causing abortions

Non-infectious agents that causeabortion in dairy cattle are nutritional deficiency, toxicity, drugs, physical,hormonal, environmental stress, and genetic disorders. These are described below-

Nutritional deficiency

Deficiencies of vitamin A, D, and Ealong with deficiency of selenium may result in abortion and other problems related to reproduction.Iodine toxicity can result in abortions. Copper deficiency is associated with a high incidence of early embryonic or

prenatal mortality. Molybdenum and sulfur may and decrease the availability of copper by forming a complex with copper (Morrow, 1970).

Toxicity

Toxicity due chemical like fertilizer nitrites and nitrates or the nitrates found in plants under certain conditions (e.g. drought-stress) may cause abortions or early embryonic deaths. Plants like perennial broom weeds, pine needles, etc. can cause abortions.Some cases of abortion due to aflatoxin and ergot alkaloidshave been reported due to feeding of a pregnant animal with fungus contaminated feed.

Drugs

Administration of vaccinein the animal cause fever that can induce abortion.Precautions should be taken while administrating themedicinesto pregnant animals because of some medicines areabortifacient.

Physical

The physical causes of abortion include douching (cleaning of the uterus with antiseptic substances) and insemination of the pregnant uterus. The gestational heat and failure to diagnose the pregnancy are the main culprits for this.

Table 1.Infection agents causing abortions in dairy cattle.

S.N.	Infectious agent		Time of abortion	Transmission	Remark
1.	Bacteria	*Brucella abortus*	Last trimester	Ingestion	Zoonotic
		Listeria monocytogenes	At any stage	Contaminated feed	Zoonotic
		Leptospirainterrogans serovarHardjo	Last trimester	Cutaneous and mucosal abrasion	Zoonotic
		Chlamydophilaabortus	Near the end of the last trimester	Inhalation, ingestion, direct inoculation into the eye and venereal	Zoonotic
		Trueperella pyogenes	At any stage	Mucosal membrane	-
		*Salmonella enterica*serovar Dublin	At any stage	Ingestion	Zoonotic
		Campylobacter foetus subsp. *venerealis*	3-4 months	Venereal	Zoonotic
2.	Virus	*Bovine viral diarrhea virus*	Upto 4 months	Horizontal and vertical	-

		Bovine herpesvirus 1	4 months to end of term months	Aerosol	-
		Blu tongue virus	Variable	Biting midges (*Culicoides*spp.)	-
3.	Fungus	*Aspergillus fumigatus*	4 months to end of term months	Inhalation	Infect only Immunocompromised humans
		*Mucor*sp.			
		Absidia sp.			
		*Rhizopus*sp.			
4.	Parasite	*Neosporacaninum*	First trimester	Transplacental	-
		Tritrichomonasfoetus	3-8 months	Venereal	Zoonotic

Hormonal

Hormones like a high dose of estrogen, corticosteroid, and $PG_{2\alpha}$ can induce abortion in the pregnant animal.

Environmental stress

Environmental stresses like high temperature, transportation, noise, anxiety, and trauma can cause abortion. Embryonic mortality increases in several species following exposure of the mother to elevated ambient temperatures, especially in tropical areas.

Genetics disorders

Genetic disorders that are responsible for fetal anomalies may cause abortion.

MANAGEMENT OF ABORTION IN DAIRY CATTLE

Once the process of abortion started in an animal, it cannot be reverted. There is no treatment available to treat abortion, but it can be prevented and controlled by adoptinggood management practices before and during the gestation period. The good management practices include-

- Proper nutritional supplements (vitamins and minerals) must be given before and during the gestation period.Vitamin A supplementation for dairy cows is 30,000-50,000 IU daily.Oversupplementation of vitamin A may impair the metabolism of Beta-carotene and should be avoided. Vitamin D supplementation is recommended at 1000 to 1200 IU per kg of dry matter intake daily. In iodine-deficient areas, 0.01 percent potassium iodide in the salt is recommended to meet the minimum requirements for animals. The dietary iodine intake for high producing cows should be limited to 50 mg daily. Copper in the ration should be 10 ppm oftotal dry matter intake in high producing dairy cows. Diets should contain 0.1 to 0.2 ppm of ration dry matter of selenium daily (Morrow, 1970).
- If abortion is caused by an infectious agent, then first segregate the infected animal from healthy animals. Samples like uterine discharge and blood should be collected

properly and send to the laboratory for the identification of the infectious agent. Infected animals should be treated with appropriate chemotherapeutic agents. Abortion due to an infectious agent,if not properly handled, may lead to repeat breeding or infertility.

- Pregnant animals should be kept in the environment free from any stress like high environmental temperature, transportation, trauma, anxiety, andrash handling.
- Avoid vaccination and administration of hormones like estrogen and PG2α to pregnant animals.
- The sick pregnant animals must be treated cautiously because some medicines can cause abortion.
- Vaccination of female calf between 4-8 months of age against *Brucella abortus*using Brucella S-19 live vaccine (calf hood vaccination).
- The strict biosecurity measures should be followed by the dairy farmers to prevent the entry of infectious agents of abortion in the herd.

CONCLUSION

Abortion in dairy cattle causes significant economic loss to the dairy farmers. The loss due to abortion in an individual animal and herd can be controlled by following strict preventive and control measures as discussed above.Most of theinfectious agents that cause abortion in the animals, can also infect humans (zoonosis). So, dairy farmers should take proper care while handling the aborted fetus and should take the help of a veterinary doctor or veterinary assistant.

REFERENCES

Barkallah, M., Gharbi, Y., Hassena, A.B., Slima, A.B., Mallek, Z., Gautier, M., Greub, G., Gdoura, R. and Fendri, I., 2014.Survey of infectious etiologies of bovine abortion during mid-to late gestation in dairy herds.*PLoS One*, *9*(3).

Dinka, H., 2013. Major reproductive disorders of dairy cows in and around Asella town, Central Ethiopia.*Journal of Veterinary Medicine and Animal Health*, *5*(4), pp.113-117.

Hafez, E.S.E. and Hafez, B. eds., 2013.*Reproduction in farm animals*.John Wiley & Sons.

Morrow, D.A., 1970.Diagnosis and prevention of infertility in cattle.*Journal of dairy science*, *53*(7), pp.961-969.

Robotics and Autonomous Systems in Agriculture

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ABSTRACT

Robotics and autonomous systems are transforming every industrial and non-industrial sector of economy. Increasing the agricultural production and productivity is of top priority all over the world, owing to the growth in population, urbanization, environmental disasters and disease pandemic such as the recent COVID 19. Precision agriculture involves acquisition and processing of huge data related to crop cultivation. Soil parameters, plant physiological parameters such as chlorophyll content, water potential, stomata conductance, weather parameters like temperature, relative humidity, air at the field and crop micro-environment are included. Analysis of such data derived from deployment of sensors and drones help in decision making in crop selection, pest and disease management, nutrient management and precise irrigation based on requirements in specific crop growth stage. Automation ensures optimized resource utilization in agriculture, livestock management and poultry. Future of sustainable and commercially successful agriculture and allied sector greatly depends on effective and extensive exploration of robotics and autonomous systems. Future prospects and need for automation in small farms are also discussed.

Keywords: Agriculture; Automation;Internet of Things; Precision farming; Robotics

INTRODUCTION

Our food production has to increase another 60% by 2050 to meet the demands. This is possible from efficiency-improving technologies in agriculture. Internet of Things (IoT) based precision agriculture and automation using robotic systems are such technologies. High resolution imaging of crops are obtained from air-borne drones which are used to gather information for decision making in soil use pattern, reclamation procedures for problem soils, cropping system, pest and disease management, monitoring of physiological disorders and various abiotic stress conditions that impact crops. Non-availability of agricultural field workers has been

recognized and experienced as a greater challenge in the past two decades in India. Large mechanization is not affordable in many of the agricultural farms due to reasons like involvement of huge investments and the fragmented field holdings. Robotic automation and precision agriculture can ensure optimized usage of resources, solve the limitations in labour availability, and also provide employment to large number of skilled and educated youth. Since the sensors, robots, drones are being improved to fit the agriculture specific needs, multiple small robots are expected to revolutionize the future of agriculture.

AUTOMATION IN SOIL AND CROP MANAGEMENT

Soil compaction caused by the usage of heavy weight machineries has been a concern in agricultural fields. Compaction of soil causes water logging, surface loss of irrigated water, release of nitrous oxide, increased need for fertilizers, damage to the soil microbiome and other beneficial organisms. Light weighted robots in other hand are better supplements to large machines. Usage of field robots for agricultural operations has every benefit of bringing back the soil physical, chemical and biological function. Field robots are already in use in many countries and commercial farms to perform optimization of irrigation water, application of fertilizers, herbicides and pesticides, and harvesting of agricultural produce. Crop weeding robots use aerial sprayers, lasers and camera guided weeding equipment to control the weeds. Robots are also being designed to operate in orchards to pull the deep rooted weeds. Advanced robots are developed that can measure the soil quality using various sensors and modules and the different parameters like soil pH, moisture availability, compactness, soil color, texture, structure and water holding capacity are monitored in a dynamic way.

Sensor driven artificial intelligence is useful in evaluating agricultural fields for suitability to crop cultivation (Vincent et al., 2019). Wireless sensor networks have led to the design of cost effective miniature sensors with the IoT empowerment as a promising system for automation for decision making in cropping patterns. For research purposes, small field robots have been designed with high-voltage electrode that can kill weeds through electrical discharges. Machine vision and location of weeds based on imaging are the key components of this robot-assisted weed control. BoniRob is a robot developed for multipurpose applications such as plant phenotyping, weed control and precision spraying (Zhang et al., 2016).

Robots and drones can help the farmers to identify the pest and diseases and apply pesticides to prevent them. The drones are provided with a camera, which is used to image the affected areas of the field and can eliminate those pests at the early stage itself. The advantage of using robots is that, only the affected part of the plant alone is removed precisely and the healthy part remains safe. In case of manual work by humans, the whole plant or the healthy parts may also be lost. Thus immediately eliminating the affected plants will save the other plants and also the neighbouring field.Harvesting is one of the labour intensive works and it involves many stages. A crop in the same field matures at different times. Humans can identify those matured fruits and vegetables alone and harvest easily. But the robots cannot differentiate the matured

one from the other. However, advanced robots are provided with a color camera that can image the fruits and vegetables and they can precisely identify the matured produce to perform selective harvesting.

PRECISION FARMING

Precision agriculture deals with precise soil-water-crop management at the sub-field scale compared to the whole field scale practices followed in conventional agriculture. Precision agriculture comprises usage of IoT sensors for remote sensing which help to monitor the crop status at different and critical stages of growth and at multiple levels (Shafi et al., 2019). The data generated and analyzed provide knowledge on which are the parameters that are optimal at a given crop growth stage and thus the farmers can precisely follow-up with required farm operations. For example, plant chlorophyll content data reveals the nutrient status of the plants. This information is integrated with the data obtained from soil nutrient monitoring and weather data. Comparative analysis of these data is further used to make decisions on amount and type of nutrients to apply. All these are done in real-time and thus agriculture is transforming from a static and manual state to a more dynamic and smart state.

Sensing technologies and automation are essential components of smart farming to address the spacio-temporal variability in agricultural fields. Data obtained by using sensors in soil for moisture and nutrient status, crops for monitoring physiological parameters, pest and disease surveillance and the crop imaging data provide wealth of information for smart farming. This can result in precise usage of inputs like water, fertilizers, pesticides etc thus improving the sustainability. IoT and big data analytics are helpful to analyze and integrate real-time data for interpretation and decision making in agronomic practices at right time needed for a given crop. For example, the moisture sensors provide information leading to application of irrigation water. Integrating the real-time dynamic weather data and predictions on evaporation and transpiration loss, would help to decide the actual quantity of water to be used for irrigation. Robotic platforms thus support the management and care for individual plants in a field based on water requirements precisely calculating the possible loss in field and the amount of water that can be available to individual plants.

ROBOTICS IN LIVESTOCK MANAGEMENT

Robotic systems are already in use in the livestock management including milking of animals and are slowly replacing the need for 'milking men'. It has been predicted that in another five years, 50% of the livestock animals in Europe will be milked by robots (UK-RAS White Papers, 2018). In automated milking system, part of the feed for the cows is provided during milking time and hence the animals are attracted towards milking system. However, it was found that the milking frequency and milk yield are dependent on many interesting factors such as farm layout, flooring, and traffic arrangement for the cows, health status and stage of lactation (Bach and Cabrera, 2017). On the other hand, automated milking system provides precise feeding based on nutrient needs of individual cows resulting in maximum productivity of the system.

Robots also find application in silage making, composting, waste management, animal health monitoring etc. Appropriate monitoring and collection of data have greater impact on improving the productive of the livestock farm. Individual animal specific health care assessment and medication are parts of precision livestock farming. Early indication of health condition of animals by using sensors for alerting the veterinarians is an important aspect of animal health care (Halachmi et al., 2019). Wearable devices like smart collars are provided for the cows that can track the activities of animals and detect the body temperature, fertility, milking capacity, rumination and also the early disease symptoms and immediate treatments can be given. Cameras are also provided with the device that can detect the external threats and diseases like bacterial infection and mastitis.

Poultry precision farming has received considerable attention worldwide but it is yet to be practiced in larger scale.Sensors and cameras are used to collect the health and physical data of broiler and layering birds. Cameras are placed even in poultries and pig farms that monitor the movements of birds and animals to spot any problems quickly. The behaviour of birds towards the heat lamp in the poultry can be used as an indicator of any discomfort. When the temperature is too hot, the birds will move away from the lamps, when it is too cold the birds will stay close near the lamp.

CONCLUSIONS

Many of the applications of robotics and sensors are in infant stage and there is still a long way to reach fully automated farming. In addition, perfect combination and level of automation are yet to be derived and practiced. Commercialization of robots for field application is slow due to safety concerns. Most of the agri-robots are developed to fit the larger industrial scale commercial farms or the vertical indoor farms. The small farms are left behind from realizing the benefits of automation. To some extent, automated irrigation systems are followed by larger farms and orchards. There are some critical ethical issues related to data control and access. Open systems approach is needed for everyone to benefit from the technologies. The next generation robotics need to be much smart, flexible, cost effective and consider usage of robotics in parallel with human resources. A close collaboration of robots and humans would help increase the productivity in agricultural farms. However, innovations and need based improvements made in sensors, data analytics, robotics and automated control systems are changing the way agricultural practices were carried out in the past and making sustainable and commercially viable agriculture a reality.

REFERENCES

Bach, A., Cabrera, V. (2017). Robotic milking: Feeding strategies and economic returns. Journal of Dairy Science, 100: 7720-7728.

Halachmi, I., Guarino, M., Bewley, J., Pastell, M. (2019). Smart animal agriculture: Application of real-time sensors to improve animal well-being and production. Annual Review of Animal Biosciences, 7: 403-425.

Shafi, U., Mumtaz, R., Garcia-Nieto, J., Hassan, S.A., Zaidi, S.A.R., Iqbal, N. (2019). Precision agriculture techniques and practices: From considerations to applications. Sensors (Basel), 19: 3796. Doi: 10.3390/s19173796.

Vincent, D.R., Deepa, N., Elayarasan, D., Srinivasan, K., Hussain, Chauhdary, S.H., Iwedi, C. (2019). Sensors driven AI-based agriculture recommendation model for assessing land suitability. Sensors (Basel), 19: 3667. Doi: 10.3390/s19173667.

Zhang, Q. (2016). In: Precision agriculture technology for crop farming. CRC Press, Florida, USA, pp. 133-176.

Hybrid Napier: A Prominent Fodder Crop

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India has recently emerged as largest producer of milk (187.7 million tonnes) in the world but livestock productivity is very low as compared to the developed countries. Malnutrition or under nutrition due to large gap in demand and supply of feed and fodder in the country is the main reason for the low productivity of our livestock.Fodder crop cultivation has remained almost neglected due to small and fragmented land. It consists mostly of marginal land with poor fertilityand dependency on grass lands which are too poorly managed. Therefore, it is necessary to evolve, standardize and demonstrate fodder production technologies that have potential to promotion of dairy farming as private or public enterprises has high possibility for high monetary returns from small and marginal farmers in a sustainable manner. Hybrid Napier grasscultivation has better option to overcome poor quality and insufficient availability of fodder in our country.

Hybrid Napier (*Pennisetumglaucum*x *Pennisetumpurpureum*)is a robust perennial grass belongs to *Poaceae*family.It is called as Elephant grass due to its tallness, vigorous vegetative growth and favorite food of elephants.It grows wellat high temperatures and canwithstand the drought conditions forfairly long spell.It provides nutritive and palatable fodder throughout the year. It's fodder contain 8-10% crude protein, 2.1% ether extract, 30.5% crude fibre, 41.0% nitrogen free extract, 16.2% ash, 0.37% phosphorus and 50-52% dry matter digestibility.

Origin & History: Napier is native of Rhodesia (South Africa). The name 'Napier grass' was given in honour of ColonelNapier who first drew theattention of Napier in the Departmentof Agriculture in 1909 to the fodder value of this grass in Rhodesia. It was introduced to India in 1912 from South Africa.

Botanical Description: It is an inter-specific hybrid between bajra and Napier grass.Plants are tall i.e. about 150-400 cm. Stem is erect and solid, lower portion of stem is smooth and

upper portion is hairy. Theleaves are large and green, the sheaths are softer and the margins less serrated and hence theherbage is palatable. It is juicer and succulent at all stages of growth. It is less fibrous andmore acceptable.Root system is fibrous and adventitious. The influences are erect, cylindrical, spike, light yellow in colour and about 15-25 cm long.

Area and Distribution: It is mainly grown in Asia, Africa, South Europe and America. In India, it is grown in Punjab, Haryana, Uttarakhand, Uttar Pradesh, Bihar, Madhya Pradesh, Orissa, Gujarat, West Bengal, Kerala, Tamil Nadu and Assam. Area in India is 0.1 M ha & Productivity is 70-100 t / ha.

Climatic requirements: It is grown throughout the year in thetropical and subtropical regions.The optimum temperature is about 31° C. Light showers alternated with bright sunshine are very congenial to the crop. Total water requirement of the hybrid Napier is 800-1000 mm. It is susceptible to frost and very cold condition. It can also with stand low temperature in subtropical regions.

Soil: Itgrows on light textured with sandy loam to loamy soils. The best yields can be obtained from well-drained fertile loamy soils. Sufficient moisture is required for growth of crop but cannot survive in water logged condition. It tolerates soil pH ranging from 5 to 8.

Field preparation: Well prepared weed free field is required for its cultivation because hybrid napier grass is vegetative propagated. One plough followed by 3-4 narrow and plank is sufficient to make soil pulverized.

Sowing time: In North India, hybrid Napier grass can be planted in February to March under irrigated conditions but under rainfedconditions, it is planted after the onset of monsoon i.e. June to August. In South India,hybrid Napier can be planted throughout the year.

Varieties: Some of the important varieties of hybrid Napier are given below:

SI.No.	Hybrids / Varieties	Area of suitability	Average green fodder Yield (t ha^{-1})
1.	Pusa Giant	First hybrid of Napier grass which was developed in 1953 from IARI. Suitable for entire country	150-160
2.	CO-1	Suitable for South zone of the country	280-300
3.	IGFRI-5	Suitable for cultivation in areas of sub-mountain and low hill sub-tropicalzone of H.P.	110-115
4.	IGFRI-3, IGFRI-6	Suitable for Central India, North-East and Northern hills	90-160
5	IGFRI-7	Suitable for hilly, sub-humid and sub-temperate areas of India	140-170
6	IGFRI-10	Suitable for whole country	150-180
7	Hybrid Napier-3 (Swetika)	Suitable for North and Centralzone of the country	70-80

8	Yashwant	Suitable for irrigatedareas of Maharashtra	140-150
9	PBN 233	Suitable for Punjab	350-375
10	APBN-1	Suitable for Andhra Pradesh, Karnataka, Tamil Nadu	200-250
11	CO-2	Suitable for South zone of the country	300-350
12	CO-3	Suitable for Central and South zone of the country	150-200

CROPPING SYSTEM/INTERCROPPING

In North India, it remain in dormant stage during winter seasons so, Berseem or Lucerne can be grown in winter season and in *summer* season, cowpea can be grown in between two rows of hybrid Napier (3 rows of cowpea in between two rows of hybrid napier).Important cropping systems for roundthe year fodderproduction are given below:

1. Hybrid napier + Berseem - Cowpea
2. Hybrid napier + Berseem
3. Hybrid napier + Lucerne
4. Hybrid napier + Velvet bean - Berseem + Mustard
5. Hybrid napier + Cowpea - Lucerne

Intercropping of annual legume with hybrid Napier grass has following advantages:

(i) We get more nutritive fodder yield
(ii) Checks weed growth
(iii) Improves soil fertility
(iv) Increases water holding capacity of soil
(v) 15 kg N / ha / cut can be saved

In Southern India, it grows very well throughout the year.

Methods of propagation: Hybrid Napier is established using stem cuttings, root splits or whole cane.

1. **Stem cuttings:** Stem consisting of three to four nodes obtained from mature stems. The stems should have grown over two meters high. Farmers should preferably use the middle part of the stem. Care should be taken not to damage the buds during handling.
2. **Root splits:** Splits are uprooted parts of a hybrid Napier plant after the leaves/stems have been cut back to 10 – 15 cm. Care should be taken not to damage the roots. Each split should have some roots and soils. Root splits establish faster. Splits preferably used to gap filling in field of hybrid Napier.
3. **Whole cane:** Involves utilization of an entire stem as the planting material. The stem/cane is laid end to end in shallow furrows and covered with soil. Care should be taken to ensure that the stems have active buds (buds that can grow).

Spacing: For pure crop of hybrid Napier grass row to row and plant to plant spacing should be 50 x 50 cm. When intercropping is followed then row to row and plant to plant spacing should be 90-100 cm x 50cm.

Seed rate:40000 and 20000 root slips/stem cuttings/hais required for sole and intercropping stands.

Manure & Fertilizer: Hybrid Napier requires well decomposed FYM @ 20-25 t ha^{-1}which should be applied 10-15 days before sowing at last harrowing. At the time of planting, a basal dose of 60 kg N, 50 kg $P_2O_5$and 40 kg K_2O per ha should be applied. 30 kg N ha^{-1}should be applied after each cut. When hybridNapier is intercropped with berseem/lucerne and cowpea then 15 kg N ha^{-1} should be given.

Irrigation: In summer season irrigate the crop at the interval of 15-20 days. In rainy season there is no need of irrigation. In winter season irrigation is beneficial to protect the crop from frost.

Weed control: Two-three weedings are required to control weeds. During winter months, there is more problem of due to poor growth of the crop so remove the weeds in the month of February – March when temperature starts rising.

Pests and Diseases: There are no major pests and diseases, except leaf blight damage caused by *Helminthosporiumsacqhri*in some varieties.

Cutting management: DuringIst year, first cutting of hybrid Napier grass should be taken 60-65 days after planting and subsequent cutting at the interval of 35-40 days. Crop gives fodder upto 5-6 years. In a year, 6-7 cuts in North India and 9-10 cutting year in South India are possible. The cutting height should be 10-15 cm above ground level for better re-growth. A good crop yields about 150-300 t green fodder/ha/year.

SUMMARY

Hybrid Napier grass can be cultivated without much difficulty as sole and intercropped invarious agro-climatic conditions of India.It provides nutritive, palatable and adequate quantity of fodder throughout the year. It is not only helpful in increasing socio-economic of rural people but also help in balance diet for livestock's.