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Science for Agriculture and Allied Sector

A Monthly e Newsletter

Volume 1, Issue 3

Oct. 2019

Growing seed

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Science for Agriculture and Allied Sector: A Monthly e Newsletter
Volume 1 – Issue 3
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ZERO BUDGET NATURAL FARMING (ZBNF): SECURING SMALLHOLDER FARMING FROM DISTRESS

Article Id: AL201916

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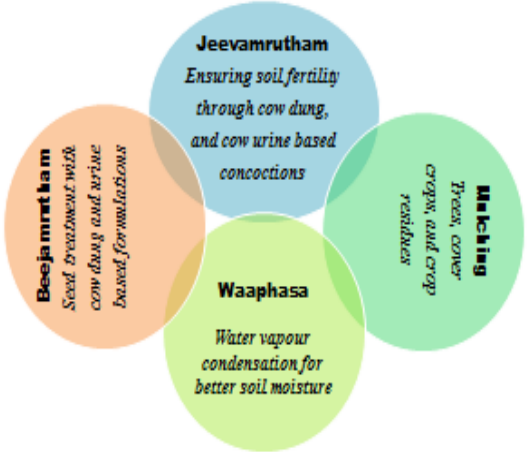
Alternative low-input farming practices have emerged in India and across the world likely to reduce input costs and higher yields for farmers, chemical-free food for consumers and improved soil fertility. Zero Budget Natural Farming (ZBNF) is one such low-input, climate-resilient farming that inspires farmers to use low-cost and locally-sourced and available inputs, eliminating the use of artificial/chemical fertilisers and industrial pesticides (Tripathi et al., 2018). ZBNF emerged as a is a distinctive method of farming requiring no monetary investment especially for purchase of key agricultural inputs like seeds, fertilizers and plant protection chemicals from the market or other sources. It has been observed that in recent time farmer grown hardy local varieties of crops without application of chemical inputs (fertilizers and pesticides). Since it is a zero-budget farming no institutional credit would be required and dependence on hired labor is also reduced to minimum (Padmavathy, 2011). Different agroecological principles like diversification, nutrient recycling followed by increasing beneficial biological interactions(Palekar2006). ZBNF opposesexternal/chemical inputs or synthetic fertilizers use in the farming practices.

Agriculturist Subhash Palekarh as popularise ZBNF practices across the country and identified four aspects that are integral to ZBNF

(1)*Beejamrutham*, anmicrobial coating/ traetment of seeds using cow dung and urine-based preparations;

(2)*Jeevamrutham*, an application of mixture of cow dung, cow urine, jaggery, pulse flour, water and soil for multiplication of soil microbes;

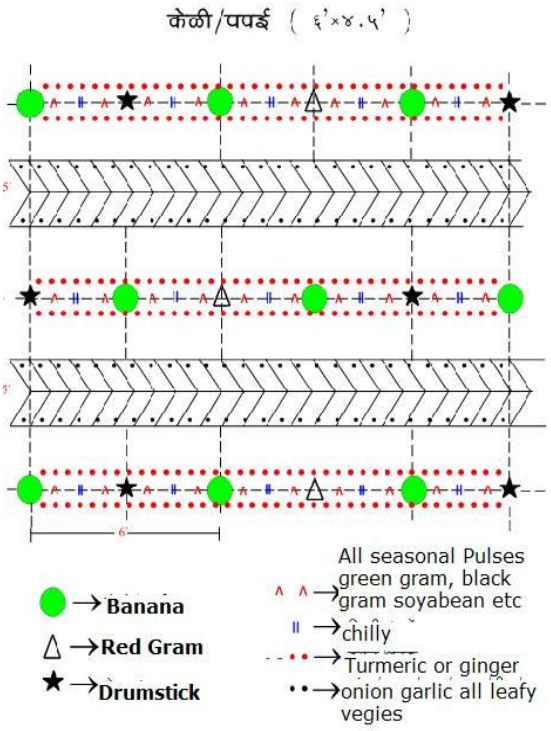
(3) Mulching, a layer/bed of organic material to the soil surface in to prevent/reduce water evaporation; and



(4)*Waaphasa*, soil aeration through a favourable microclimate in the soil.

Practitioners clarified that 'Zero budget' does not literally mean that costs are 'zero', but it implies that the need for external financing is zero, and that any costs incurred can be offset by a diversified source of income which comes via farm diversification rather than dependence on one monoculture (APZBNF 2018).

Figure 1.A version of the five-layer Palekar model.



Source: (BNNMurali2016)

Palekar's most popular model is what he calls the five-layer model; a type of agroforestry model which integrates trees with various levels of plant canopies, each layer at an optimum level to harvest the sunlight. It includes various crop and tree combinations, including living fences on the edges, and trenches for water harvesting. Farmers have further adapted this model according to their needs and in many states and many local versions Have been found. See Figure 1to see a version of the model.

ZBNF for combating Climate change

ZBNF is positioned as a solution to the debt crisis among Indian farmers. Most recent available figures by the government of India show that about 52% of the agricultural households in the country are in debt (NSSO, 2014).The Government of Andhra Pradesh has decided to transmute farming to Zero Budget Natural Farming (ZBNF) by the year 2022. AP Government has decided to approach 60 lakh (6 million) farming households to adopt Climate Resilient Zero Budget Natural Farming (CRBZBNF)as "a farming practice that believes in natural growth of crops without supplying any chemical fertilizers, pesticides or any other external inputs. The phrase Zero Budget refers to the zero-net cost of production of all crops (inter crops, border crops, multi crops). The inputs used for seed treatments and other inoculations are locally available in the form of cow dung and cow urine (RSS website).

ZBNF as viable option for higher yield

Different farmers has adopted ZBNF and found that, Giddaiya, a local farmer of Andhra Pradesh, has been practising ZBNF (tomatoes, red gram and pearl millet) since last year on 2.02343 hectares (ha) after thorough government training. He observed the reduction in cost of cultivation of Rs 10000. Marappa Naidu has 4.04686 ha of land. Right now, practising ZBNF on five acres. He followed *navdhanya* concept where nine types of crops are grown to increase the yield. Similarly, InAnantapuram district, a 136 per cent higher yield in groundnuts under natural farming was observed. Naidu gets five quintals (1 quintal is 100 kg) of red gram under ZBNF compared to three quintals under non-ZBNF. In Gosanipalli village, around 150 farmers are practising ZBNF. Ramajaneyulu, a local farmer, has 0.81ha of land practising ZBNF for two years and witnessed nine quintals of groundnut as compared to six or seven under non-ZBNF. Besides groundnuts, he also grows onions, tomatoes, carrot and red gram (Niyogi, 2018).

Conclusion

ZBNF has been emerged as a farming model for small and marginal farmers to overcome the farming distress and sustaining the livelihood and followed the basis of natural farming and keeping the health of family on top priority. It reduces farmers' costs through eliminating external inputs and utilising in-situ resources to rejuvenate the soil, simultaneously increasing incomes, restoring ecosystem/soil health and climate resilience through diverse, multi-layered cropping systems. These types of farming models having such a vibrant, encouraging results should be adopted and replicated in other state as in Andhra Pradesh. Now Indian government has also proposed in the budget 2019-20 for ZBNF. There is need to sustain the farming system for nutrition and developing a proper marketing and supply value chain inculcating the best possible options for standardised methods for validation and developing linkages and convergence with other departments.

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Science for Agriculture and Allied Sector: A Monthly e Newsletter
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www.agriallis.com

BIOCHAR: A BENEFICIAL SOIL AMENDMENT

Article Id: AL201917

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Continuous application of inorganic fertilizers in agricultural land to increase productivity deteriorates soil health. Depletion in soil nutrients and faster decomposition of soil organic matter are posing great threats to the sustainability of agricultural production in the tropical regions. Moreover, burning of crop biomass is a serious problem in North India. Apart from loss of almost entire C, it leads to loss of about 80-90% N, 75% S and 20-25% P and K present in the straw. In recent years, processing of surplus crop biomass to produce biochar and applying to soil is being considered as a sustainable way of agricultural waste management. To restore the contaminated sites, biochar is considered as a potential soil amendment. It is a carbonaceous product obtained through the thermal decomposition of biomass in the absence of oxygen or small amount of oxygen at very high temperature. It is difficult to decompose due to its aromatic structure and crystalline graphing sheet present within it.Soil nutrient availability from biochar is a function of various factors like type of feedstock, pyrolysis temperature, residence time, heating rate. In general, application of biochar helps to improve the soil nutrients status by raising soil pH, attracting more microbes, improving cation exchange capacity (CEC) and retaining nutrients.

Properties of Biochar

The properties of biochar depend upon the type of feed stocks (viz. crop residue, organic manure, vermicompost, woodchips, municipal solid waste) and pyrolysis conditions. Biochar mainly produced by slow pyrolysis process due to its moderate operational conditions and relatively high yield. A number of studies have investigated that the proportion of elemental carbon in the biochars increases with increasing pyrolysis temperature that indicates the increase in the degree of carbonation by the thermochemical conversion of more labile form of organic residue in the feedstock to highly stable form of

carbon. The stability of biochar in soil is a critical factor to be tested before these are applied to the soil as an amendment. If biochar is produced at high temperature will have high micro pore and contain few nutrients. Biochar produced through woody feed stock is coarser and more recalcitrant as compared to that produced from agronomic wastes. The properties of Biochar such as pH, nutrients, C content, porosity and surface area affect the mechanisms of interaction between soil inhabitants, thus influence aboveground and belowground ecosystem response. The amount of volatile matter content decreased continuously with increasing pyrolysis temperature rendering higher decomposition rate and making these unsuitable for long-term C sequestration. Rapid loss of elements like O and H was found between 300 to 500°C temperatures.

Benefits of Biochar

Addition of biochar in the soils resulted in the better physical condition of soil in terms of soil texture, more porosity, good structure, and particle size distribution. Application of biochar can be extremely useful for the improvement of soil organic carbon, water holding capacity, stimulating soil microbial activity and their biomass, increasing availability and retention of nutrients, bettering crop yield as well as reducing greenhouse gases emission and increase carbon sequestration. Effects of biochar as soil amendment are evaluated by measuring the improvement in pH and organic carbon content in soil. However, the efficiency of biochar application practices is site specific in nature varied with different climatic conditions. Hardwood Biochar produced by traditional methods processed the most consistent increase in soil fertilization when added to soils. The greatest effects with regard to soil analyses were usually seen in coarse soils with biochar from feedstock containing sufficient nutrients itself.

Improvement of nutrient availability in soils

Better soil texture, more porosity, good structure, and density and particle size distribution were observed by incorporating biochar in the soils. Biochar is applied on the soil resulted in oxidation of the surface of particles. With higher porosity and more surface area it can help in the providing space for microorganisms which are beneficial for the soil. Biochar application especially for long-term leads to the increase in pH of the soil and that leads to improved availability of essential nutrient elements like P, K, Mg, Ca, Mo and B. The increase in pH in acidic soils had the effect of alleviating the Al toxicity in ultisols which increase CEC that increases bio available phosphorus. The reason behind the high CEC is the

oxidation of aromatic carbon that leads to the formation of functional groups like carboxyl. The increase in CEC aids in increasing the fertility of soil, as the nutrients will remain on surface soil opposing the leaching process because of CEC. When highly oxidized organic matter attached with the surface it will create negative charge on the surface. This results in the decrease of positive charge on the sites. Additionally, the porous structure of biochar that retained water and improved water balance leads to better nutrient availability. Biochar amendments also increase the soil organic carbon (SOC) content and total N. High levels of SOC accumulation in soil enhanced N efficiency, thus offer an opportunity to save N fertilizer. A substantial amount of K (10%) and S (20-28%) were recovered with the amendment of biochar from sewage sludge. The increase in plant-available water with biochar suggests that the application of biochar to croplands could contribute to the reduction of the frequency of irrigation which is particularly important in water-limited or semiarid regions. The positive effect of biochar on increasing water retention can be larger in sandy soils with lower micro porosity and a smaller specific surface area than in clayey soils.

Increases crop yield

As biochar incorporation improve soil fertility that significantly increase in the crop production as growth of seed is also better with biochar application. Increase in radish dry matter was observed from a study due to the presence of N fertilizer along with biochar but there was no increase in the yield even with highest rate of fertilizer without biochar. Another study claimed the increase in the yield of maize grain by almost 98% with the application of biochar. Cow manure biochar applied at a rate between 10 and 20 t ha^{-1} and poultry manure biochar showed the strongest positive effect among all different kind of feedstock. Similar results were found in the soil of China cultivating paddy, the yield of rice increased by 12 to 14% in the soils where no fertilizer was added by the addition of 10 and 40 t $ha^{-1}$of biochar while 8.8 to 12.1% increase in the yield was observed with the addition of N fertilizers.

Reduction of environmental pollution

Biochar application on the soil helps in the reduction of environmental pollution. It increases the retention of nutrients like N and P in the soils, thereby decreases the leaching of nutrients to the groundwater and saves the nutrients from erosion due to the surface water flow. By the pyrolysis of animal manures, a significant amount of reduction in the mobility of phosphorous of animal manures can be achieved. This technique will help in disposing the bulk amount of the organic wastes easily. It also has the ability to convert the soluble

inorganic phosphate resent in the manure into the adsorbed phosphate in biochar. Biochar pyrolysed at 700°C from poultry litter and pine chips resulted in reduction in *Escherichia coli* transport.

Reduction of hazardous materials from environment

Biochar is highly efficient to adsorb major environmental contaminants from the soil. Many organic pollutants are being sequestered by using biochar to alter their effects on the environment. Biochar acts as a critical binding material for different organic pollutants in the environment due to its resisting nature towards microorganisms and its extraordinary sorption affinity. There are carbonized and non-carbonized type of organic matter in the biochar which plays the great role in sorption depending on their bulk and surfaces. It is reported that biochar made up of incompletely burned wheat and rice residues adsorbed 400 to 2500 times more pesticides than that of normal soil. Another report revealed that charcoals derived from red gum have the efficiency to sorb diuron pesticide from the polluted soil. Biochar made up manure derived from dairy have the sorption capacity for heavy metals like lead and other organic contaminants. Biochar derived from *Pinus radiata* have the higher efficiency for the sorption and desorption of a pollutant named phenanthrene from the soil. The sorption capacity of soil for hydrophobic organic compounds is higher when treated with biochar depending upon the content of that soil, the properties of biochar and the contact time between the soil and biochar. Biochar is more likely to adsorb organic contamination like persistent organic pollutants (POPs), poly aromatic hydrocarbons (PAHs) as they have high affinity for biochar because it is naturally occurring.

Mitigates climate change

Excessive amount of carbon dioxide is being released in the atmosphere due to the burning of fossil fuels and decomposition of biomass that increases the CO_2 levels in the atmosphere. Application of biochar on these soils can help decrease the CO_2 emission as it can store 50% of the carbon from feedstock. Biochar is highly stable so that it significantly restrains the emission of CO_2 from organic matter decomposition and plays a vital role in controlling the release of methane (CH_4) and nitrogen dioxide (NO_2) from the soil which are the potential greenhouse gases. This reduction in the release of NO_2 is because of the ability of biochar to adsorb and retain the ammonium in soils and then reduce the availability of N

for denitrification process. Studies showed that the agricultural soils contribute 12% in the total CH_4 emissions globally, mostly from paddy field. The emissions of CH_4 from the soil treated with biochar mainly depend on the type of soil, the properties of biochar and environmental condition. In the fields, CH_4 emissions from the fields get lowered when treated with biochar. However, the emissions of NO_2 were found 40-51% less in soils than that of those soils which are not treated with biochar. These facts show that global warming gases from soils decreases by amending soils with biochar. Studies showed that pyrolysis seems to propose added opportunities as by the application of biochar into the soil leads to scrubbing of greenhouse gases.

Factors affecting benefits of Biochar application in soil

1. Placement method

Biochar benefits can depend on the biochar placement method. It is commonly incorporated into the soil to reduce losses from wind and water erosion as well as to improve biochar-soil contact. Mixing of biochar with soil reduced soil water repellence and bulk density when compared with surface application. Surface application of biochar has positive effects on reducing soil surface albedo than biochar incorporated deep into the soil. Application of biochar to no-till systems without incorporation could reduce surface albedo.

2. Age of biochar

The effect of biochar on soil properties may change with the time after application. Fresh wooden biochar are found to be higher water repellent than older biochar. Oxidation and drying of biochar with time reduces hydrophobic properties due to reduction of organic compounds on the surface of biochar particles. Physical, chemical, and biological reactions on the surface of biochar particles alter with time which, in turn, influence soil physical properties.

3. Biochar particle size

Biochar particle size can directly affect biochar–soil interactions, influencing changes in soil physical, chemical and biological properties. Small Biochar particles could more easily mix or interact with soil particles to form aggregates than large biochar particles. In addition, the smaller the biochar particles, the greater the specific surface area per unit of mass.

4. Feedstock type

Biochar could have different impacts within herbaceous or wood feedstock groups. Herbaceous feedstock can have more beneficial effects on soil physical properties than woody feedstock. It is found that wheat straw reduced bulk density and increased the amount of water-stable aggregates and available water more than wood feedstock.

5. Pyrolysis temperature

The temperature used during the thermochemical conversion of biochar can influence the extent to which biochar affect soil properties. Biochar produced at high temperatures (>500°C) retain more water and have lower water repellency than those produced at low temperatures due to removal of the hydrophobic organic materials that coat the surface of biochar particles at elevated temperature. Biochar when produced at 500°C 13-fold decrease its water repellent property compared with when it was produced at300°C. Some have found that differences in the pyrolysis temperature of biochar may have small effects on soil physical properties.

Conclusions

Biochar application generally improves structural quality of the soil. Biochar appears to have the most consistent effect on water retention among all the soil physical properties of the soil. It improves soil fertility, soil texture, sorption for nutrients which then helps in lowering the unjudicious use of fertilizer which leads to the decrease in pollution through fertilizer run off. Biochar is highly efficient in increasing the crop yield. It helps in combating the climate change by sequestering the CO_2 from the atmosphere and reducing the release of GHGs (NO_2 and CH_4). It can also be used for the rehabilitation of degraded lands. Combined application of biochar with other amendments has been proposed as an option for improving fertilizer use efficiency of soil. Further, more inter-disciplinary and location-specific research has to be taken up for facilitating the long-term effects of biochar in combination with other amendments to study soil nutrient dynamics. Biochar is posing benefits to the agricultural environment and economy in the longer run, so it is highly recommended to incorporate it in agriculture practices.

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Volume 1 – Issue 3
www.agriallis.com

ROLE OF EXTENSION IN ORGANIC FARMING

Article Id: AL201918

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The US Department of Agriculture defines organic farming. "Organic farming is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators and livestock feed additions. To the maximum extent feasible, organic farming systems rely on crop rotations, crop residues, animal manures,legumes, green manures, off-farm organic wastes and aspects of biological pest control to7maintain soil productivity and tilth, to supply plant nutrients and to control insects, weedsand other pests" (Lampkin, 1990).Organic farming system in India is not new and is being followed from ancient time. It is a method of farming system which primarily aimed at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (biofertilizers) to release nutrients to crops for increased sustainable production in an eco friendly pollution free environment.

Principles of Organic Farming

Health: Organic agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one individual.

Ecology: Organic agriculture should be based on living ecological systems and cycles, work with them and help sustain them.

Fairness: Organic agriculture should be built on relationships that ensure fairness with regard to the common environment and life opportunities.

Care: Organic agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment

General Principles of Organic Farming

- Conversion of land from conventional management to organic management
- Management of the entire surrounding system to ensure biodiversity and sustainability of the system
- Crop production with the use of alternative sources of nutrients such as crop rotation, residue management, organic manures and biological inputs
- Management of weeds and pests by better management practices, physical and cultural means and by the biological control system and
- Maintenance of livestock in tandem with the organic concept and make them an integral part of the entire system

Why Organic Farming?

The salient features of production in organic farming involves –

1. Minimum tillage,
2. Adoption of integrated agriculture system,
3. Recycling of organic matter,
4. Proper crop rotation,
5. Intercropping, mixed cropping, and poly-cropping,
6. Use of well-decomposed organic manures,
7. Green manure cropping,
8. Use of bio-fertilizers,
9. Mulching of weeds,
10. Integrated pest management and
11. Judicious use of irrigation water.

Organic Farming – World Scenario

- At present, organic farming is practiced in more than 120 countries.
- Globally 30.4 million hectares.
- Constitutes 0.65 % of agricultural land.

Country	Area
Australia	12 m ha
Europe	7 m ha
Latin America	5.8 m ha
Asia	2.9 m ha
North America	2.2 m ha
Africa	0.9 m ha

Source: FiBL

Organic Farming – Indian Scenario

- India ranks 33rd in total land under organic cultivation.
- 88th position for the agricultural area under organic crops.
- The percentage share of organic land to the total agricultural area is 0.3 %.

State	Area
Madhya Pradesh	1.63 lakh ha
Maharashtra	1.15 lakh ha
Orissa	74,585 ha
Jammu and Kashmir	32,541 ha
Rajasthan	24,868 ha
Kerala	14,744 ha

Source: FiBL

Present Status of Organic Products in India

Total production (tones)	5,85,970
Total quantity exported (tones)	19,456
Value of total export (million Rs)	3,012.4
Total area under certified organic cultivation (ha)	3,39,113
Number of farmers	1,41,904

(Source.www.apeda.com)

Benefits of Organic farming

- ✓ These feature of farming helps in maintaining environment health by reducing the level of pollution,
- ✓ Reduces human and animal health hazards by reducing the level of residue in the products,
- ✓ Helps in keeping agricultural production at a higher level or makes it sustainable,
- ✓ Reduces the cost of production,
- ✓ Ensures optimum utilization of natural resources and also conserve them for the future generation,
- ✓ Saves energy for both animal and machine,

- ✓ Reduces the risk of crop failure,
- ✓ Improves the soil physical properties such as granulation by giving good tilth,
- ✓ Facilitate easy root penetration through proper aeration,
- ✓ Improves water-holding capacity,
- ✓ Improves soil chemical properties such as supply and retention of soil nutrients.

Role of extension

- ✓ Spreading information
- ✓ Changing attitudes
- ✓ Training and capacity building
- ✓ Motivation
- ✓ Front line demonstration
- ✓ Provide Knowledge of pest and disease management.
- ✓ KrishiVigyan Kendra, CAU, Imphal East, Andro is providing technological back up for organic agriculture.
- ✓ Field visits.
- ✓ Farmers training.
- ✓ Transfer of technology.
- ✓ Adoption and Diffusion

Certification of organic products and their production processes (NPOP guidelines)

1. Formation of organic farmers group.
2. Registration of farmer's group with distinct authorities.
3. Documentation of individual farms/farmer's records.
4. Service providers.
5. Accreditation agencies.
6. Certification and inspection agencies.
7. Periodic inspection of organic farms.
8. Organic certification.

Organic Fertility Management

1. Field exercises/demos: - Effects of organic amendments winter cover crop evaluation,
2. Lab/classroom exercises: - Organic nutrient management plan,
3. Evening discussions: - Building soil organic matter and nutrient pools in South-eastern soils
4. Field trips: - Organic farm visit

5. Homework: - Organic nutrient management plan

Information Delivery

Lab/classroom exercises: Working with organic growers Accessing electronic resources

Field trips: Organic farm visits

Homework: Farm visit evaluation

Publicity and Awareness Campaign

National Centre of Organic Farming (NCOF) at Ghaziabad and six Regional Centres for Organic Farming (RCOFs) organize various programs for awareness viz., literature distribution, arranging exhibitions, radio talks in a regional language, TV programs and press releases.

Awareness campaigns involving press, radio, television, etc. should be made for popularising the benefits of consuming organic foods. DD Kisan channel can have dedicated time slots for organic growers.

A Media Plan aimed at spreading awareness about the advantages of organic farming among

Farmers: dissemination through media vehicle having extensive reach in area have to be used for this purpose prominently like DD network, AIR network, FM channel, Community Radio, C&S channel, Digital Cinema, SMS and regional and vernacular print media.

Training

Training on organic farming to encourage and motivate the farmers, on Organic Farming Techniques (giving emphasis on crop residues management and enhancement of organic carbon), input production techniques, Participatory Guarantee System and marketing of produce.

Problem Faced by Organic Farmers	Solution by extension
Paperwork/Bureaucratic red-tape.	
Time constraints.	Advisory Service
Marketing challenges/Low farm prices.	
Organic certification.	
Lack of farm management skills	
Access to information.	Facilitation
Media relations.	
Access to Extension educators.	
Peer support.	
Low level of operator education	Training and capacity building
Computer skills	
Customer relations.	

Conclusion

It is imperative that the impacts of extension programswould be able to increase farm income and productivity, boost food production, enhance food safety assurance, and enable surplus food produced be exported to other countries. In this perspective, planning and executing extension programs must get continuous support from various parties including stakeholders in food production. The current market environment demands agricultural products of a certain level of standards and quality. Consumer's preferences are moving toward safe foods and at the same time convenient of preparation. Good Agriculture Practice which is based on rules and following principles in food production and technological advancement in agriculture should be the guide-post for extension activities to provide food from farm-to-table that is safe for human consumption.

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Volume 1 – Issue 3
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USE OF CONVENTIONAL AND UNCONVENTIONAL FEEDS AND FODDERS FEEDING OF ANIMALS DURING SCARCITY

Article Id: AL201919

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India is an agricultural-based country with 70 percent of its population living in villages. Their livelihood is dependent mainly on agriculture and animal husbandry. India has a vast livestock population of over 512 million, **(livestock census 2012**) and poultry (729) millions, yet the production of milk per animal and other livestock products is the very lowest in the world. India is highly deficient in various livestock products, though we have about one-fourth of the total cattle population of the world. Scarcity of feeds and fodder resources is a big problem limiting animal production. Among all, flood and drought is the major devastating natural calamity leading to a massive loss of vegetation. On average, about 50-60 percent of the cropped area in wave affected area remain submerged, and it takes at least a minimum of 30 days to bring the field for cultivation purposes.Increase in livestock and human population and decrease in land under cultivation has resulted in acute shortage of feeds and fodder for livestock which further increases due to natural calamities like droughts due to uneven monsoon and flood whose intensity is increasing nowadays, these the worst to suffer are the livestock. In these situations, the use of the feed and fodders not commonly used gives some relief. The need for using these unconventional feed and fodders in livestock ration is increasing day by day due to the shortage of animal feeds. The primary source of such feeds is agricultural and forest by-products. Such feeds are not used either because of the traditional benefits of livestock owners or due to less palatability and presence of toxic factors in them. It also happens that specific un-conventional feeds are being traditionally fed to animals in a particular region, but the same may be neglected in other areas. Recent studies indicated that quite a large number of agricultural by-products and industrial waste materials could be used to fulfilling the scarcity of feeds and fodders.

Different kinds of damages caused by floods can be categorized as follows

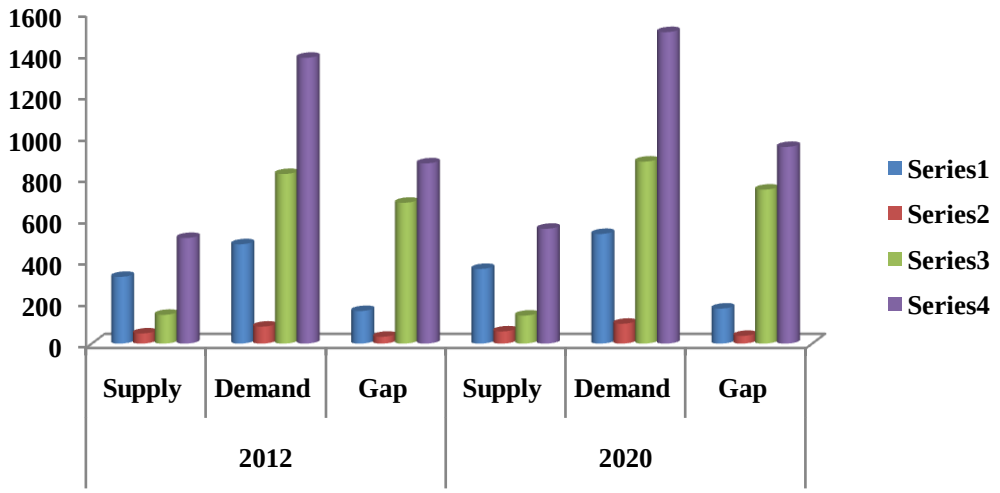
- Loss of standing crops due to flood water.
- Damage of stored dry roughage due to not proper storage facility.

- Dry roughage stored in open space by aggressive currents of floodwater.
- Damage of stored grains and brans by water soaking followed by fungal growth resulting in loss of nutrients and production of harmful/toxic metabolites.
- Pollution of water with dung, urine, debris, and other wastes.

On the other hand, drought causes a different type of loss where there is no or limited growth of plants. In such condition, there is an acute shortage of feeds and fodder in flood-affected areas. Feeding strategies during scarcity depend on the specific conditions prevailing in any particular area. In general, the farmer has to make decisions based on economics, knowledge of nutrition, the availability of feed resources and his calculated guess on the length of the drought.

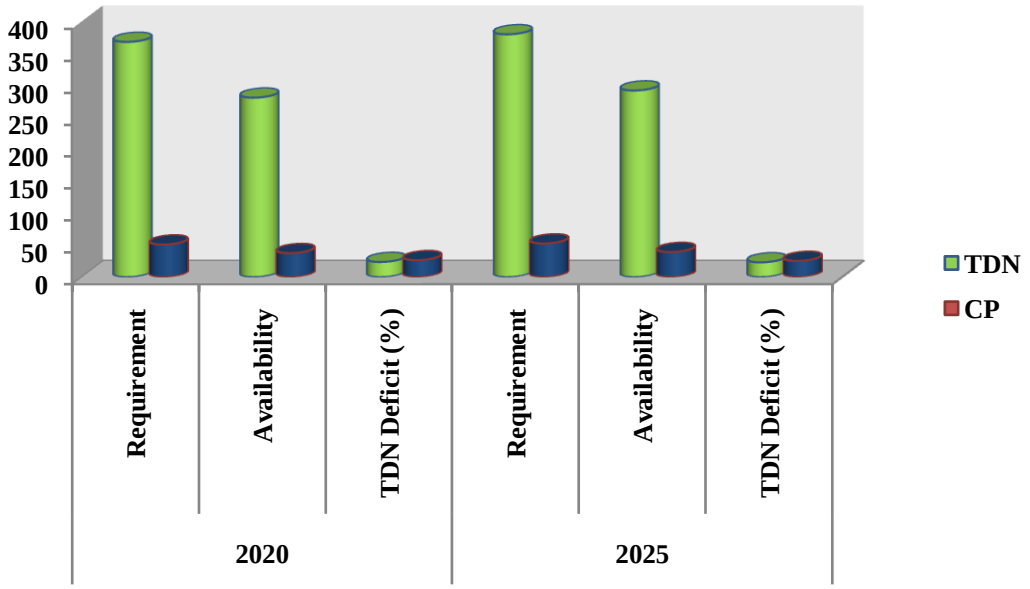
Table 1. Projected demand and supply of feed (million tonnes)

S. No.	Resource	2012			2020		
		Supply	Demand	Gap	Supply	Demand	Gap
1.	Dry fodder	322.6	480.2	157.4	360.9	530.0	169.1
2.	Concentrate	48.9	82.0	33.1	58.8	96.0	37.2
3.	Green fodder	139.1	820.0	680.9	135.4	880.0	744.6
4	Total	510.6	1382.0	871.4	555.1	1506.0	950.9



Requirement & availability (MT) of TDN & CP UP TO 2025

S. No.		2020			2025		
		Requirement	Availability	Deficit (%)	Requirement	Availability	Deficit (%)
1.	TDN	368.63	281.24	23.73	380.5	292.46	23.14
2.	CP	51.05	37.6	26.53	52.69	39.31	25.38



Widening of the gap between demand and supply of concentrates and green forage (especially legumes) would also imply the widening of protein and energy deficit in (Table1).

Meeting the requirement for different feed resources in the coming year is no doubt a Herculean task, but with concentrated efforts and right approach and strategies, it may not be challenging to achieve the target.

Unconventional feeds are described under the following categories:

- Protein sources
- Energy sources
- Miscellaneous alternative feeds.

Feeding technologies to be used during feed scarcity

- Complete feed blocks
- Urea molasses mineral block licks
- Urea treatment of straws
- Use of dry and fallen tree leaves
- Use of conventional and unconventional feeds

Quality/characteristics of NCFR

- They are the end products of production and consumption that have not been used, recycled, or salvaged.
- They are mainly organic and can be in a solid, slurry, or liquid form.

- Their economic value is often less than the cost of their collection and transformation for use, and consequently, they are discharged as wastes.
- The feed crops which generate valuable NCFR are excellent sources of fermentable carbohydrates, e.g. cassava and sweet potato, and this is an advantage to ruminants because of their ability to utilize inorganic nitrogen.
- Fruit wastes such as banana rejects and pineapple pulp, by comparison, have sugars which are energetically very beneficial.
- Some of the feeds have harmful effects on animals, and not enough is known about the nature of the active principles and ways of alleviating the effects.
- They have considerable potential as feed materials, and for some, their value can be increased if there were economically justifiable technological means for converting them into some usable products.
- More information is required on chemical composition, nutritive value, toxic factors, and value in the feeding system.

Use of conventional and unconventional feeds. The different kinds of traditional and unconventional feedstuffs for the preparation of rations of different categories for feeding of flood-affected animals been listed below

Minor by-product feeds from various sources

Crop residue

Paddy straw constitutes the good sourceroughage of livestock in different north-eastern states of India. It is usually stored on wooden or bamboo platform raised over the ground. This is required to minimize spoilage in the dense rainfall areas.

Sugarcane crop residue

Sugarcane is cultivated in some part of India. After harvesting the sugarcane tops available as a waste can be used for the feeding of livestock. Some quantity of cane tops is converted into hay at some places, while the vastamount of it goes waste, which can be preserved by ensiling. Sugarcane trash mostly used as fuel for the preparation of jaggery may also be used to supply part of the roughage requirement after chaffing and enriching with more palatable and nutritious feeds.

Bagasse is available in sugar factories and crushers after extraction of juice. A small quantity is also available with a farmer during the process of jaggery preparation. Parity large proportion of bagasse is used as a source of energy in the form of fuel for boilers.

Aquatic plants

Several types of aquatic plants are available in the river, pond and other water logging areas may be used for the feeding of farm animals. Besides supplying protein and energy, they are rich sources of carotenes. So far, the common aquatic plants tested for the food of farm animals are water hyacinth, aquatic spinach, stalks and leaves of lotus plant (Neumbiull sp.), water chestnut (Trapanatans), hydrilla, pistia, aquatic weeds.

Industrial by-products feed by cattle

Lemongrass

Lemongrass grows widely in large areas in many parts of the country. After the extraction of oil which is used for the preparation of vitamin A and also in the pharmaceutical and cosmetics industry, large quantities of spent lemongrass are available and can be fed to animals. It has been found to contain 1.03% DCP and 53.5% TDN.

Tapioca

Thebitter variety of tapioca is, generally, used for commercial production of starch from its tuberous roots. The fibrous waste, left after the extraction of carbohydrate known as tapioca spent pulp as tapioca starch waste, has been fed to cattle and found to contain 72% TDN.

Sugar beet

Sugar beet pulp, a by-product of the sugar beet industry has been fed to Murrah buffaloes and found to contain 3.42% and 59.23. TDN and dry matter basis.

Rice husk

Rice husk is available in large quantities from the rice milling industry; it has high silica and lignin contents.

Mulberry

The leftover of mulberry leaves and stalks after feeding to silkworms have been feed to cattle and found to contain 7.80% DCP and 48.0% TDN.

Guar

Guar meal is available as a by-product after the extraction of gum from guar seeds. When fed as a sole concentrate, it resulted in chronic diarrhea in growing calves. Guar meal as a good protein supplement to crossbred calves could achieve a high body weight gain @ of 655 g/day as compared to only 640 g/day in calves fed GNC.

Other unconventional feed resources

Azolla

Azolla is an aquatic fern mostly utilized as Bio-fertilizer for wetland paddy and ponds. It belongs to the family of azollaceace. It contains almost all the essential Amino acids, many probiotics, Biopolymers, and B carotene. The higher crude protein content (above 23 % on dry matter basis) and presence of essential amino acids (high lysine content) vitamins like A & B and minerals like calcium, phosphorous, potassium and magnesium made Azolla useful feed supplement for livestock, poultry, and fish.

Food and vegetable waste

In most states, losses in fruits and vegetables are to the tune of 30%, thereby resulting in the production of vast quantities of FVW. Only 4 percent of fruits and vegetables produced in the country are processed, as compared to western countries.

Straw and Stover

It is significant food crops, like wheat, rice, maize, and pulses, are in abundance. Most of these are burnt, causing environmental pollution/ global warming. Technology to harvest and pack the straw as blades and densified complete feed block for use as basal roughages, with or without urea treatment should be developed.

Table 2. Conventional feed as concentrate

S. No.	Ingredients	Parts mixture in concentrate
1.	Mango seed kernel	22-24
2.	Kapok	20-25
3.	Cassia tora seeds	25-30
4.	Babul	20-23
5.	Akra	20-25
6.	Mahua cake	10-25
7.	Sal seed meal	20-22
8.	Oak	9-16
9.	Vegetable and fruit processing waste	25-30
10.	Seaweeds and fishmeal	25-28

Tree leaves as fodder

Considering the highest shortages of nutritious conventional feeds, efforts made to utilize various tree leaves as livestock feed resources during the past several decades, as shown below.

Table 3. Major By-Product Feeds from Tree and Crops

S. No	Hindi name of the tree leaves	Botanical name	DCP (%)	TDN (%)
1.	Bargad	*Fiscus bengalesis*	2.00	44.80
2.	Pipal	*Fiscus religiosa*	7.90	40.38
3.	Gular	*Fiscus glomerata*	6.70	53.82
4.	Shisam	*Delbergiasisso*	9.06	52.46
5.	Gauj	*Milletiaauriculata*	15.56	44.87
6.	Bambo	*Dendracalamusstrlctus*	9.33	48.84
7.	Mulbery	*Mors indica*	10.70	59.57
8.	Ardu	*Ailanthus excelsaRoxb*	13.06	63.03
9.	Subabul	*Lucalenalucocephala*	12.64	51.70
Other unconventional Roughages resources				
1.	Jute	*Corchorus olitorius*	13.93	60.59
2.	Sunhemp	*Crotlariyajuncea*	12.60	64.02
3.	Chakunda	*Cassia toralinn*	4.17	55.30
4.	Water hyacinth	*Eichhorniacrassipes*	5.64	40.25
5.	Jhanji	*Scripusauriculantus*	9.28	43.80
6.	Banana leaves	*Musa paradiosica*	8.02	61.00
Agriculture by products Other unconventional Roughages resources				
1.	Ground nut haulms	*Arachis hypogaea Linn*	5.39	50.7
2..	Soybean bhoosa	-	1.95	45.0
3.	Moong straw	*Phaseolus aureus* Roxb	3.95	49.2
4.	Urad straw	*Phaseolus mungo*	3.90	49.2
5.	Rice bean straw	*Phaseolus calcartus*	6.91	31.2
6.	Horse gram	*Dolichosbiflorus* Linn	3.00	49.2
7.	Arharbhoosa	*Cajanus indicus*	3.85	49.4
8.	Cowpea hull	*Vigna catjung*	3.29	59.0
Unconventional feeds as concentrate resources				
1.	Jamun seeds	-	5.36	45.5
2.	Mango seed kernel	-	6.00	72.0
3.	Coconut pitch (coir waste)	-	-	62.7
4.	Tea waste	-	9.50	44.0
5	Pea hull	-	-	-
6.	Salseed meal	-	1.68	43.0
7.	Tapica starch waste	-	1.89	60.0
8.	Spent annatto seed	-	7.50	67.5

9.	Guar meal	-	23.8	66.0
10.	Mahua cake	-	7.56	60.2
11.	Mahua flower	-	3.96	74.0
12.	Kidney bean chuni	-	16.35	66.9
13.	Rubber seed cake	-	18.60	54.2
14.	Tamarind seeds	-	5.36	61.0

Conclusion

The main reason for the reduced animal production is the less supply and poor quality of feeds due to a severe shortage of feedstuffs. A significant gap exists between the supply and demand of nutrients for feeding of livestock; the nonconventional feeds could partly fulfill this gap. Farmers are not aware of the nutritive value of some feed sources and the way for their adequate level of feeding in livestock. The involvement of local extension workers/agencies in technology development for the efficient use of NCFR.

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Science for Agriculture and Allied Sector: A Monthly e Newsletter
Volume 1 – Issue 3
www.agriallis.com

NATIVE CATTLE BREEDS – A LOSING LIGHT?

Article Id: AL201920

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India is known for its rich varieties of biodiversity. Due to lack of attention and ignorance, not only the wild animals, but most of the native breeds of cattle are also on the verge of extinction. Native breeds are being lost due to misdirected crossbreeding with exotic breeds to increase milk production, improper application of crossing native breeds and slaughter of native breed bulls for beef consumption and export. Indigenous breeds which are well adapted to Indian climatic conditions and disease resistance capacity are being gradually replaced by exotic breeds.

One of the major reasons for neglecting the native breeds of cattle was that the blind acceptance of the western notions of what constitutes a “good breed”. Breeds-a selected group of animals of the same species, with distinctive inheritable traits-have adapted to local conditions over a period of time. During this time, desired traits are continuously selected and bred to get a unique pool of genes in a breed. The exotic breeds of cattle are mainly selected for high milk yielding and have less disease tolerance.

There are about 37 recognised breeds of cattle present in India, in addition to a large number of non-descriptive cattle. Nowadays, most of the indigenous cattle breedpopulation

are declining due to their poor milk-producing ability and the introduction of machinery for draught purpose.

The advantages of indigenous cattle breeds over exotic breeds are

1. Superior disease resistance than exotic breeds
2. Highly suitable for low input management system
3. Better adapted to the tropical climate
4. Suitable for draught work

In addition, the superior indigenous breeds can be utilised for the development of new synthetic breeds. So, it is important to conserve, develop and proliferate the native cattle breeds.

Various conservation strategies

(A) Breeding policy

The state government should take initiative and may review their breeding policies to give importance to the local breeds for their conservation in their local tract. Strict measures have to be taken to prevent crossbreeding of native cattle breeds in the home tract of important and recognised cattle breeds.

(B) Implementation of the Breeding programme

1. The state government should analyse and identify the geographical boundaries of the areas where non-descript cattle should be upgraded by crossbreeding programmes with bulls of native breed. Once such areas are marked, no cross breeding of non-descript cattle, other than with bulls of native breed should be permitted.
2. The areas for cross breeding of non-descript cattle with exotic breeds can be identified.

(C) Promotion of Breeders Organisation

1. Breeding farms

The existing state breeding farms of native breeds should be used for the production of superior germplasm of that breeds and used for breeding programmes. Only pure breeding should be practised in these farms.

2.Gaushala

There are a large number of gaushalas with small population of pure native breeds but do not have resources for maintaining and improving those animals. Such gaushalas can be improved by providing superior germplasm and support.

(D) Use of science and technologies

There are many technologies and methods present for improving and conserving the breeds. The application of such technologies for propagation and improvement of the native breeds have to be done.

1. Technologies such as artificial insemination, Frozen semen production, embryo transfer technology, progeny testing should be used.
2. National Gene banks should maintain superior germplasm in the form of semen and embryo.

(E) Creation of Public awareness

1. Cattle fair or shows should be arranged for the native breeds and the cattle owner should be rewarded for maintaining pure native breeds.
2. Farmers who are maintaining the native breeds should be encouraged and veterinary help should be provided if required.
3. The information available on different native breeds should be published as leaflets, pamphlets, newspapers, journals etc. This will create awareness and motivate farmers to conserve the native breeds.

(F) Database

1. A reliable database should be created with regards to the details of the native cattle breeds including their breeding tracts, numbers, characterization, milk yield, gene makeup, etc.
2. A breeding network should be setup by modernizing and networking all AI outlets, semen stations, breeding farms and gaushalas.

The native cattle breeds (Fig 1) have to be conserved to use their genetic potential in the future as part of our culture, ecosystem, tradition and also for scientific studies. They

possess unique genetic characteristics such as the genetic variation in heat resistance genes like Hsp70, some disease resistance genes and A2 allelic variant in cow milk which makes them well adapted to the tropical climate of India. Government should bring more policies and motivate farmers to rear native cattle breeds by making them understand the importance of their conservation.

Fig 1: Different native cattle breeds of India

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AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly e Newsletter
Volume 1 – Issue 3
www.agriallis.com

EFFECT OF STRESS ON FARM ANIMALS

Article Id: AL201921

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Stress can be defined as the sum of all physiological and behavioural changes in animals in response to physical, emotional or mental stimuli. Generally, it is used in a negative sense and described as harmful effects of several factors on the health and productivity of animals. Stress disturbs the normal physiology or homeostasis of the animal. The Humane Slaughter Association, UK has described stress as

S= Situations
T= That
R= Release
E= Emergency
S= Signal for
S= Survival

In a condition of stress animal always tries to regain the normal condition. Therefore, a stressor is an internal or external stimulus that evokes physiological responses in the body to re-establish homeostasis. A stressor can be a biological agent, chemical compound or environmental condition. As the stress has detrimental consequences in animal, it should be removed for the benefit of the animal. In this article, we have discussed the different stress conditions and how they affect the animal.

Type of stressors and biological response to them

As discussed above, there can be several types of stressors. It can be internal or external. It can also be classified as biotic and abiotic.

Biotic stresses are caused by living organisms. These include

- Bacteria
- Virus
- Fungus
- Mycoplasma
- Insects
- Parasites etc.

The abiotic stressors mainly include-

- Cold stress
- Heat stress
- Poor housing
- Social stress etc

The different types of stressors and their effect in the physiological system are presented below (Table 1)

Table 1: Type of stressors and biological response to them

Stressor	Symptom	Physiological system activated or inhibited
Heat	Elevated body temperature	Heat loss mechanism increased, decreased phagic drive
Cold	Reduced body temperature	Heat gain mechanism enhanced, heat loss mechanism reduced, food intake enhanced
Infection	Elevated body temperature	Immune system activated; hypothalamic body temperature set point altered
Poor housing	Increased lameness	HPA axis activated
Poor nutrition	Deficiency symptoms	Mobilization of the nutrient reserve, altered behavior
Social	Altered behavior	Food intake reduced, HPA axis activated

Effect of stress on production

The major consequence of any types of stress in an animal is loss of production. The animal has to spend energy to reduce the effect of stress. It results in production loss. The mechanism is described below with a diagram (Fig 1).

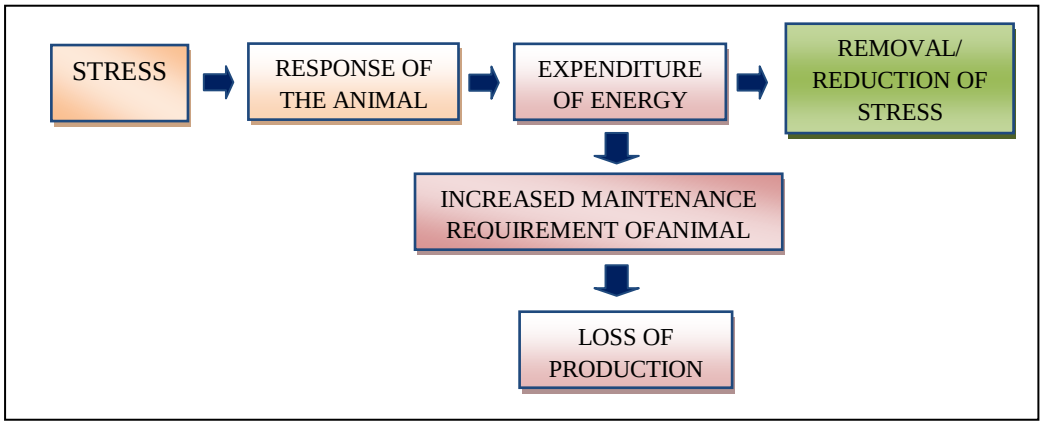

Fig 1: Consequences of stress resulting loss of production in animal

Consequences of different physiological and environmental stress on the animal

A. Pregnancy and parturition

Pregnancy causes prominent physiological stress in farm animals. In the case of cattle, during the first six months of gestation, the metabolic energy requirement increases upto 16%. In the last trimester, this energy demand increases to 175% compared to non-pregnant cows. On the day of calving, the rumen contractility decreases and simultaneously the feed intake also. It has been observed that there is a rise in serum cortisol also at that time. So, it is utmost important to provide good nutrition and management throughout the pregnancy and at the time of parturition. It will ensure the birth of a healthy calf and its good productivity later.

B. Lactation

Lactation imposes huge metabolic stress in animals. The energy demand is very high to maintain milk production. Often, the animal shows a negative energy balance. The heat production becomes nearly twice due to increase in several metabolically active organs. The increase in organ size during lactation is presented below (Table 2).

The dry matter intake (DMI) also increases rapidly after parturition. It becomes nearly double at two weeks post-partum and triples at three weeks postpartum. It reaches a maximum value at three months in cattle.

Table 2: Increase in organ size/function during lactation

Organ size/Function during Lactation	Increase (%)
Mammary gland	73%
Liver, Heart, Lung	22-25%
Metabolic demand of Liver	25%
Digestive tract mass	29%
Energy expenditure	28%

C. Environmental cold exposure

During the cold seasons, the energy expenditure increases to produce more metabolic heat. Simultaneously, feed intake also increases. The decrease in environmental temperature hampers milk production. This effect is more prominent in Jersy cows compared to Holstein. It may be due to the smaller body size of the Jersy resulting more surface area. The level of thyroxin hormones also increases with decrease in temperature. Interestingly, the high producing cows don't show much increase in thyroxine level as it produces more metabolic heat due to milk production. If the animals are not allowed to take more feed during cold stress, it will increase the thyroxine level to enhance the metabolic rate.

D. Heat exposure

High producing cows are more sensitive to heat stress. During the hot seasons, the animals reduce their feed intake in order to decrease the heat production of digestion and metabolism. But, this decreased feed intake results in decreased milk production. If a comfortable environment is provided to the lactating animals, milk production will be unaffected. The installation of the fan-cum-mist system in big farms can help.

Immune function in stress

The immunity is suppressed and the animals become more susceptible to disease at stressful conditions. Stress activates the HPA (Hypothalamic pituitary adrenal) axis. It results in the secretion of cortisol which is an immuno-depressant. The activity of reactive oxygen species increases at heat stress and causes cell damage. It has been observed that weaning stress can cause digestive problems. So, it is essential to take care of the animals in any stress conditions to protect them from other diseases.

Effect of stress on reproduction

Stress has a negative impact on all the reproductive parameters including semen quality, sexual behavior, fertility rate, follicular dynamics etc. In dairy bulls, semen volume, sperm concentration, sperm motility and sperm survival decreases during summer seasons. Prolonged heat exposure to animals can decrease the rate of fertilization and inhibit embryonic development. In cows, lengthened estrous cycles, shortened estrus duration and decreased estrus intensity can be observed in hot seasons. The mating behavior is altered and the endocrinological balance is also disturbed.

Conclusion

It is very clear that stress is a threat to the animals. It disturbs the homeostasis, affects the health and reduces the production. There are several internal and external stressors and have a negative impact on animals. So, it is utmost important to reduce these stress and provide a comfortable environment. It will ensure good health and better productivity from the animal and economic stability to the farmer.

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Volume 1 – Issue 3
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USE OF FERTILIZER IN FISH POND

Article Id: Al201922

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Fish is a deliciousfood item consumed by a large population of India. Proper cultivation and management of fish in the fish pond are very important to obtain a good production. It has been observed that the presence of an adequate amount of natural food in the pond is a crucial factor which influences fish growth in the water body.These natural feed, present in the waterbody also require food for their survival. Thus, various types of organic and inorganic fertilizer are used in aquaculture. They increasethe amount of available nutrients in the ponds. These are very much essential for the growth of natural food as well as the growth of fish.So, adequate and optimum levels of fertilizer in the pond promote good fish growth in the water body.Two types of fertilizers are generally used for the culture of fish in the pond i.e. organic fertilizer and inorganic fertilizer. In this article, we have briefly described how to use fertilizer properly to ensure good productivity of fish and better economy of the farmers.

Inorganic fertilizer

Generally, nitrate and phosphate fertilizers are used in the pond. On the other side, fertilizers containing potassium are not used in the pond.Among nitrate fertilizers, urea and among phosphate fertilizer, single superphosphates are mostly utilized in the fish pond. Importance of phosphate-fertilizer application is more compared to other fertilizers in the pond because they contribute to the plantgrowth more prominently.Within a few minutes of application of phosphate-fertilizer in the water body, they are readily absorbed by plant-tissue

for their growth.Uses of nitrate fertilizers along with phosphate fertilizers create a synergistic effect on the benefits of using these fertilizers.

The application procedure of inorganic fertilizers in the fish pond

The main disadvantage of using phosphate fertilizer is their insolubility in water, but nitrogen fertilizers are very much soluble in water. So, phosphate fertilizers should not use in dry condition otherwise, they will be readily absorbed by bottom soil instead of being absorbed by plant tissue or phytoplankton.So,these fertilizers should be soaked in the water before 3-4 hours of their application.Then,the next day morning, it should be mixed with any nitrate-fertilizer in a large container and then should be spreaded in the pond.

Amount of inorganic fertilizer to be used in the pond

How much inorganic fertilizer should be used in the pond,depends upon the nature of the water and soil of the pond. Before application of the inorganic fertilizer in the pond, the density of the plankton should be determined in the pond which in turn, should be determined by the transparency of the Secchi disk.

- If transparency of Secchi-disk is between 30-40 cm, then generally no need to apply any fertilizer in the fish pond.
- If transparency of Secchi-disk is above 40 cm,then fertilizer should be used in 15-day intervals.
- If transparency of Secchi-disk is above 60cm,then fertilizer should be used weekly, until Secchi disk transparency reduced to 30-40 cm.
- If transparency of Secchi-disk is below 30 cm,then application of fertilizer in the fish pond should be totally prohibited.

Some other factors which determine the amount of inorganic fertilizer to be applied

- In thecase of turbid water, there is no benefit of the application of inorganic fertilizer,as due to turbidity of the water, sunlight cannot adequately enter into the water.
- Before the application of fertilizer in the pond, aquatic plants present in the waterbody should be eradicated otherwise, nutrient of the fertilizers will be absorbed by those plants present in the water body.As a result of that, the growth of the aquatic plants will create problems in the culture of the fish species.
- In thecase of the algal dominated pond, inorganic fertilizers should not be used atall.

- In case of cloudy days or before sun-rise fertilizers should not be used in the pond, as plants cannot perform physiological functions adequately in the absence of sunlight.
- If the wind blows in the pond from northward to southward,then the amount of applied fertilizer should be 30% in the north direction and 70% in south direction.
- If total alkalinity of the pond below 20 mg/l, then no benefit will be extracted from the application of inorganic fertilizers.
- In the pond, phosphate-fertilizers and lime should not mix with each other, as lime make precipitation of phosphate at the bottom soil of the pond.

Organic fertilizer

Animal and plant-derived fertilizers are known as organic fertilizer.Advantages of using organic fertilizers are:

- ❖ Organic fertilizers enhance the growth of zooplankton in the fish pond.
- ❖ Organic fertilizers disintegratevery slowly in the pond in a longer period of time and increasethe amount of nutrient material in the pond; as a result, the pond becomes fertile.
- ❖ They create a synergistic effect on the function of inorganic fertilizer.

Classification of organic fertilizers: Organic fertilizers can be divided into two groups.

1. **Plant-derived fertilizer:**These kinds of fertilizes are produced from plant or plant-derived materials.Ex- compost fertilizers,oil-cake fertilizers etc.
2. **Animal-derived fertilizers:**These kinds of fertilizers are produced from animal or animal-derived material.Ex- poultry fertilizers,swine-derived fertilizers.

Some important organic fertilizers used in fish culture and their application procedure

- ❖ **Green-fertilizers:**This fertilizer is generally used in nursery pond.This fertilizer increases the amount of nitrogen in the pond, as a result of which productivity increases a lot.
- ❖ **Compost-fertilizers:**Different types of aquatic plants, grasses and leaves are mixed with raw cow-dung and then compost-fertilizers are produced.This fertilizer helps to control the pH of the fish pond.
- ❖ **Oil-cake fertilizers:** Among plant-derived fertilizers, most widely used fertilizer is oil-cake fertilizer.After extracting the oil from mustard, mohua, til and badam, the

residue is known as oil-cake.Oil-cake contains different chemical components like nitrogen, phosphate and potash. Generally, mustard oil cake and mohua oil cake are widely used in the pond.

Use of mustard oil cake

Mustard oil cake is used as fertilizer in the fish pond and also serves as supplementary feed. It is used as fertilizer in the fish pond after mixing with cow-dung.When it is used as supplementary feed in the fish pond, it should spread in the pond water directly after grinding it into small pieces.

Use of mohua oil cake

Initially mohua-oil cake act as a poison in the pond so, it kills unwanted fishes in the pond.Later it becomes converted into fertilizer so, it increases the productivity of the fish pond.This oil cake containsalkaloids, named saponin, which is water-soluble.It enters the blood of fish, snake and frog through gill and mouth and destroys red blood corpuscles of blood and death of these unwanted species occur.After sometime, mohua oil cake degrades and increasesthe amount of nutrient components in the water.As a result, the growth of zooplankton enhances in the water body and it serves the function of fertilizers.

Amount of mohua oil cake to be used in the fish pond: To kill the unwanted fish species, 250 ppm mohua oil cake should be used in the fish pond.

The procedure of application of mohua-oil cake in the fish pond: Most of the portion of mohua-oil cake is in cake form, so it does not dissolve directly in water of the fish pond.So, if we directly use it in the fish pond in cake form, the optimum result does not occur.So, an adequate amount of mohua oil cake should be spread in the fish pond water,before the day of application in the evening.

Use of cow dung in the fish pond

- Raw cow dung can be used directly in the fish pond water.
- In case of application of cow dung fertilizer in the pond, cow-dung will be disintegrated with the help of microbes. As a result, cow-dung will release nitrogen, phosphorus and potash components in the water, which makes water very much fertile.

Disadvantages of using organic fertilizers

- Organic fertilizers especiallyanimal-derived organic fertilizers should not be used in a fish pond in excessive amount.
- Application of excessive amount of organic fertilizers can create the problem oxygen depletion in the fish pond.
- Application cow dung in raw condition can give birth to some harmful bacteria in the pond,
- Use of organic fertilizers in the fish pond in large amount can become the cause of fish death in the pond later.

Conclusion

It is very clear that the use of fertilizer in the fish pond is an essential part of fish cultivation. Both organic and inorganic fertilizers can be used according to need. It helps in supplying food for the fish and increasing the growth rate. Goodproduction will secure the economy and livelihood of the fish farmers.

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