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## Technology demonstration and their impact


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# Success Stories on technology demonstration and their impact on production, productivity, profitability and sustainability in vegetable crops

**S.S. Singh* and S.K. Dwivedi****

*G.B. Pant University of Agriculture and Technology, Krishi Vigyan Kendra Dhakrani, Dehradun, Uttarakhand (E-mail: sssindia02@gmail.com)*
**Present Address : Professor, Entomology and Head, Krishi Vigyan Kendra, Almora, Uttarakhand*
***Scientist 'G' (Horticulture) and Director, Field Research Laboratory (DRDO), Tezpur, Assam*

Vegetable crops provide sustainable income, nutritional security and generating employment opportunity, both in rural and urban areas. One of the significant development of vegetable sector in Uttarakhand is that, vegetable cultivation has moved from rural confine to commercial production due to diversified agro climatic conditions, technological advancement and strategic and visionary planning provided by various agencies and Government which has encouraged private sector investment in production system management (Sardana and Bambawale, 2011; Sardana and Sabir, 2007; Singh and Singh, 2005). The area and production of vegetable crops in Dehradun district have increased from the last one decade particularly in mountain areas of Dehradun. Farmers of hills of Dehradun grow vegetables especially tomato, capsicum, vegetable pea, cabbage, cauliflower from March to October which is the lean period of these vegetables in the plains of Dehradun. Hence, farmers get handsome return of their vegetables despite of low productivity (Singh, 2012; Singh *et.al*, 2014; Singh *et.al*, 2013). If productivity and quality of these vegetables improves by technological interventions, the area, production, productivity and availability of the vegetables grown by the farmers can be enhanced. Some other lucrative vegetables like broccoli, carrot, spinach, coriander, etc. can also be introduced at large scale for off season cultivation as demand of these vegetables is increasing rapidly in the domestic markets. The dream of doubling farmers' income can be achieved by attracting the attention of farmers towards commercial cultivation of off season vegetables along with providing them proper technological guidance suited for the region.

## DIAGNOSTIC SURVEY UNDERTAKEN:

The diagnostic survey was conducted by me in various parts of vegetable growing areas of Dehradun district. During survey I held discussion with vegetable growers to find out their practical difficulties in obtaining maximum yield from their crops. It has been emerged out from the survey that poor availability of high yielding

hybrids and varieties was one of the major constraints in production of vegetable crops. Besides, most of the farmers were not aware about quality and effective chemical pesticides in the area which resulted in high incidence of pests and diseases. During base line survey, group discussion with farmers was held. The observations on varieties, hybrids, incidence of pests and diseases, judicious use of chemical pesticides, their time of application, pest monitoring, nursery raising etc were recorded during group discussion with farmers. It was found that majority of the vegetable farmers were not aware about the high yielding varieties, hybrids and incidence of pests and diseases. Hence, to mobilize the farmers towards technological advancement in vegetable production, trainings were imparted. During training of the farmers, sites were also selected for conducting demonstrations.

1. The prevailing agro climatic conditions in the district of Dehradun was very conducive for commercial vegetable cultivation particularly off season vegetable farming in the mountain and tribal areas of Dehradun.
2. Some farmers involved in vegetable cultivation but they were not getting remunerative price and good productivity from their crops due to lack of knowledge.
3. Keeping in view the enormous potential and increasing demand of vegetables particularly off season vegetables in the market project was formulated to mobilize and sensitize the farmers.
4. Accordingly, diagnostic survey was undertaken in which meeting and survey were organized in the potential areas of the farmers to find out their views on commercial vegetable production. It was observed that almost all the farmers were convinced for vegetable production. Most of the farmers told that they were willing for vegetable farming but due to lack of knowledge and poor productivity obtained by the some farmers they were helpless.

After conducting diagnostic survey, encouraging attitude of the farmers and seeing the potential, trainings and demonstrations had been started organizing by me which gave tremendous impact on the farming community within very short span of time.

## Socio-economic and technological relevance of the project objectives:

The socio economic and technological relevance of the project objectives were to demonstrate the protection and production technologies in vegetable crops to the farmers with an aim to improve the productivity and quality. Due to poor awareness among farming community, most of the farmers were not getting optimum productivity and income from their vegetable crops. It was realized that lack of proper knowledge among vegetable growers on various aspects of protection and production technologies including high yielding hybrids and varieties was the major constraints in achieving expected outcome. Hence, despite of hard work and spending money, they were unable to maximize the productivity which affected their socio economic condition. Accordingly to sensitize the farmers towards high yielding hybrids and varieties and other production and protection aspects, farmers have been trained through imparting trainings and organization of demonstrations so that they could get maximum productivity from their vegetable crops.

According to an estimate about 400 farmers have been trained under training and demonstrations of vegetable crops on protection and production technologies from the last 5 years. The socio economic condition of the farmers increased significantly due to vegetable farming. The data recorded on vegetable faming shows that more than 400 farmers have been benefited directly due to training and demonstration on vegetable crops in Dehradun. Besides, economic losses caused by various pests and diseases have also been reduced in the areas where technological intervention was made. Shoot and fruit borer in brinjal and okra, bacterial wilt in brinjal, chilli, tomato, yellow vein mosaic in okra, fruit borer in tomato, late blight disease and early blight disease in tomato, fruit rot in tomato, leaf curl mite in brinjal and okra, fruit fly in cucurbits, powdery mildew disease in cucurbits, damping off disease in vegetables during nursery, cabbage butterfly in cabbage and cauliflower, etc. were the serious pest problems but now their incidence has been reduced drastically due to timely, judicious and right use of effective chemical pesticides.

1. The additional area under vegetable cultivation particularly in the mountain and tribal area of Dehradun has increased up to about 600 ha which shows that my intervention has helped the farmers in increasing productivity and income both. Thus, their socio economic conditions have also improved.
2. The technological intervention made to mobilize and sensitize the farmers towards commercial vegetable cultivation by conducting trainings and demonstrations.
3. Area under vegetable crops particularly tomato, cauliflower, cabbage, vegetable pea, capsicum is increasing year after year which shows that farmers are getting very handsome return from their crops due to which their involvement is rapidly increasing.
4. The technological intervention made on various aspects of integrated crop management particularly introduction of high yielding varieties and hybrids and pest and disease management has been widely accepted and adopted by the farmers which fetched very profitable income and also attracted the attention of neighboring farmers towards commercial vegetable production.

The training and demonstrations conducted on farmers fields under the project shows that demonstrated technologies have been widely accepted and adopted by the farmers due to which their socio economic conditions improved many fold.

## The methodology used for implementing the project:

The trainings and demonstrations based on technological interventions in vegetable crops namely cauliflower, cabbage, brinjal, chilli, okra, bittergourd, tomato and cucumber were carried out by me in different parts of district Dehradun of Uttarakhand during 2012 to 2017 under the centrally sponsored project i.e. Front Line Demonstration programme of KVK, Dehradun, Tribal sub Plan project funded by ICAR, ATMA and NABARD. Before conducting demonstrations, base line survey of vegetable growing areas of Dehradun was done to find out the major constraints in vegetable production. During base line survey, group discussion with farmers was held. The observations on varieties, hybrids, incidence of pests and diseases, judicious use of

chemical pesticides, their time of application, pest monitoring, nursery raising etc were recorded during group discussion with farmers. It was found that majority of the vegetable farmers were not aware about the high yielding varieties, hybrids and incidence of pests and diseases. Hence, to mobilize the farmers towards technological advancement in vegetable protection and production, trainings were imparted. During training of the farmers, sites were also selected for conducting demonstrations. The demonstrations were conducted for 5 years (2013 to 2017) on farmers fields. Seeds of vegetable crops were given free of cost to the farmers. Besides, necessary chemical pesticides were also distributed to the farmers time to time for seed treatment and to manage the menace of pests and diseases in standing crops. Demonstrations were laid out in my close observation. The application of chemical pesticides, if necessary against any pests and diseases was done by the farmers in my supervision. In order to find out the incidence of pests and diseases, crop and pest monitoring thrice a week was advocated to the farmers. Crop and pest monitoring also helped in timely application of chemical pesticides which also reduced the unnecessary use of pesticides. The varieties, hybrids and chemical pesticides identified for demonstrations had already been evaluated and validated by me at KVK, Dehradun. The observations on varietal performance, crop duration, production, incidence of pests and diseases their extent of loss etc were recorded during demonstrations conducted by me on farmers fields to compare the impact of technological interventions implemented in demonstrations with the help of farmers.

## SALIENT OUTPUTS OF THE PROJECT:

**Trainings organized on protection and production technology in vegetables ( 2013 to 2017)**

| Topic | No. of trainings conducted | No. of farmers benefited |
|---|---|---|
| Protection and production technology in vegetables | 42 | 400 |

From the last 5 years (2013-2017) I conducted 42 trainings in which about 400 farmers have been benefited on various aspects of commercial vegetable production. Besides, 500 demonstrations have been conducted in different vegetable crops in about 30 ha area. The demonstrations were conducted in tomato, cauliflower, cabbage, brinjal, chilli, capsicum, okra, bottle gourd, bitter gourd, smooth gourd, onion, garlic. The demonstrations conducted on the farmers field and trainings imparted to them have helped the farmers in expansion of area under vegetable cultivation. According an estimate 600 ha area has been increased under vegetable cultivation in Dehradun district of Uttarakhand from the last 5 years. Introduction of high yielding hybrids and varieties along with effective pest and disease management have enhanced the income of the farmers by improving productivity and quality. The varieties and hybrids introduced for commercial cultivation were Arka Rakshak, Abhinav, Heamsohna, Dipanker, Shaksham, Indam-13407, Abhirang, Ansal, Rakshita Gold in tomato. The

farmers are getting net income of Rs. 3.86 lacs per ha from these hybrids of tomato. In cauliflower, Madhuri, Candid Charm and Girija varieties have been cultivated by the farmers from which farmers are receiving about Rs. 3.12 lacs per ha. net income. Cabbage is also important vegetable crop in which Varun, Krishna and Green Soccer hybrids were recommended through demonstrations and cultivation of these hybrids of cabbage fetched about Rs. 3.45 lacs per ha net income. In brinjal, Chhaya and Nishant hybrids have been recommended to the farmers for commercial cultivation. Due to high productivity and pest and disease management, farmers receiving handsome return of about Rs. 3.93 lacs per ha net income. Chilli is also important crop whose productivity was low but after intervention and cultivation of Soldier and Lahar hybrids enabled the farmers to get about Rs. 4.52 lacs per ha net income. Introduction of Indra and Aasha hybrids of capsicum doubled the production and income of the farmers. Cultivation of these hybrids is fetching net income of Rs. 4.52 lac per ha. In okra, incidence of Yellow Vein Mosaic virus was a serious problem which was adversely affecting the productivity. Demonstrations of Shakti and Sonal hybrids not only improved the productivity but also showed resistance against Yellow Vein Mosaic virus due to which now farmers are earning Rs. 1.90 lacs per ha net income from 3-4 months. Warad and Anokhi hybrids of bottle gourd was also introduced in which farmers getting Rs. 3.82 lacs per ha net income. Bitter gourd is an important cucurbit having very high demand in the market. In this crop, commercial cultivation of Palee and Naudhan hybrids, farmers earning about Rs. 3.04 lacs per ha net income. Similarly in smooth gourd, Lohit and Alok hybrids were advocated to the farmers for commercial cultivation which attracted the attention of vegetable growers due to high productivity and quality. The cultivation of Lohit and Alok hybrids enabled the farmers to get about Rs. 4.0 lacs per ha net income. Onion and garlic are also commercially grown but due to lack of high yielding varieties, farmers were getting poor yield from both the crops. Demonstrations of garlic variety Agri Found Parvati in tribal region of Dehradun improved the productivity due to very good bulb size. Cultivation of this variety helped the farmers in getting net income of Rs. 3.62 lacs per ha. Agri Found Light Red variety of onion also introduced through supply of saplings for demonstrations. This variety has very good adaptability to grow in plains and hills both. The commercial cultivation of this variety fetched net income of about Rs. 2.90 lacs per ha.

1. The area under vegetable cultivation in Dehradun district of Uttarakhand increased up to 600 ha from the last 5 years (2013 to 2017). The technological interventions made by me helped the farmers towards commercial vegetable cultivation.
2. The intervention was made by implementing various projects i.e. training and demonstration programmes of KVK, Dehradun, Tribal Sub Plan project funded by ICAR, ATMA and NABARD.
3. A total of 42 trainings were organized in different parts of Dehradun district from the last 5 years in which about 400 farmers have been benefited directly.
4. The impact of training and demonstrations conducted on farmers fields helped them in knowing the various issues of integrated crop management in vegetable

crops such as introduction of high yielding varieties and hybrids, judicious use of chemical pesticides for pest and disease management, balance use of chemical fertilizers etc.

5. The farmers are receiving 3 times more income particularly in tomato in mountain and tribal region of Dehradun. This happened due to introduction of high yielding varieties and hybrids, pest and disease management followed by nutrient management.
6. About 500 demonstrations on protection and production technology of vegetable crops were conducted by me from the last 5 years in 30 ha area. The result of the demonstrations encouraged the farmers towards vegetable cultivation due to lucrative income as compared to other crops grown by them.
7. From the last 5 years, area under tomato cultivation is increasing rapidly due to off season production (June-October). Due to off season cultivation of tomato, farmers are receiving remunerative price of their tomato fruits in the market particularly Delhi markets.
8. The losses due to incidence of pests and diseases have been managed due to judicious use of chemical pesticides and other IPM practices as vegetable crops are more prone to attack of pests and diseases.
9. The mindset of the farmers has completely changed particularly in mountain and tribal region of Dehradun where vegetable farming is taking the shape of enterprise. Small and marginal farmers whose population is more in mountain and tribal region of Dehradun are also getting premium price due to high productivity of vegetable crops in general and tomato in particular.
10. Keeping in view the commercial production of vegetables in mountain and tribal areas of Dehradun, Government of Uttarakhand has decided to establish cold storage and other post harvest management facilities to encourage the farmers and reduce the post harvest losses.

## Impact of the technologies on the knowledge, skills, attitudes and adoption rate of recommended technologies by the target population

The interventions taken under the project have significantly increased knowledge, skills, attitudes and adoption rate of recommended technologies demonstrated on the farmers fields on protection and production technologies in vegetables. Organization of trainings and technological demonstrations have given tremendous impact on strengthening of knowledge, skills, attitudes and large scale adoption of various farmers friendly technologies pertaining to protection and production in vegetables. A total of 42 trainings organized on protection and production technology in different vegetable crops also encouraged the farmers towards vegetable farming. According to an estimate more than 400 farmers have been trained under training and demonstrations of vegetable crops on protection and production technologies. A total of 500 demonstrations were conducted in 5 years (2013 to 2017) in which 30 ha area were covered. The introduction of hybrids and varieties likeArka

Rakshak, Abhinav, Heamsohna, Dipanker, Shaksham, Indam-13407, Abhirang, Ansal, Rakshita Gold in tomato, Madhuri, Candid Charm, Girija in cauliflower, Varun, Krishna, Green Soccer in cabbage, Soldier, Lahar in chilli, Indira, Aasha in capsicum, Chhaya, Nishant in brinjal, Warad, Anokhi in bottle gourd, Palee, Naudhan in bitter gourd, Lohit, Alok in smooth gourd, Shakti, Sonal in okra, Agri Found Light Red in onion, Agri Found Parvati in garlic under KVK activities. These hybrids and varieties have played an important role in improving productivity per unit area in short span of time and have attracted the attention of vegetable growers for area expansion due to high remunerative return.The organization of demonstrations and their result in terms of improving productivity by introduction of high yielding hybrids and varieties and management of various pests and diseases have also enhanced the knowledge, skills, attitudes and adoption rate among farming community. Besides, some selective insecticides viz., Chlorantraniliprole, Imidacloprid, Spinosad, Indoxacarb, Acetamiprid, Emamectin benzoate, Novaluron, Hexithiazox, Propargite, Fenazaquin have been found effective against economically important pests in vegetable crops, hence farmers should select these insecticides in proper fashion under IPM programme. Among fungicides, Thiophanate methyl, Difenoconazole, Carbendazim, Carbendazim + Mancozeb, Dinocap, Hexaconazole, Tebuconazole, Metalixyl + Mencozeb, Captan + Hexaconazole, Copper oxychloride, Mancozeb have shown their effectiveness against major diseases in vegetable crops.

1. The implementation of the project on protection and production technologies in vegetable crops gave significant impact on knowledge, skills, attitudes and adoption rate of recommended technologies among the farmers particularly in mountain and tribal region because poor productivity in vegetable crops and limited area was mainly due to lack of knowledge, skills, attitudes and adoption rate of recommended technologies by the target population.
2. A total of 42 trainings were organized from the last 5 years in which 400 farmers benefited and exposed on various aspects of protection and production technologies in vegetable crops. The organization of training helped the farmers in knowing about the high yielding varieties and hybrids, losses caused by pests and diseases and their effective management along with nutrient management.
3. There were 500 demonstrations on protection and production technologies in vegetable crops conducted in 30 ha area from the last 5 years under various projects and programmes.
4. The impact of trainings and demonstrations helped the farmers in getting 3 times more productivity and income because earlier limited farmers were cultivating vegetable crops, and they were also not adopting recommended technologies due to which productivity and income from their vegetable crops was very low.

The training and demonstrations organized on the farmers fields and their tremendous impact in productivity and income completely changed the mindset of the farmers due to which the area under vegetable crops is increasing year after year. From the last 5 years the area under vegetable increased up to 600 ha particularly in mountain and tribal region of Dehradun.

**Impact of the technologies on the production, productivity, profitability and sustainability of the relevant agricultural production systems**

| Before Intervention | | | | | After Intervention | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Crop** | **Variety/ Hybrid** | **Average Production (Q/ha)** | **Gross Income (Rs .in lac/ha)** | **Net Income (Rs .in lac/ha)** | **Variety/ Hybrid** | **Average Production (q/ha)** | **Area spread in ha** | **Gross income (Rs .in lac/ha)** | **Net income (Rs .in lac/ha)** | **Remarks** |
| Tomato | Heamsohna | 282 | 2.82 | 2.02 | Arka Rakshak | 582 | 725 | 5.82 | 4.32 | Resistant against bacterial wilt, early blight and leaf curl |
| | | | | | Abhinav | 536 | | 5.36 | 3.86 | Good demand in the market due to round shape and good for distant marketing |
| | | | | | Heamsohna | 512 | | 5.12 | 3.62 | Excellent demand in the market due to round shape and very good for distant marketing but susceptible |

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| | | | | | | | | | | against bacterial wilt |
| | | | | | Dipankar | 520 | | 5.20 | 3.70 | Tolerant against bacterial wilt and good for distant marketing |
| | | | | | Shaksham | 532 | | 5.32 | 3.82 | Tolerant against bacterial wilt and good for distant marketing |
| Cauliflower | Snowcrown | 296 | 2.36 | 1.71 | Madhuri | 492 | 160 | 3.93 | 3.13 | Field holding capacity is very good and demand in the market is very high |
| | | | | | Girija | 490 | | 3.92 | 3.12 | Field holding capacity is very good and demand in the market is very high |
| Cabbage | Varun | 342 | 2.39 | 1.89 | Varun | 512 | 100 | 4.09 | 3.29 | Demand in the |

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| | | | | | | | | | | market is very high due to soft heads |
| | | | | | Charmant | 535 | | 4.28 | 3.48 | Field holding capacity is very good |
| | | | | | Green Soccer | 582 | | 4.65 | 3.85 | Field holding capacity is very good |
| Brinjal | Shyamali | 372 | 2.60 | 2.10 | Chhaya | 589 | 220 | 4.71 | 3.91 | Demand in the market is very high due to good size, shape and attractive colour. Tolerant against bacterial wilt |
| | | | | | Nishant | 596 | | 4.76 | 3.96 | Demand in the market is very high due to good size, shape and attractive colour. Tolerant |

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| | | | | | | | | | | against bacterial wilt |
| Chilli | Divya Jyoti | 148 | 2.22 | 1.77 | Soldier | 232 | 140 | 4.64 | 3.64 | Demand in the market is very high due to long and thin fruits and attractive colour |
| | | | | | Lahar | 220 | | 4.40 | 3.40 | Demand in the market is very high due to long and thin fruits and attractive colour |
| Capsicum | California Wonder | 137 | 2.05 | 1.60 | Indira | 242 | 85 | 4.84 | 3.84 | This hybrid having very good demand in the market due to its fruits size, shape and attractive colour |
| | | | | | Aasha | 235 | | 4.70 | 3.70 | This hybrid having very good demand |

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| | | | | | | | | | | in the market due to its fruits size, shape and attractive colour |
| Okra | Arka Anamika | 152 | 1.21 | 0.91 | Shakti | 245 | 45 | 2.45 | 2.00 | It is resistant against yellow vein mosaic virus |
| | | | | | Sonal | 222 | | 2.22 | 1.80 | It is resistant against yellow vein mosaic virus |
| Bottle gourd | Pusa Summer Prolific Long | 312 | 2.49 | 2.04 | Warad | 482 | 35 | 4.82 | 3.82 | This hybrid having very good demand in the market due to its fruits size, shape and attractive colour |
| Bitter gourd | Kalyanpur Baramasi | 154 | 1.54 | 1.14 | Palee | 256 | 45 | 3.84 | 3.04 | This hybrid having very good demand in the market due to its fruits size, shape and |

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| | | | | | | | | | | attractive colour |
| Smooth gourd | Pusa Chikni Tori | 138 | 1.79 | 1.39 | Lohit | 240 | 50 | 4.80 | 4.00 | This hybrid having very good demand in the market due to its fruits size, shape and attractive colour |
| Onion | Nasik Red | 226 | 1.80 | 1.40 | Agri Found Light Red | 345 | 80 | 3.45 | 2.90 | Problem of bolting is nil and having keeping quality of 6-7 months |
| Garlic | Local variety | 118 | 2.36 | 2.01 | Agri Found Parvati | 256 | 15 | 5.12 | 3.62 | Bulb size is very good and keeping quality of 4-5 months |
| **Total area spread under vegetable cultivation in Dehradun = 1700 ha** | | | | | | | | | | |

## DIFFUSION OF THE TECHNOLOGIES IMPACT ON THE NEIGHBOURING FARMERS

The impact of the demonstrations indicated that diffusion rate is quite encouraging as the technologies demonstrated in the areas are also adopted by the neighboring farmers. The impact of trainings and demonstrations encouraged the neighboring farmers towards vegetable cultivation due to high productivity and remunerative income. According to an estimate more than 600 ha area have been increased from the last 5years due to trainings and demonstrations in vegetable crops under various programmes like Tribal Sub Plan (TSP), ATMA, KVK extension programmes, Watershed Management programmes in Dehradun. The area under vegetable crops especially tomato, okra, cucumber, chilli, brinjal, onion, cabbage and cauliflower has increased considerably in Dehradun district because the farmers involved in vegetable production are getting remunerative return of their produce as compared to other crops grown in the area. According to an estimate more than 2.0 crores seedlings of different vegetable crops including onion have been supplied to the farmers under various programmes from the last 5 years. Some farmers have been identified as motivators under Watershed Management programmes to sensitize other farmers towards vegetable production. The motivators have also been trained on protection and production technologies and management of various pests and diseases. The introduction of onion variety like Agri Found Light Red (developed by NHRDF, Nasik) has achieved the trust and faith of the farmers due to its high productivity, outstanding keeping quality and having property of growing in diversified agro-climatic conditions (plain to high hills). The demonstrations, trainings on various aspects of vegetable crops not only increased the area under vegetables in Dehradun but also helped the farmers of Tehri Garhwal, Uttarkashi and Pauri Garhwal districts of Uttarakhand. Farmers of these districts of Uttarakhand come for trainings at KVK, Dehradun which motivated them towards commercial vegetable cultivation.

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|  |  |
| Scientist imparting training to the farmers | Scientist educating the farmers on poly tunnel technology |
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| Performance of Indra hybrid of Capsicum | Performance of Chaya hybrid of Brinjal |
|  |  |
| Demonstration of Madhuri variety of Cauliflower | Demonstration of Goody Ball-65 variety of Cabbage |

# Broiler Goats – A Solution to Nutrient Deficiency

**Sandeep* and Dhawal Kant Yadav**

[1]PhD. Scholar, Vety. Medicine, RAJUVAS, Bikaner, Rajasthan
[2]PhD Scholar, Livestock Production Management, NDRI, Karnal, Haryana

*Corresponding Author: drsandeepyadav2005@gmail.com

## INTRODUCTION

Broiler goat production system is an intensive system of rearing goats to provide energy, protein and other nutrients in required proportions by feeding semisolid concentrate up to 3months of age, It is highly suitable in areas where green fodder is not available or due to lack of grazing land, It improves the economy of the rural farming community

## WHAT ARE BROILER GOAT KIDS?

There is not any specific breed for this purpose. The kids produced from goats (whatever breed available in your area) can be used for broiler goat rearing. These include both male and female animals. The business is suitable for farmers having goat rearing experience, goat business plan that include construction of shed to marketing is enough to manage broiler goat rearing. For example suppose a farmer is having 50 goats, out of these 20 goats delivered at an avg of 2kids/goat at a time. Total number of kids becomes 40. Let out of these 40 kids (20 male and 20 female) which are having higher birth weight are selected as broiler goat kids

## SELECTION OF KIDS

The goat kids of about fifteen days to one month old i.e. usually the time before the kids start to eat green leaves, they should have good birth weight and must not be used for further breeding. Selected kids should not be allowed to feed on green fodder or grazing green grasses in open field. Deworming should be done on 45th day of rearing as broiler goat and repeated every months till the goats are sold

## METHOD OF REARING

The selected kids are to be reared intensively by providing concentrate feed (goat feed) @5g mixed with equal quantity of rice gruel (broken boiled rice) initially i.e. at start (15-30days). Increase the amount day by day as per feed intake (e.g.: 7g, 10g, and 15g). Add coconut cake, rice bran or groundnut cake with minimum level of 1-2g/day/kid to a maximum of 150-200g/day/kid. Pure water should be available at all times (24hrs)

## FEED SUPPLEMENT

Liver tonic and fish oil should be given twice in a week @ 2.5ml/kid/day initially upto 5-10ml/kid/day. Young kids allowed for mother's milk twice/thrice in a day

## FEED MIXING

Goat feed available in the market or we can prepare feed mix by using following ingredients
Deoiled groundnut cake - 12parts
Horse gram - 30parts
Wheat/maize/jowar (grain) - 30parts
Rice polish/wheat bran - 15parts
Dried unsalted fish - 10parts
Mineral mixture - 1.5parts
Common salt - 1.5parts
Vitamin A, $B_2$, $D_3$- 25g/100kg feed mix

## BROILER GOAT FEED

Based on new technology the special complement feed was developed in modern feed plants. Palletisation is an important process in production of feed. The raw ingredients are selected to meet the nutritional specification of broiler goat feed such as amino acids, glucose and fatty acids, Furthermore the balancing of macronutrients with micronutrients is necessary to accomplish better and faster growth rate.

## WHY NEW FEED TECHNOLOGY??

### 1. AVAILABILITY OF LAND IS LESS

It was a common knowledge that ruminant animals could not survive without consuming forages and fibres. Goat also could not be exempted. Economics of feeding plays a vital role for feeding forage to ruminant animals and depends on capability of these animals to convert non-edible fibre by virtue of rumen fermentation to digestible nutrients like microbial biomass and VFAs. When land availability become less for such forage cultivation the technologists were encouraged to develop new feed technology.

### BYPASS NUTRIENT TECHNOLOGY

By this technology the dietary nutrients are saved from rumen fermentation that will reduce the nutrient losses in animal system. If dietary protein is fermented in rumen the availability of protein through microbial route at the lower tract would be less than 20% but if it is bypassed then yield is around 60%. It is true for glucose and Fatty acid The broiler goat achieve FCR 2.5.

### NUTRITIONAL BIOCHEMISTRY

If 1mole of amino acid was fermented it may yield 1.5moles of ATP In the case of starch 1mole will yield only 0.8 mole glucose whereas when bypassed it yields over 1.6mole glucose. Fatty acids when fed with less fibre will yield more dietary energy when kids are fed at their preruminant stage it becomes more feasible

## HOUSING/SHELTER

A low cost house with raised platform (about 1m height from ground level) can be made by using bamboo/wooden poles or 'pakka' building by establishing concrete pillars. The roof can be thatched with coconut leaves, grass or asbestos sheets. Floor and side walls are to be made up of wooden material. Average floor space per kid is 0.75-1 sq. meter. The floor should have 1cm space between bamboos/wooden planks to allow passage of dung and urine down to the ground

## BREEDING OF PARENT STOCK

Parent stock should be allowed for mating by using good quality male (superior breed) or by using frozen semen at about 45days postpartum (after delivery). There by the farmers can get continuous supply of goat kids for broiler goat production

## ADVANTAGES OF BROILER GOAT REARING

No need to observe estrus signs

1. Fixed time breeding at 72hrs and 96hrs following PGF2α injection
2. Delivery of all mated or inseminated animals at a particular time
3. Reduced inter-kidding interval
4. Effective feed management
5. Gain weight at faster rate, double income
6. Minimum chance of getting infection and disease Easy monitoring and record keeping
7. Easy collection of manure
8. Well protected from heat, cold and severe climatic condition Less risk of predator as they are raised in controlled environment Easy to manage and produce quality tender goat meat

## CONCLUSION

Broiler goat production system has increased FCR, average daily gain and body weight of kids as compared to natural system of rearing, In this system of production the dressing % is higher and chevon produced was tender with less goaty odour. This system doubles the net profit during the same period as compared to natural suckling system. Broiler goat production system can be recommended for chevon production in shorter time period with more profit.

# Tank Silt – An Eco-friendly Soil Health Enhancer

**C. Subha Lakshmi[1*] and G. Ranjith Kumar[2]**

[1]*Acharya N G Ranga Agricultural University, Andhra Pradesh, India*
[2]*Dr. PanjabraoDeshmukhKrishiVidyapeeth, Akola, Maharashtra, India*

**Corresponding Author: subhalakshmi2410@gmail.com*

Soil healthis the capacity of a living soil to function, within ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and promote plant and animal health. In order to meet the dietary requirement of burgeoning population enhancing production continues as an inevitable demand. Fertilizers have played major role and are major components aiding in enhancing crop yields but indiscriminate use of chemical fertilizers by farmers to augment production poses several negative impacts on soil health. The perils associated with excessive application of fertilizers include impairment of soil biological community and soil reaction.Utilizing ecofriendly nutrient rich sources either solely or in integration with chemical fertilizers are viable nutrient management options benefitting the enhancement of soil health along minimizing environmental pollution.

Unsustainable land use management coupled with vagaries of climate aggravate the process of soil erosion which results in loss of top soil rich in nutrients. Soil erosion reduces the fertility of lands and also causes siltation in the water harvesting structures such as earthen dams, tanks built downstream of these lands.Sediments at the bottom of the tank deposited due to upstream land erosion and leaching is referred to as *tank silt*. Tank silt is rich source of nutrients (Table 1) and its application to cropland soils could be regarded as a viable option to supplement nutrient needs of crops ultimately curtailing the quantity of chemical fertilizer application.Silt deposition in the tanks reduces the water storage capacity and also the percolation potential by forming silt pan. Therefore, periodic desilting is traditionally practiced.

**Table 1.Nutrient contents in tank silt collected from some tanks of eight districts of Andhra Pradesh**

| Parameter/Nutrient | Content (Range) |
|---|---|
| Organic carbon (%) | 0.4 -2.0 |
| Mineral Nitrogen (mg $kg^{-1}$) | 200 -1400 |
| Available P (mg $kg^{-1}$) | 8.0 - 35.2 |
| Available K (mg $kg^{-1}$) | 400 - 600 |
| Available S (mg $kg^{-1}$) | 12 - 50 |

| | |
|---|---|
| Available Zn (mg $kg^{-1}$) | 0.7 - 2.2 |
| Available B (mg $kg^{-1}$) | 0.3 - 1.0 |

*Based on several tank silt samples in eight NAIP clusters

Source: Srinivasarao et al. 2011

Tank silt also contains significant amount of organic carbon and its application considerably contributes to elevate soil organic carbon (SOC) levels. SOC affects the chemical and physical properties of the soiland the biological activity of microorganisms hence augmenting SOC levels is crucial for soil health maintenance.Tank silt application improves water holding capacity by forming stable aggregates and could be applied to soils having high permeability.

This technology if adopted would aid in elevating soil health status, alleviating drought stress in crops and curtailing the expenditure on synthetic fertilizers. Reduction in fertilizer application rates contribute to reduction in emanations of greenhouse gases into atmosphere eventually aiding in climate change mitigation. Apart from this, desilting of tanks and its application on lighter soils is labour intensive and hence could serve as a source of generating off-season employment in the villages.

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# Consequences of Land Reforms and Way Forward

**Diwaker Singh Tome[1] and Alok Singh Jayara[*2]**

*[1]Research Scholar, MJP Rohilkhand University, Bareilly-243006 (Uttar Pradesh)*
*[2]Asst. Professor, Himgiri Zee University, Dehradun - 248197 (Uttarakhand)*

*Corresponding Author: aloksingh.jayara@gmail.com

## ABSTRACT

Land is one of the four factors of production in agriculture. The viability of land holding emanates from the size of land holding. It determines the economies of scale of various agriculture operations. The historical injustice to the cultivators through zamindari system had led to the implementation of the land reforms after independence. With time gradual fragmentation of land through inheritance laws has reduced the per capita land holding. This has reduced the viability of land holding as a consequence of reduced economies of scale. It is required to delve on the issue as it will decide the future of agriculture in India. We have tried to bring out the issue for the critical thinking among researchers and policy makers.

**KEY WORDS:** Agriculture, Viability, zamindari system, land reforms, fragmentation, inheritance, economies of scale

## INTRODUCTION

Agriculture is the one of the most primitive activities human has undertaken for his existence. The long history of interaction of man and land has gone through various stages. The word stages need to be elaborated here. The word stage is in the context of interaction between man and land which had been multi-dimensional in nature and exhaustive in its scope. It not only contains the methods and the methodology of the farming and the changing style and methods with advent and advancement of the agri science and technique but also discuss about the measurement and ownership patterns which evolved over time.

The financial viability of agriculture is important for the economy of any nation. This is even more important for a nation like India as it is the largest employer and also the central wheel of the chariot of the economy. Agriculture has a share of 16.5 per cent of GVA in year 2019-20 (Economic survey 2019-20) and shared 42.39 per cent of the total workforce in year 2019 (Statista 2020). Though there had been a decline in the share of agriculture in Gross Domestic Product over the years since independence,

comparative decline in terms of its share in employment had been miniscule. Thus it had also become a performance parameter of the economy and the welfare index of society at large.

Like any other sector, agricultural development requires both scientific and policy interventions. The scientific intervention had been in form of Green revolution and it is continuously improved as the situation demands. The policy interventions are required mainly in land, credit supply and product marketing. Land is an important aspect for improving crop productivity. This becomes more important in our country as we share 17.5 per cent of the total global population and only 2.3 per cent of the global land area. In this paper, we will discuss the land holding pattern and arrangements in three periods i.e. pre-independence British era, post independence and the present times.

## HISTORY OF LAND REFORMS IN INDIA

Once we zoom in to the revenue and income generation of the agriculture all these three times had clearly visible priorities. In the pre-independence period, the primary aim of British Government was revenue generation. The peasants were forced to cultivate the crops which were most profitable for the Government e.g. *Tinkhatia* system where peasants were forced to grow indigo crop in 3 *bighas* out of 20 *bighas.* The idea of doing any kind of welfare of improving the condition of peasants was alien to the contemporary rulers and they could only think of the style and arrangements of land cultivation, taxation and ownership which suits to their administrative style and efficacy the most. The major arrangements of the time were zamindari, ryotwari and mahalwari systems. The zamindari system was the most exploitative as there was no security of tenure.

Then comes the era of post dependence Agricultural conditions. Due to the peculiarities of the time and the primarily chaotic prevailing conditions of India and the world over, it was a distant dream to think about beyond the food production for masses and India was facing severe shortage of food grains. With the passage of the time, post-independent India started stabilizing and the thrust started shifting from the stabilizing and normalcy creation to the developmental and betterment ideas. The mind of policy maker started exploring and focusing on the broader aspects like poverty eradication, self-sufficiency, socialistic pattern of society, literacy, rich poor gap, redistribution of the national resources, growth rate, infrastructure, social security and a long list on this continuum. Owing to the recommendations of the J.C. Kumarappa committee, reforms started creeping in all the dimensions of agricultural growth and development. Additionally, due to widespread poverty as high as the 70 percent at the time of independence the government had a challenge to reduce this number and improve the conditions of the Indian population. Agriculture being the pivotal economic activity then, contributed 48 to 60 percent of the national GDP and approx. 70 % of total employment. Any solution of addressing the poverty issue had to go throughthe route of Agri revolutions. It is from here the attention of the policy framers was drawn to the

uneven distribution of land occupancy and the genesis of the redistribution of land was sown. Land reforms were basically to comprise of abolition of intermediaries/ zamindari, land ceiling & redistribution, tenancy reforms and land consolidation. One more dimension added to this in recent times is modernization of land records. The legislations regarding land reforms were aimed at following:-

1. To abolish the Zamindari system and the removal if intermediately between the tillers and the government.
2. Giving the cultivating rights to the actual tillers.
3. Reforming the legislation with regard to the tenancy
4. Streamlining the land tenure system
5. Ensuring the viable holding size and concentrate the scattered fragments to adjoining units.
6. Bring uniformity in succession rules.

The zamindari system prevalent at that time was a major bane and the conditions of the real tillers were pathetic. Further the distribution of the land was also unjustified. The prevalent Agricultural system was a major cause of widespread poverty of Indian rural masses. The re-distribution of land was a swift solution and apparently justified to settle the many socio-economical problem of that era. Thus, the states passed zamindari abolition and land ceiling acts. No common measure of land holding was made, with every state enacting its own system of arrangement more suited to its geo-political requirements. Further the revision in the act was done in 1970 – 71 in order to bring uniformity across the nation. With the implementation of Zamindari abolition act, intermediaries between the land and the government were abolished and nearly 20 million of tillers were made the owner of the land and were made a direct party with the government. Further nearly 142 Lakh acres of land was distributed among the landless peasants. However, in comparison of abolition of intermediaries, Government was not able to implement other acts in letter and spirit. For example, under the ceiling law only 1.7 per cent of total cultivated area has been declared surplus and only 1 per cent of it has been distributed (Misra and Puri, 2000). Further, lot many exceptions were created in the law, which in itself resulted in to massive litigation and im-proper implementation of the land ceiling. The affected landlords approached to court, primarily on the issue of compensation. There had been tussle between the judiciary and executive as the Right to property was then the part of the fundamental rights (Art 12-35) of the constitution. Consequently, the provisions pertaining to land reforms were brought under Schedule IX of constitution of India to escape the judicial scrutiny. Without going into nitty-gritty of the legislative arrangement, it would be suffice to mention that at that time the redistribution of the land was considered as the panacea for solving the mammoth poverty and settling the contemporary social problems.

As it has been earlier mentioned that among the various legislations, abolition of intermediaries and land ceiling act were implemented. There may be the lack of calculations pertaining to the redistributions and their fragmentations generations after

generations. Below is a hypothetical table indicating how inheritance laws impact the outcome and by itself turn out to be a menace for itself in the third generation. In the simplest scenario we take case of family of 5 members, and with an irrigated land of 7.30 hectare. (as originally conceived under UP imposition of ceiling on land holding act, 1960).

**Table 1: A hypothetical case study of land redistribution based on the inheritancecustoms**

| | | |
|---|---|---|
| Original (First stage) | 7.30 Ha | Above the individual ceiling of 02 Ha allotted and considered as proper by law |
| First division(Second stage) | 7.30 Ha/3 =2.43 Ha | Near the individual ceiling of 02 Ha allotted and considered as proper by law |
| Second division(Third stage) | 2.43 Ha/3 =0.81 Ha | Near the individual ceiling of 02 Ha allotted and considered as proper by law |

The following assumptions have been made while calculating the division of land holding in the table above.

1. Standard family of five consists of parents and three children.
2. The family division is only among the children's and the temporary sub rights of mother are not taken into consideration.
3. The land is neither added by any means nor reduced by selling out.
4. All the sons have the similar family size and all the siblings are authorized for equal division.
5. No other change in land laws and legal provision takes place during this whole study period.

Once we interpret the above table we can easily conclude that the provisions which were made at the first stage were doomed to fail and itself turn into the menace itself maximum by the third stage, and the vicious cycle of the poor will complete the whole tern by mid of second stage of maximum by the beginning of the third stage. The main thrust behind the redistribution of the land as to uplift the poor and giving land to the landless people, and by the end of first division they are almost back to square one. So, the whole of the benefits thorough land redistribution were sure to nullify within a medium span of period. Though the inverse relationship between the land holding size and productivity is well documented, the economies of scale in small farms make them highly unprofitable. It is evident with the fact that Green revolution had benefitted the large farmers mostly due to the economies of scale. The marketable surplus is also reduced as the land holding decreases which can also jeopardize the food security of the nation. Thus, implementation of land ceiling act in absence of any roadmap for land consolidation clearly seems to be devoid of long-term pragmatism and foresightedness and had in itself the genesis of self-destruction.

If we consider the larger than this average family size, the condition of the second division will advance by the whole one new generation period and the slipping of benefits will start from the second stage itself.

## WAY FORWARD

Any study which reveals only the lacunas and does not provides for the solution is lopsided and does only partially serves its purpose. There is strong need to analyse the causes and remedies for the declining land holdings. One of the major step required is the reducing the dependence of the population on the agriculture. It had been seen that the agriculture has seen a decline in the share in national GDP, however, the comparative decline in employment is very less. Thus, it can be inferred that the other sectors e.g. services which had replaced the agriculture in the GDP are not strong enough in providing employment to masses. It is needed to develop the manufacturing and small scale enterprises which are more employment intensive.

Making the land holdings economically viable will require two fold approaches to the problem. One is reducing the further fragmentation of the land holding and second is to take out more and more people out from the agriculture in general and subsistence agriculture in particular. To reduce the further fragmentation of land holdings, fixing the minimum viable land holding and beyond which its compulsory acquisition by the Government can be good option. It will deter the farmers from further fragmentation of land. However, the compulsory acquisition of the unviable land holding should take care of the livelihood of the affected farmers. It should also be ensured that prices of acquisition of such land shouldn't be a loss situation for them. The land acquired under this programme should have destined utilization strictly for agricultural purposes. Consolidation of land holdings is another good option. However, the major barrier towards the consolidation is the differing nature of the land quality at different locations. In such situations, the classification of land according to their suitability needed to done (e.g. it can be done in line with land capability classification of United States Department of Agriculture). The farmers if allotted the alternative land at some other place of inferior or superior quality suitable compensation in form of rent should be ensured.

The various land leasing legislations are not uniform across the states. In some states they are non existent. It is needed to have strong land leasing act in every state so that there should not any fear of losing the land or tenancy rights. The lesser population in the country side depending on agriculture and strong land leasing legislation can act complementary in land consolidation in agriculture.

Contract farming is the another option. The recent Government initiatives in form of Farm Bill, 2020 are praiseworthy steps. These will not only ensure the economies of scale of unviable land holdings but it will also promote the investment in the post harvest management of the agricultural produce.

The fragmentation of land in Indian perspective occurs mostly on account of inheritance. This becomes more important where agriculture is the main source of livelihood. This not only makes the land holdings after certain generation but it also leads to subsistence form of agriculture with disguised unemployment. The remedy lies in promoting the employment in allied activities where the requirement of land is less

e.g. livestock and poultry and the non farm employment like small scale industries and agri processing industries.

The above measures are indicative in nature. The research and development in the field along with the study of the land holding pattern of different states can bring out some successful models to the fore. The promotion of farming system approach in the field of agriculture research will help in generation of technologies which will be more aligned with the small and marginal land holdings.

## CONCLUSIONS

India is blessed with varied geographic and climatic conditions. Thus in almost all the agricultural and horticultural produce, we are having good position. Hwoever, when we compare the productivity with peer nations like China, there seems to be big gap. This is certainly have an impact on the production. India has total arable land of 160 mha, which is around 11 per cent of the global and stands nest to USA. The productivity gain can transform the food production scenario of India. Land consolidation can bring economies of scale which will definitely play a big role in the productivity improvement in India.

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# Ideal nursery trees for advanced high density orchard planting systems

**K.L. Kumawat[1] and W.H. Raja[2]**

[1]*ICAR-Central Institute for Arid Horticulture,*
*Sri Ganganagar Highway, Beechwal Industrial Area, P.O. Bikaner-334006, Rajasthan*
[2]*ICAR-Central Institute for Temperate Horticulture, K.D. Farm, Old Air Field, Rangreth, J &K*

*Corresponding Author: kishan84hort@gmail.com

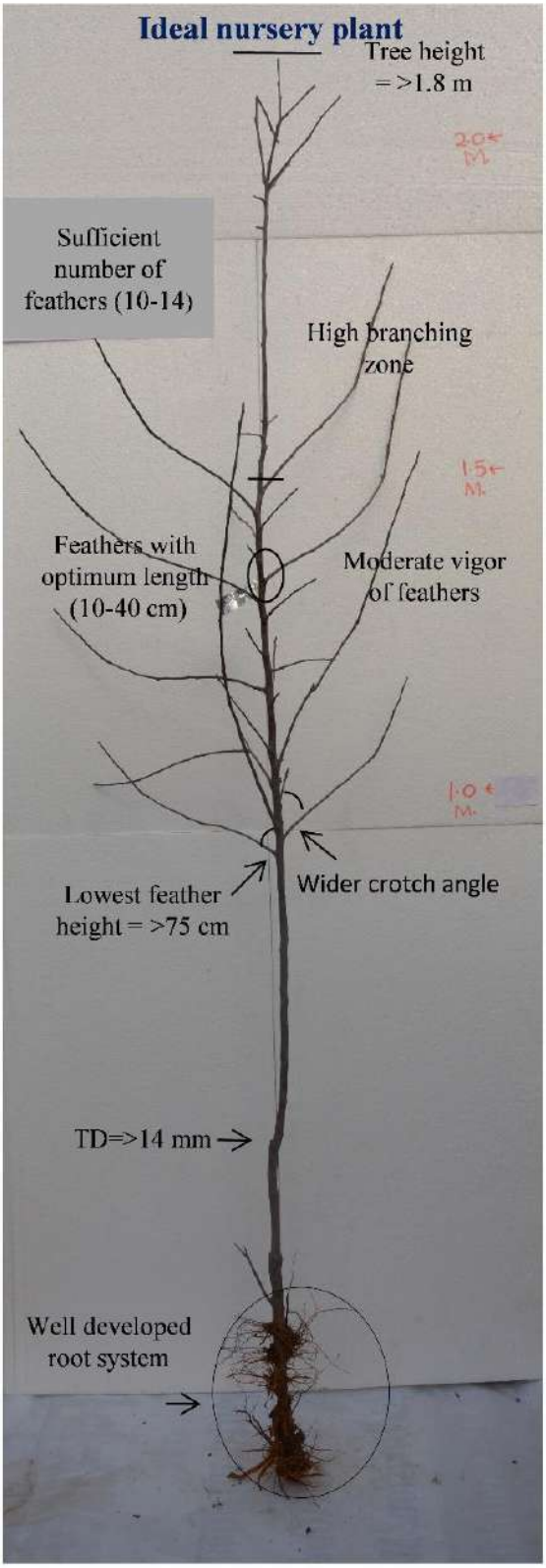
Selection of planting material does not end with choosing right cultivar on right rootstock. Suitable nursery plant must be chosen based on an orchard planting system because the quality of nursery plants has a main impact on the early production and profitability of high density orchards. Now a day's vertical planner orchard planting systems (VPOPS) with conic shaped canopy *viz*. Tall Spindle, Vertical Axis, Slender Pyramid, SolAxe, HYTEC *etc*. are dominating systems for apple high density planting throughout the world. These systems are specially designed for apple high density by utilizing high quality feathered nursery plants to ensure early production, which in turn help to cover the substantial increased cost for establishment of high density orchard.

## CHARACTERISTICS OF AN IDEAL NURSERY TREES.

1. Ideal nursery plant should be at least 6 feet tall with dominant straight central leader. Tall nursery plant is beneficial for obtaining high yield efficiency in initial years. Well-developed flower buds on the upper parts of the leader promote yield in the second year and sustain autonomous branching with bourse shoots in the subsequent years. Additionally, tall nursery plant help in acquiring targeted tree height (10 feet at the end of second year) in VPOPSs.
2. The initial large caliper of the nursery plants at planting leads to greater growth and yield in initial 4 to 5 years. At early age of tree, crop load is generally determined by trunk diameter, hence ideal nursery plant should have at least 14 mm trunk diameter at 10 cm above bud/graft union to produce significant yield during second year.
3. It is considered that well feathered nursery plants should have at least 5 to 7 feathers but now a days with rapid adoption of VPOPS which is completely based on renewal pruning, utilize 10-12 feathered apple nursery plant for planting.
4. Once lateral develop on nursery plant they need to grow a desirable length since feather length and orchard tree productivity are linked positively. Generally feathers less than 10 cm in length are not considered as ideal feathers. For high density

planting the feather length of apple nursery plant should be less than 40 cm to reduce branch manipulation after planting.

5. Nursery plants should have feathers with moderate vigor to avoid renewal pruning in early years of orchard establishment. In general at lower part of plants, feather diameter should not be more than 50 per cent of the trunk diameter whereas, at upper part of plants it should not be more than 33 per cent of the trunk diameter.
6. The height of first feather from ground is important determinant of quality of nursery plant. VPOPS in which tying down of lower branches (to manage vigor and induce early high yield) is essential component of system, optimum height of starting feathers is 75-80 cm.
7. Feathers should be distributed along the leader at regular interval.
8. Ideal nursery plants should have feathers with > 45º crotch angle from central leader. Feathers with wide angle form strong union and result in early bloom, higher productivity, balanced vegetative growth, and are easily positioned after planting.
9. Ideal nursery plants should have an abundance of healthy roots to support tree canopy during first year.




## ADVANTAGE OF FEATHERED NURSERY TREE-

1. High quality feathered nursery plants with large caliper and high root volume will quickly establish, grows to desired height and fill their allotted space in orchard and consequently improve total light interception in early life of orchard.
2. Feathers form flower buds during first year in orchard and will produce significant yield during second year which will help to cover the cost of establishment.

3. Early cropping controls vegetative vigor and consequently results in optimum growth for flowering and fruiting.
4. With the use of well-feathered nursery plants, ideal tree canopy can be obtained easily after planting.

**Comparison between whip and Feathered Tree**

| S.No. | Whip tree | Feathered tree |
|---|---|---|
| 1 | Readily available, easy to grow | Harder to get, harder to grow |
| 2 | Easy to handle and plant | More care required |
| 3 | Not suitable for VPOPS | Essential component of VPOPS |
| 3 | Additional training and pruning required | Less training required |
| 4 | Delayed bearing by at least one year | Yield at least one year earlier |
| 5 | Need heading back | Can be planted at a higher density than whip to the same variety and same rootstock |
| 6. | Difficulty in obtaining of ideal tree canopy | Easy in obtaining ideal tree canopy |
| 7. | Less profitable | Much more profitable |

# Poultry ectoparasites and their management

***Ekta Singh and Devina Sharma**

*Assistant Professor, Department of Veterinary Parasitology, DGCN COVAS, CSK HPKV, Palampur*

**Corresponding author: ektasingh90@gmail.com*

Poultry industry is one of the promising and fast growing sector in India. This sector constitutes two components, the bigger component pertains to the organised commercial sector and the smaller is backyard poultry sector. The smaller sector forms a key component in the sustainment of small and poor farmers by providing a sense of security in terms of food and income generation. According to 19th Livestock census approximately 30 million farmers are engaged in backyard poultry. Despite being an important source of nutrition, the poultry birds are often exposed to several serious threats which directly or indirectly affect the economic growth and development of landless or marginal farmers. Ectoparasitic infestation of poultry cause huge annual losses to the poultryman. These parasites belong to the phylum Arthropoda which contains over 80% of all known animal species. Parasites of poultry are economically important for several reasons. Some transmit disease, but all cause irritation and stress to some degree and can cause anaemia through blood loss, weight loss, drop in egg production and in cases can be fatal.

## IMPORTANT ECTOPARASITES OF POULTRY

1. **LICE:** Heavy louse infestation is known as pediculosis and is particularly common in poultry. Different species of lice on birds includes *Goniocotes gallinae, Cuclotogaster heterographus, Goniodes dissimilis, Lipeurus caponis, Menacanthus stramineus, Menopon gallinae*, etc. They are of importance because of the direct damage they cause by chewing the skin or feathers, although some blood-feeding may occur when the base of feathers are damaged. Clinical importance is therefore usually a function of the density of the lice present. Transmission is usually by direct physical contact.

   **TREATMENT:** Insecticidal compounds, such as permethrin, carbaryl, malathion, cypermethrin, can be used to kill lice. Deep-litter or free-range birds may be more easily treated by scattering carbaryl, coumaphos, malathion dust on the litter.

   CONTROL: Regular checking and spraying of birds will enable infestation rates to be controlled. In addition, cross-contamination should be avoided. This is achieved by treating any birds in the environment of the chickens and restricting contact

between wild birds and poultry. The housing and nesting should be thoroughly cleaned to eliminate sources of reinfestation such as egg-laden feathers.

2. **MITES:** Infestation by mites can result in severe dermatitis, which may cause significant welfare problems and economic losses. Mites cause feeding lesions most commonly seen on the breast or legs of the bird. The feeding nymphs and adults cause irritation, restlessness and debility, and in heavy infections there may be severe, and occasionally fatal, anaemia. Newly hatched chicks may die rapidly as a result of mite activity. Egg production may decrease significantly.

   **TREATMENT:** Treatment of birds is only palliative, and attention should be paid to the mite habitats in buildings. Individual birds may be treated by spraying or dusting the birds with an acaricide such as a pyrethroid or carbaryl, coumaphos, malathion. Systemic control by repeated treatment with ivermectin or moxidectin is effective for short periods.

   **CONTROL:** Buildings and equipment should be cleaned, scalded with boiling water and treated with an acaricide such as carbaryl or synergised pyrethroids. Dimethoate and fenthion may be used as residual house sprays when poultry are not present. Where the mites have invaded dwelling houses their ability to survive in nests, without feeding for several months, makes these important as reservoir sites, and all nests should be removed from eaves once the fledglings have departed.

3. **FLIES:** Several species of manure-breeding flies may be found associated with poultry production facilities which includes the house fly (*Musca domestica*), little house fly (*Fannia canicularis* and *F. femoralis*), black garbage fly (*Hydrotaea aenescens*), black soldier fly (*Hermetia illucens*), blow flies (family Calliphoridae) and several other species of small gnats. Accumulated poultry manure can be highly suitable for fly breeding, especially where general sanitation is poor and when there is excessive moisture. Suitable fly-breeding conditions can be present year round in enclosed high-rise egglayer houses with long-term manure accumulation and controlled indoor temperatures and in shallow pit houses in which manure is held for several months.

Control: Successful fly control in poultry operations should be an integrated approach with emphasis on proper manure management. Four basic management strategies make up a successful integrated fly control program:

a) **PHYSICAL CONTROL:** Management of poultry manure so that it is not conducive to fly breeding is the most effective means of control. Dry manure management is practiced under two types of systems: frequent manure removal (at least weekly) and long-term, in-house storage of manure.

b) **BIOLOGICAL CONTROL:** Manure management practices encourage the survival and build-up of beneficial predators and parasites that can suppress house fly populations. Keeping manure dry also encourages the increase in other insects that compete for nutrients in the manure habitat. Such beneficial organisms as predacious mite (e.g., *Macroceles* sp.) and small black hister beetles (*Carcinops*

*pumilio*) will readily feed on house fly eggs and first-instar house fly larvae. Another group of beneficial insects includes tiny parasitic wasps. Female wasps oviposit their eggs in fly pupae. Inside the fly pupa, the developing larval wasp kills and consumes the fly before it emerges. A natural pathogenic fungus, Beauveria bassiana, has been formulated into a spray product which is sprayed directly over accumulated manure. Adult house flies come in contact with spores of Beauveria that develop hyphae that penetrate into the body cavity of the flies, resulting in death.

c) **MECHANICAL CONTROL:** Screens and fly traps are two methods of mechanical fly control. Where possible, doors and windows should be screened to prevent entry of flies, especially in processing areas. Several kinds of fly traps are available. Some traps consist of a fly attractant in a liquid to attract flies, and others are electrical, employing a black light with either an electrically charged grid to kill the insects or sticky sheets to get attracted flies stuck.

d) **CHEMICAL CONTROL:** Insecticides should be considered as supplementary to sanitation and management measures aimed at preventing fly breeding. Producers should monitor fly populations on a regular basis to evaluate their fly management program and to decide when insecticide applications are needed. Chemical insecticides can play an important role in an integrated fly control program. However, improper timing and indiscriminate insecticide use can lead to increased fly populations. Also, selective application of insecticides can avoid killing beneficial fly predators and parasites. Insecticide applications may be directed to adult flies (adulticides) or fly larvae (larvicides).

## CONCLUSION

Ectoparasitic infestation in poultry is a ubiquitous problem responsible for creating deleterious effect on poultry production. These diseases are not life threatening to poultry but they indirectly are responsible for decrease eggs and meat production in poultry industry. To help the farmers in raising healthy birds, it is required that proper knowledge of important parasitic diseases and their management should be given to them, so that these farmers can gain maximum profit.

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# Climate change impacts and alternate practices to climate change

**Jatinder Kaur**

*Research Fellow, Department of Climate Change and Agricultural Meteorology*
*Punjab Agricultural University, Ludhiana - 141004*

**Corresponding author: jkbrar7@gmail.com*

**ABSTRACT**

The United Nation's Framework Convention on Climate Change (UNFCCC) defines climate change as "a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, and that is in addition to natural climate variability over comparable time periods". Climate change has also been connected with other damaging weather events such as more frequent and more intense hurricanes, floods, downpours, and winter storms.Climate change and global warming scenarios are adversely affecting crop productivity in different regions.Productivity of crops is highly dependent on climatic changes, but it needs to be maintained at a higher level to meet the future food demands of increasing population in India.

**Key words:** Climate change, crop production, alternate practices, agriculture

Climate is one of the most important input factors for agricultural productivity all over the world. Global warming due to greenhouse effect is expected to change the climate of many regions on entire earth surface, which can have adverse impacts on crop productivity. Previous studies have shown that crops would respond positively to increased $CO_2$ in the absence of climatic variability (Sushila, 2001), but the associated impacts of changing temperatures, rainfall pattern and frequency of damaging events like floods, may unite to decrease yields and increase risks in agricultural productivity in different parts of the world. Studies carried out in India indicate the possible loss of 4-5 million tons in wheat production with every 1$^{o}$C rise in temperature, even after considering carbon fertilization but no other adaptation benefits and changes in irrigation water availability (Aggarwal, 2008). IPCC (2014) has predicted a rise of global surface temperature within range of 0.4–2.6$^{o}$C in 2046–2065 and 0.3–4.8$^{o}$C in 2081–2100 relative to the reference period of 1986–2005. Indo-Gangetic plain is likely to experience a 0.5–1.0$^{o}$C rise in average temperature during mid-century (MC) and 3.5–4.5$^{o}$C rise in end century (EC); and increased frequency of extremely wet rainy seasons. The state of Punjab, the food bowl of India, is also experiencing the fluctuating weather conditions.Kaur et al., (2013) reported a significant increase in temperature especially minimum temperature in Punjab during

the last 40 years. The temperature and rainfall fluctuations have already started taking a toll on wheat productivity in the state under climate warming and higher $CO_2$ concentration; the crop production could be affected in several ways. Under such conditions, there is a need to evaluate the climate variability impact on productivity of crops on regional level, so that management strategies can be worked out accordingly.

## POTENTIAL IMPACTS OF CLIMATE CHANGE ON DIFFERENT SECTORS OF AGRICULTURE

### CROP

- Increase in ambient $CO_2$ concentration is beneficial since it leads to increased photosynthesis in several crops, especially those with $C_3$ mechanism of photosynthesis such as wheat and rice, and decreased evaporative losses. Despite this, yields of major cereals crops, especially wheat are likely to be reduced due to decrease in grain filling duration, increased respiration, and / or reduction in rainfall/irrigation supplies.
- Increase in extreme weather events such as floods, droughts, cyclones andheat waves will adversely affect agricultural productivity.
- Reduction in yields in the rainfed areas due to changes in rainfall patternduring monsoon season and increased crop water demand.
- Incidence of cold waves and frost events may decrease in future due to global warming and it would lead to a decreased probability of yield lossassociated with frost damage in northern India in crops such as mustard and vegetables.

### WATER

- Demand for irrigation water would increase with rise in temperature and evapo-transpiration rate. It may result in lowering of groundwater table at some places.
- A significant increase in runoff is projected in the wet season that, however, may not be very beneficial unless storage infrastructure is vastly expanded. This additional water in the wet season, on the other hand, may lead to increase in frequency and duration of floods.

### SOIL

- Organic matter content, which is already quite low in Indian soils, wouldbecome still lower. Quality of soil organic matter may be affected.
- The residues of crops under the elevated CO2 concentrations will have higher C:N ratio, and this may reduce their rate of decomposition and nutrient supply.
- There may be a change in rainfall volume and frequency, and wind may alterthe severity, frequency and extent of soil erosion.
- Rise in sea level may lead to salt-water ingression in the coastal lands, turning them less suitable for conventional agriculture.

## ALTERNATIVE PRACTICES TO CLIMATE CHANGE

- **Conservation Agriculture**

Conservation agriculture is a management system that maintains a soil cover through surface retention of crop residues with no till/zero and reduced tillage.

- **Minimal mechanical soil disturbance**

The soil biological activity produces very stable soil aggregates as well as various sizes of pores, allowing air and water infiltration. This process can be called "biological tillage" and it is not compatible with mechanical tillage. With mechanical soil disturbance, the biological soil structuring processes will disappear. Minimum soil disturbance provides/maintains optimum proportions of respiration gases in the rooting-zone, moderate organic matter oxidation, porosity for water movement, retention and release and limits the re-exposure of weed seeds and their germination.

- **Permanent organic soil cover**

A permanent soil cover is important to protect the soil against the deleterious effects of exposure to rain and sun; to provide the micro and macro organisms in the soil with a constant supply of "food"; and alter the microclimate in the soil for optimal growth and development of soil organisms, including plant roots. In turn it improves soil aggregation, soil biological activity and soil biodiversity and carbon sequestration.

- **Diversified crop rotations**

The rotation of crops is not only necessary to offer a diverse "diet" to the soil microorganisms, but also for exploring different soil layers for nutrients that have been leached to deeper layers that can be "recycled" by the crops in rotation. Furthermore, a diversity of crops in rotation leads to a diverse soil flora and fauna. Cropping sequence and rotations involving legumes helps in minimal rates of build-up of population of pest species, through life cycle disruption, biological nitrogen fixation, control of off-site pollution and enhancing biodiversity.

- ***Cultivation systems***

Bed planting in rice-wheat system is a technique for improving resource use efficiency and increasing yield. This technique not only saves the resources like water, nutrients and labour but also facilitates the greater diversification of cropping system. In this system wheat is planted on top of raised beds that are usually superficially reshaped for sowing the next crop. Irrigation is applied through the furrows between the beds which greatly enhances water conservation and drainage. The great benefit for wheat production resulting from bed planting is the tremendously enhanced field access which facilitates controlling weeds and other pests, handling nutrients, reducing tillage and managing crop residues.

Zero tillage is a technology where the crop is sown in a single tractor operation using a specially designed seed-cum-fertilizer drill without any field preparation in the absence of anchored residue at optimum to slightly wetter soil moisture regimes. Zero tillage allows timely sowing of wheat, enables uniform drilling of seed, improves fertilizer use-efficiency, saves water and increases yield up to 20%. Success has also been achieved in

bed planting of wheat, cotton and rice. This has resulted in savings in irrigation water, improved fertilizer use and reduced soil crusting.

- ***Breeding for stress tolerant cultivars***

In view of the future climate change scenarios, breeding of stress resistant / tolerant cultivars seems to be the need of the hour. Identification of stress tolerant genes and their incorporation into high yielding varieties is a challenging task for the breeders and biotechnologists. The latest breeding and biotechnological techniques are required to put in action to develop stress resistant cultivars to face challenges of future climate scenarios especially cool season crops like wheat.

- ***Mulch application***

**Mulching**, that is using plant residue to cover soils and that way facilitate their incorporation during tillage into the soils as organic matter (soil organic carbon) is another way to improve soil resilience to climate change. This is because the integration of mulch into the soil increases its humus content, improves soil structure and soil organic carbon content. It increases water holding capacity of the soil thereby making water available to plants during dry spells. Such soils are also less prone to nutrient leakage and soil erosion by water. However, the effectiveness of mulching depends on environmental conditions, agricultural practices, type of crops and time of application.

- **Crop rotations**

Well managed and synchronized crop rotations (for example, growing green manure legumes as fallow crops) help revitalize the soil and reduce the persistence and spread of crop pests and diseases. Plants with a deep root system serve well for drought resistance and carbon sequestration (e. g. perennial crops and trees) while those with shallow roots (mainly annual crops) serve well for quick establishment of plants. As these different plants explore different and complementary regions of the soil profile they increase the water use efficiency and nutrient cycling.

- **Alley cropping**

This increases nutrient cycling through increased total biomass production with or without fertilizer. Alley cropping can improve nutrient cycling whereby nitrogen-fixing trees are planted in parallel rows to crops. Through alley cropping, biomass production can also be increased. Food crops are then planted in between the rows in the "alley" while the trees protect the soil from erosion and fix nitrogen in the soil. Products from the tree like wood, fruits, livestock fodder can enhance farmers' incomes.

- ***Crop simulation modeling***

Crop simulation modeling studies can be of great benefit to assess the impact of climate change scenarios on crop productivity, to evaluate sensitivity of different regions to these impacts and to explore most effective options for managing climate change impacts. This otherwise requires very expensive infrastructure to conduct research under controlled climate conditions and poses a serious hindrance to research studies especially in the developing countries. However, crop simulation

modeling can replace these requirements and can be used quite effectively climate change for impact and management.

- ***Weather forecast and agro-advisory services***

Availability of effective weather forecast and agro-advisory services is another important step for managing climatic risks in crop production. Based on the weather forecast and agro-advisory bulletins farmers can take short-term decisions of irrigation application, spray application etc. to avoid wastage of costly inputs and improve crop productivity by saving it from adverse weather conditions. For instance, withholding irrigation application in view of prediction of rainfall / dust storms, which is quite common under Punjab conditions during the month of March coinciding with maturity period of wheat crop, can save electricity and reduce cost of cultivation along with improving wheat productivity by saving the crop from lodging and thus avoiding yield losses. By adopting weather based agro-advisory bulletins farmers had significantly reduced input cost and increased net returns. Weather forecast and agro-advisories help in increasing the economic benefit to the farmers by suggesting them suitable management practices according to the weather conditions.

## CONCLUSION

Undoubtedly, the changing climate scenarios are posing severe threat to crop productivity in different regions. Different climatic parameters namely, temperature, moisture, sunlight and wind etc. during crop growing period, especially during reproductive growth phase, have significant effect on crop productivity. Thus, deviations in these parameters under global warming and changing climatic scenarios will have adverse impact on crop productivity. Different alternative measures need to be adopted. In addition to this, breeding for stress tolerant cultivars, conducting crop simulation modeling studies, and following weather forecast and agro-advisories for taking tactical short term decisions is the need of the hour to sustain crop productivity under changing climatic conditions.

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# Plasmid Free- Gene Editing

**M. Swetha Sree**

*Ph.D Scholar, Department of Crop Physiology, SV Agricultural college, ANGRAU, Tirupati -517502.*

*Corresponding author: m.swethasree92@gmail.com*

Genetic variability is a vital resource for phenotype enhancement and crop improvement. For a genetic variation to occur naturally it takes thousands of years. The phenotypic and genetic variations of a plant also depend on the environment variables and scientist have to use different methods to induce heritable mutations in a genome.

In the past century, the use of various mutagens like use of chemical compounds and irradiation were commonly used in traditional breeding programs to induce random mutations. These approaches however have many disadvantages including non specific existence of mutations There by targeted gene editing gained importance. The development of sequence-specific engineered endonucleases, the mega-nucleases, zinc finger nucleases (ZFNs), transcription activator-like effector nucleases (TALENs) and type II clustered regularly interspaced short palindromic repeat (CRISPR)/CRISPR-associated protein 9 (Cas9), has paved the way for targeted gene editing in plant genomes. The most effective gene editing tool available, the well-developed CRISPR/Cas9 system, is an RNA-directed DNA endonuclease adapted from the bacterial immune system.

These days, probably the most commonly used gene-editing approach in labs is the CRISPR/Cas9 system, in which a guide RNA—specially designed to match part of the sequence of a target gene—positions the Cas9 nuclease at that gene, enabling it to chop the DNA. Ressearchers have been using DNA plasmids, both naked and inside infecting bacteria, to transfer Cas9 and guide RNAs into plant tissues and cells. This method uses *Agrobacterium tumefaciens*–mediated transfer of plasmid (T-DNA) encoding Cas9 and guide RNA. *A. tumefaciens* bacteria carrying the plasmid infect plant tissue. This method is mostly used in Sexually reproducing crops, such as wheat, rice, and maize, can be crossbred to remove the T-DNA.Asexual crops, such as grapes, potatoes, and bananas, will retainthe T-DNA. This approach require protoplast regeneration which is a tedious process, time consuming, runs the risk of creating additional mutation.

## GENE EDITING WITHOUT A PLASMID

Sunghwa Choe of Seoul National University and colleagues have devised a technique that avoids the use of plasmids.

## METHODOLOGY:

Preassembling the Cas9 protein and guide RNA complex invitro and then mixing the plant cells that have cell walls removed. The edited protoplasts can then be cultured into small clumps of plant tissue called calli, from which a mature plant can be regenerated. Choe and colleagues have created genetically modified lettuce plants using this approach and have also edited genes in the protoplasts of three other species. Avoiding the use of plasmids should not only prevent any additional unwanted DNA damage. Suitable for sexual and asexual crops

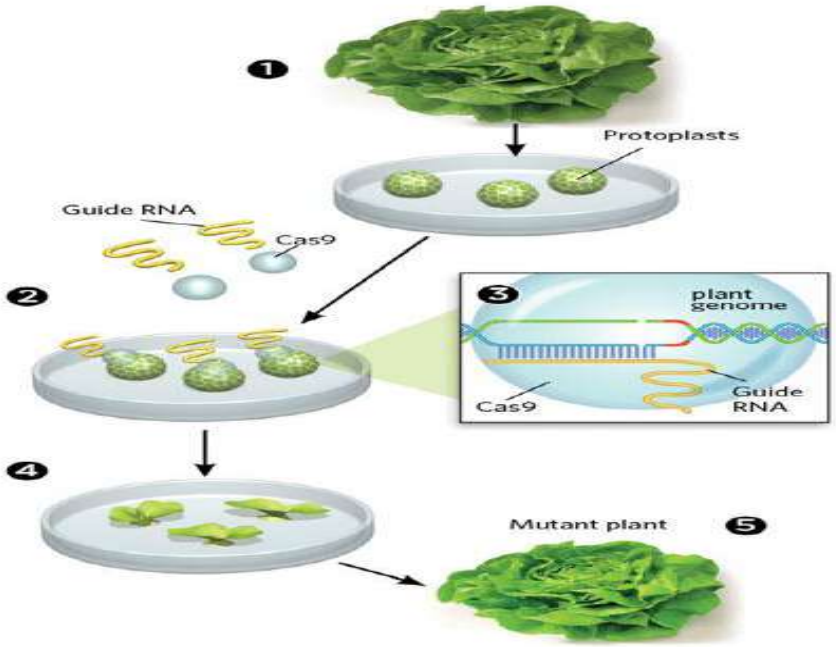


**Fig 1. Plasmid Free genome editing in plants**

(1). Preassembled CRISPR complexes, including a tailor-made stretch of guide RNA and the nuclease Cas9, are introduced into the protoplasts
(2). The complex homes in on the target gene and cuts the DNA at a locus specified by the guide RNA
(3). Protoplasts are then grown in clumps called calli
(4) Which are regenerated into a mature, genetically modified specimen
(5) Development of mutant plant

## CONCLUSION

Genetic manipulation in plants and are likely to assist in the engineering of desired plant traits by modifying endogenous gene. Plasmid mediated gene transfers results in additional mutations. Plasmid mediated gene transfer prevents DNA damage and additional mutations.

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# Planning procedure for setting-up a commercial dairy farm

**Priyanka Lal[1] and Gunjan Bhandari[2]**

*[1]PhD Scholar and [2]Scientist, Division of Dairy Economics, Statistics and Management, ICAR-National Dairy Research Institute, Karnal-132001*

**Corresponding author: gunjanbhandari5@gmail.com*

## ABSTRACT

Dairy farming in India is known for providing supplementary source of income to around 70 million rural households. Earlier it was usually done at subsistence level but gradually it is being commercialized. Demand for milk and milk products are continuously increasing in India with rise in household income, urbanization and health consciousness. Due to this dairy farming is now attracting not only rural population but also highly qualified professionals who are interested in setting up their own successful enterprise. Commercial Dairy Farms generally rear more than twenty animals which unlike traditional dairy farms are mostly of the same breed. Milk produced in these farms is then either directly sold to the consumers, processed for making value added products or sold to other processing units. With this background, the present chapter discusses step-by-step planning procedure for a commercial dairy farm including site selection, selection of breed, initial investment, sources of finance and need of training. It also briefly introduces user friendly software that can be used to simplify the planning process.

## INTRODUCTION

Dairy farming is an important activity in India which supports 70 million rural farm households by giving them an additional source of income. It is generally practiced in small scale with an average herd size of 2.4 animals (Hemme et al., 2010). Though, India leads the world with 187 million tonnes of milk production but this comes from 1.5 adult female cows or buffaloes per farm. The milk productivity also stands at the lower side with 4 litres of milk per farm per day. On the other side, demand for milk and milk products is rapidly growing due to rising population, increasing income levels and urbanization. Demand for processed and packed value added dairy products is also increasing due to changing and fast-moving lifestyle. To intercept this increasing demand and avoid shortage, supply also needs to be increased.Increasing the supply continuously that too in a scenario of depleting resources and climate change is only possible by following scientific practices in intensive dairy farming set-up. This opens

the arena for well-planned Commercial Dairy Farms which are now attracting highly qualified professionals besides the traditional dairy farmers.There is a persistent rise in the number of farm households with 10-15 cows (Dairy farms in India become bigger, 2017)and efforts are being made for modernization of dairy owing to its positive returns. The increasing demand, manageable risks, faster returns and low cost of production are the main drivers leading to large scale commercial dairy farmsin India. Commercial dairy farms are the ones in which cows having high milk productivity are raised commercially for milk production. These are usually mechanized dairy farms which rear more than twenty animals and follow advanced techniques of milk production. Starting commercial dairy farming is a tough row to hoe. It can be made profitable only with proper planning and management.Following paragraphs discuss different aspects of setting upa commercial dairy farm.

## PLANNING A COMMERCIAL DAIRY FARM

Proper planning is necessary for any venture to be successful. Commercial dairy farms differ from subsistence dairy farming in terms of scale of operation and the amount of investment. Thus, before setting up a commercial dairy farm, factors like breed, herd size, housing facility etc. should be carefully considered. Some of these points are discussed below-

1. Training: Before starting a commercial dairy farm, it is important for an entrepreneur to undergo training in different aspects of dairying so that he can get proper exposure. These trainings are organized frequently by various public and private institutes. ICAR-National Dairy Research Institute in Karnal, State Agricultural Universities, Krishi Vigyan Kendra (KVK) present in each districtand Department of Animal Husbandry are the major public organizations which conductfrequent trainings in dairying for the benefit of budding entrepreneurs.Training program helps in getting in touch with latest advancement in dairy farming and also enhances the know-how of practices and prospects. Besides regular training programs, customized programs are also available for the individuals. These programs usually provide hand-holding services right from planning till establishment of the venture to the entrepreneur. Private dairy consultants also provide similar services. At his own level, the entrepreneur can also gain from the experiences of progressive dairy farmers.
2. Site Selection: Once the entrepreneur has decided to set-up a commercial dairy farm, selection of appropriate site is the next important step. Location of the dairy farm has a significant effect on its viability and profitability. Dairy farm can be established either in urban or in peri-urban or rural area. While there is easy availability of feed and fodder in rural areas, close proximity to market is an advantage for urban and peri-urban dairy farms. The cost as well as returns from per liter milk has been found to be higher in peri-urban dairy farms than the rural farms(Patil et al., 2019). Better and efficient management practices followed in the urban and peri-urban farms can be the plausible reason behind

the higher returns(Manivannan et al., 2011). The difference in returns can also be attributed to different prices received due to varied marketing system (relatively shorter marketing channel in the urban areas) (Garcia et al., 2003). Other important points that have to be kept in mind during site selection are the type of consumers, size of market and level of competition.

3. Type of animal and breed selection: Next step in the planning process is selection of the type of dairy animal and its breed. Cattle and buffalo are the main animals reared in India for milk. In the case of cattle, we have both high milk yielding crossbreds like HF Cross, Jersey, Karan Fries etc. and indigenous breeds having better adaptability to the local conditions like Sahiwal, Tharparkar, Gir, Red Sindhi etc.Important breeds of buffalo in India includeMurrah, Jaffrabadi, Mehsana, Surti, Nili Ravi, Bhadavari and Toda.

   Breed should be selected according to the local climate, resource availability and market. The entrepreneurs must be well-acquainted with the adaptability of different breedsto the local conditions. Though, crossbred cattle in India are popular for their high milk yield butthey are more susceptible to diseases and the initial investment and maintenance expenditure is relatively higher in their case (Lal et al., 2016). They are also more susceptible to heat stress and ticks (Wakchaure et al., 2015). On the contrary, indigenous cattle breeds have lower productivity but they are disease resistant and thermo-tolerant (Li et al., 2011; Sodhi et al., 2013). Cost of milk production (Rs./ litre) in India is generally higher for indigenous cattle followed by buffalo and crossbred while net returns follows exactly reverse pattern with highest returns in case of crossbred (Lal, P., 2016) (Makarabbi, G., 2016) (Behera, S., 2016) (Nagrale, B., 2017).

   Indigenous cattle breeds are nowalso regaining popularity due to increase in demand of 'A2' milk.Government has also launched multiple schemes for their conservation under 'Rashtriya Gokul Mission'.Thus, despite lower yield, indigenous breeds can prove profitable to dairy farmers due to premium price for their milk, demand of byproducts (urine, cow dung, etc.) and policy support. Likewise, in certain areas buffalo milk is preferred more for drinking due to its high fat content. Thus, entrepreneur must be well aware about the taste and preferences of the market and government supportfor rearing them before selecting the breed.

4. Housing: Scientifically constructed shed for housing the dairy animals is a pre-requisite for their good health and high productivity. Heat stress, poor ventilation and over-crowdingadversely affect the milk yield. A good shed protects the animal from harsh conditions like high/low temperature, strong sunlight, heavy rainfall, humidity etc.There are two types of housing systems: loose housing system and conventional dairy barn. Loose housing system consists of open space where animals are let loose except at the time of milking when they are brought to the milking area. It is cost friendly method of making cattle shed with easy feeding and management of cattle (Sandoe et al., 1997).

Such type of housing is not recommended for heavy rainfall and temperate areas. The second housing system is conventional barn in which animals are confined on a platform and are milked on the same place. These are covered with roofs and sidewalls and are closed places with proper ventilation. These housing systems are less famous because of high cost of construction but animals are less exposed to harsh conditions. Results of various studies concurs that welfare of dairy animals is influenced by housing systems and loose-housing system have a better welfare quality than those kept in tie-stalls. (Popescu et al., 2014). The shed has to be planned carefully considering both available budget and the climatic conditions of the area.

5. Credit: Any business venture requires initial investment.Seed money in commercial dairy farming is required to buy/rent land for farm, construction of cattle shed, purchase of animals, machinery etc. It is reported that approximately one has to invest 7-8 lakhs for establishing a dairy farm with 10 cows with larger share of expenditure on buying 10 cows (Dairy farm project, n.d) for a project period of 6 years. Study of (Ghule et al., 2012) confirms that share of investment on animals is the highest followed by buildings and equipment. They also found that for average herd size of 16 dairy animals, an investment of Rs.12.17 lakhs is required.For investing this huge amount one needs finance from different sources.Government of India has started many programs in order to promote dairy farmingat commercial scale in India. Central government provides financial support by providing subsidies through interest subvention or capital subsidy. Dairy Entrepreneurship Development Scheme (DEDS) is a central government subsidy program to promote dairy farming. Under this scheme 25 per cent of the outlay (33.33% for SC/ST farmers) is given as back ended capital subsidy for rearing cattle (upto 10). In order to avail this, the entrepreneurs need to apply to their banks for sanction of the project. Bankable project reports may be generated online inorder to determine the sustainability of the project. Team-CD, a decision support system made by ICAR-National Dairy Research Institute helps in easily generating such reports which can further help the entrepreneurs in preparing their credit proposal. After appraisal of the proposal, loan amount is disbursed in installments. State government also provides support through different schemes for which one need to contact local veterinary officers.
6. Registration: Registration of dairy farm is important inorder to get legal clearance of the enterprise. According to Government of India guidelines, food business operators need license from Food Safety and Standards Authority of India (FSSAI) to carry on their business. One may be exempted from this step if they are member of a dairy cooperative society but need to get registered as milk vendor. The type of registration of FSSAI depends on annual turnover of the dairy farm. Other registrations required are company registration certificate which is required for opening of current bank account. MSME registration is required under dairy products to apply for government subsidy and bank loan.

7. Waste disposal system- With shrinking land size and increasing population, waste disposal issues are surging.Thus, waste disposal plan shouldbe prepared along with the plan for main farm. Different wastes originating from dairy farms are: cow dung, urine, feed waste, bedding material, waste water and dead animals. Most of these can be utilized for different purposes. Cow dung can be converted into manure or biogas. Similarly, feed waste can be used for making compost and cow urine can be used to make bio-pesticides. Setting up of vermicomposting unit, bio-gas production unit, etc. provides additional income to the entrepreneurs. Government of India also gives subsidy for establishing vermicomposting unit.

## CONCLUSIONS

Dairy is a profitable venture which is attracting not only the rural population but also the budding entrepreneurs.Since, demand of milk and milk products is expected to rise continuously, there are good prospects for commercial dairy farming.Proper planning and management are must for setting and running a dairy farm profitably. Training on different aspects of dairying can equip the entrepreneur with necessary skills. Hand-holding programs which help the entrepreneur right from planning till establishment of the venture can specifically prove quite beneficial.

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# The Descent of Fall Armyworm and Desert Locust in Indian Agriculture

**Bhumika Kapoor**

*PG Scholar, Division of Entomology,*
*Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu (J&K)*

**Corresponding author: katra.bhumika@gmail.com*

**ABSTRACT:**

This topic highlights the core issue to humankind that is risk to food security due to emerging and invasive pests. In present times, we have been observing the sudden outbreaks of new pests *i.e.* Fall Armyworm *Spodoptera frugiperda* (J. E. Smith) and Desert locust *Schistocerca gregaria* F. with the emerging status which have severely occupied the Indian agricultural fields. The major concern for exacerbation of these pests includes geographical range expansion, climatic variability, physiological and ecological effects, and insect herbivory alterations, multiple generations and development of strains or biotypes of insects breaking resistance of a variety. Therefore, a vast co-ordinated work among researchers will help in accessing their habitats, host suitability and lastly to find the relatable yet modern ways of phyto-sanitary measures to manage the immense damage caused by these invasive pests so as to protect our biodiversity and natural agricultural system.

**Keywords:** *Spodoptera frugiperda, Schistocerca gregaria,* Fall Armyworm, Desert locust, Agricutlure, IPM.

## INTRODUCTION:

In the 21st century, human-race is challenged with the prodigious task of providing food and environmental security to a proliferating population, particularly in developing countries. In India, about 58 % of its population get their livelihood from agriculture and also, the annual population growth is at an alarming rate of around 1.2%/year with growing population of 1.36 billion in 2019 (Anonymous, 2019). This makes it important that production of food grains should also increase at the same rate or even faster. With the help of agricultural scientists, the bourgeoned efforts have resulted in the development of high-yielding production technology and intensification in crop production practices. Consequently, a rise in cereals as well as vegetables, fruit and fibre crop production has occurred. A substantial rise in food grain production alone was recorded from 50 million tonnes in the 1950s to a record of 295.67 million tonnes in 2019–2020 (Anonymous, 2019-2020). Even with this boost in food grain production,

farmers were not able to perceive the inherent potency of crop yield, one of the reasons being the heavy losses of nearly 30% caused by insect and other arthropod pests (Bisht and Giri, 2019). The major issues behind these reductions in crop yield are due to change in cropping pattern, climatic variations, injudicious of pesticides, raising high-yielding varieties/hybrids/cultivars and so on. In the recent past, India has witnessed continuous pest invasions *i.e.* an imminent shift in pest status from minor to major or secondary to primary pest or introduction of exotic pests leading to severe imbalance to crop and human ecosystems (Rathee and Dalal, 2018). Increase in the global trade and shift in climatic conditions has amplified chances of introduction of new pests in our agricultural systems such as introduction of Fall Armyworm and Desert Locust are recent examples that caused losses in monetary terms while contributing to food insecurity for thousands of farmers in our country. Historically, the Desert Locust has always been a major threat to mankind that is well mentioned in the Old Testament-Bible and the Holy Koran. Due to its polyphagous nature, it was estimated that in a day a small swarm of locust can devours as much food as about 10 elephants, 25 camels or 2500 people (Directorate of Plant Protection, Quarantine & Storage, 2020). Whereas, Fall armyworm is a significant economic pests of maize and other crops in the Western Hemisphere along with its broad host range (over 80 host plant species reported) and long-distance migration capability. The incidence of this pest has been reported from the Indian subcontinent in mid-2018 primarily, in maize and sugarcane in multiple locations throughout the country causing heavy yield losses. Thus, there is further need to perform intensive study to attain substantial information on the occurrence and behaviour of these insects with respective to meteorological factors, the level of insect infestation, the loss incurred by their incidence and development of suitable and effective pest management practices.

**Fall Armyworm(*Spodoptera frugiperda*;J. E. Smith) (Lepidoptera: Noctuidae):**Native to the tropical and sub-tropical regions of America, a severe outbreak of an invasive alien insect *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae) was reported from African countries such as Nigeria, Benin, and Togo in 2016 (Goergen *et al.*, 2016). It has subsequently been introduced into the Indian state of Karnataka in India in the period of May-June 2018 and other Asian countries by January to July 2019 including Bangladesh, Myanmar, Sri Lanka, China, Nepal, Thailand, South Korea and Japan. As strong migration ability and localized or centralized habit of dispersion are the two main reasons responsible for introduction of fall armyworm into the Eastern Hemisphere and its extent from western Africa to south eastern Asia over a very short span of time (Nagoshi *et al.,* 2020). It is polyphagous nature insect having greater than 80 host plant species including major crops such as cotton, groundnuts, sorghum, wheat, potatoes, soybean and sugarcane and also shows a specific inclination for the family *Poaceae.*A number of fruit trees, ornamental plants and weed species are also hosts to the pest(FAO, 2020). The fall armyworm can travel over 500 km (300 miles) before they start oviposition (Prasanna *et al*., 2018). Aggregations of moths from a single generation can spread rapidly more than 1000 km away aided by wind (FAO, 2017) until they are sexually mature and ready to reproduce (Rose *et al*., 1975). FAW

comprises of two "host strains" which are identified as the "rice-strain" found mostly in pasture grass and millet, while the "corn-strain" predominates in corn and sorghum. Therefore, by using different markers the Indian FAW population was found to be predominantly 'C' type by *Tpi* and 'R' type by *COI*, which indistinctly signifies inter-strain hybrids of FAW in Africa and India, arising from a common small founder population (Suby *et al.,* 2020). The generations of this pest will be continuous throughout the year wherever host plants are present, including off-season and irrigated crops, and favourable climatic conditions.

*Spodoptera frugiperda* (J. E. Smith) is emerged as the most destructive pest of maize in India, causing economic damage to cereals and other millets. Heavy infestation is caused by FAW in maize from early vegetative to physiological maturity. The female moths laid eggs in masses on underside of leaves sometimes also on upper side and on stems, which are covered by their anal hairs. On hatching, the early instar use ballooning (spreading by wind on a thread of silk) to spread to new host plants. Then, the first and second instar larva produces round or elongated window pane damage all over the leaves. Later larval instars colonize in the whorls causing the larger holes and produce sawdust-like faecal droppings. Further, the damage is noticed to cobs which may lead to fungal infection and aflatoxins, and deterioration of grain quality. The sixth larval stage can destroy skills and developing tassels, as a result restricting ear fertilization (FAO, 2020). It was notice by Sparks, 1979 that the first three larval stages of FAW are very small and consumed 2% of total leaf matter where as the fourth, fifth and sixth larval stages reported to cause heavy damage about 4.7%, 16.3% and 77.2% in the crop. The pupal stage is noticed to take place in the soil, larva fabricates cocoon or sometimes entangled themselves in leaves detritus or other materials. Adults constitute nocturnal habit and are the most vigorous and active during warm and humid evening. The conditions that favours development of FAW includes rising temperature and humidity during insect development but in the cold conditions, the overall development slows down to one or few generations per year. Moreover, if suitable conditions provided throughout the year, this insect is capable of feeding and breeding on the crop (Malo and Hore, 2019).

Since the advent of FAW invasion in India, as an emergency response focus is directed towards chemical insecticides to tackle the menace. In many countries, the development of insecticide resistance in the Fall armywormmake them inappropriate in long run. In India, most of the farmers are small holding farmers who cannot manage to cover up the cost of expensive insecticides. Whereas, integrated use of many non-chemical management along with chemical management may prove a boon in the long run. Following strategies are suggested by Government of India (GoI) to contain, suppress and eradicate the pest population in maize, sorghum and cotton includes extensive surveying, deep ploughing, hand collection and destruction of larvae and egg, timely and uniform sowing, balanced application of fertilizers NPK, use hybrid varieties, use trap crops (e.g. Napier) and follow intercropping with pulses crop (in maize), install pheromone traps @ 15 traps/acre, compulsory seed treatment with Cyantraniliprole 19.8% + Thiamethoxam I9.8% FS @ 6 ml/kg of seed, spray with 5% NSKE or

Azadirachtin 1500 ppm or 5% Neem seed kernel extract (NSKE) at 10% plant infestation, Erection of bird perches @ 10/acre soon after emergence, Eggs parasitoids such as *Trichogramma pretiosum* @50,000/ac and *Telemonus remus* (4000/ac) can be released for destroying the egg stage, application of *Bacillus thuringensis* var. *Kurstaki* formulation 2% @ 2g/l or *Metarhizium anisoplae* or *Beauveria bassiana* @ 5g/ litre for management of early instars and following chemical pesticides such as Spinetoram 11 .7% SC or Chlorantraniliprole 18.5% SC or Thiamethoxam 12.6% +Lambda cyhalothrin 9.5% ZC, if incidence is more than 10-20% to control FAW damage (Directorate of Plant Protection, Quarantine & Storage, 2018; 2019). While, some agro-ecological interventions are included that works as a major component of IPM focus mainly on adequate soil health, enhancement of natural enemies and reduce pest population through habitat management using push-pull technology, crop rotation, nutrient and water management suited to varied agro-ecological regions of India. Also, FAW might not be a risk to the temperate northern hill zone as well, where the temperature falls well below 10$^{o}$C during winter months (Suby *et al*., 2020). However, effective awareness campaigns coordinated with proper management measures could efficaciously contain the havoc caused by the insect.

## Desert Locust (*Schistocerca gregaria* F.) (Orthoptera: Acrididae):

The word Locust isderived from the Latin *locusta*, meaning grasshopper that are a collection of certain species of short-horned grasshoppers in the family Acrididae that transform itself from a harmless solitarious individual to part of a collective mass of insects that form a cohesive swarm, which can travel long distances into new areas and quickly devours on large quantities of any kind of green vegetation including crops, pasture and fodder (Wikipedia, 2020). That's why; the desert locust is often regarded as the most important and dangerous of all migratory pests in the world. In India, there are 10 important species of locusts in the world, out of these four types of locust recorded *viz.,* Desert locust (*Schistocerca gregaria* F.) is the most destructive of them, Migratory locust (*Locusta migratoria* L.), Bombay Locust (*Nomadacris succincta* L.) and Tree locust (*Anacridium rubrispinum* B.B.) (Joshi *et al*, 2020). Desert locusts generally have two types *i.e.*a solitary phase and a gregarious phase. Under natural conditions, solitarious locusts are observed in small numbers spread throughout the deserts of North Africa, the Middle East, and Southwest Asia, trying to persist in isolation by rendering shelter on sparse annual vegetation and laying eggs about 60-80 in numbers in moist sandy soil after intermittent rains and this calm period is referred as recession because there is no widespread and heavy swarm infestations of locust (Cressman, 2016). When unusually heavy rains fall somewhere in the recession area, locusts take advantage of these rare events and multiple rapidly to increase in number. Under normal conditions, locusts can live between 3 to 6 months, and increase some 16-20 times in their numbers from one generation to the next.

Once the desert habitat starts to dry out, large numbers of locusts changed their solitarious habit and come into physical contact with one another and forage together in coherent groups. This results in a cascade of metabolic and behavioural changes that

initially formsmall groups of hoppers (wingless nymphs) and adults that eventually fuse and form dense bands of hoppers and swarms of adults and their coloration changes from green to yellowish-brown. This step is known as gregarization and the intermediate phase between solitarious and gregarious, that is, when locusts are grouping is known as transiens. Gregarization usually takes place only in those parts of the recession area, where two generations of breeding can occur in rapid cycle. When there is marked increase in locust numbers on a local scale due to concentration, multiplication, and gregarization, which unless checked, can lead to the formation of hopper bands and swarms, resulting in an outbreak (Roffey and Popov, 1968). If further rains persist, a very large increase in locust numbers initiates contemporaneous outbreaks, followed by the production of two or more successive seasons of transient-to-gregarious breeding in complimentary seasonal breeding areas, this period is known as an upsurge.A Plague is a period of widespread infestations of bands or swarms for one or more years occupying an expanding area.

The invasion area is a result of many upsurges and plagues that tend to migrate locust swarms beyond the recession areas, and attack area of about 20% of the Earth's land surface (Cressman, 2016). In India, about 12 locust plagues were observed till 1962and 13 upsurges were recorded since 1947 till 1997. Small scale localized breeding have been reported and controlled during the period 1998, 2002, 2005, 2007 and 2010. The situation remained quiet from 2010 to early 2019 and there was no such large-scale incident of breeding and swarms recorded (Directorate of Plant Protection, Quarantine & Storage, 2020). However, in late 2019 some solitary phase of Desert locust has been reported occasionally in the locality of Rajasthan and Gujarat. In year 2020, the locusts attack has registered worse in 26 years, widely affecting the states of Rajasthan, Gujarat, Madhya Pradesh, Haryana, Maharashtra, Uttar Pradesh, and Punjab (Raja and Ranganathan, 2020). These swarms movement are closely linked with westerly winds from the recently originated cyclone Amphan in the Bay of Bengal reported by FAO (Roychoudhury, 2020). The impact of locust swarms not only affects economically but also socially, according to FAO, since 1920s, the damage caused by locusts to crops was approximately about Rupees 10 crores. Although no locust plague cycles have been observed after 1962, large scale upsurges were reported during 1978 and 1993 in India with estimated damage of Rs. 2 lakh in 1978 and Rs. 7.18 lakh in 1993. Whereas, in 2019-20, around 1,79,584 hectares of crop of 8 districts of Rajasthan and 19,313 hectares of area of Gujarat were under the invasion of locust attack. Recently, incursion of locust swarms in month of May- June 2020, were reported from 10 states including Rajasthan, Madhya Pradesh, Punjab, Gujarat, Uttar Pradesh, Maharashtra, Chhattisgarh, Bihar, Haryana and Uttarakhand. According to the state government of Rajasthan about 33% crop loss has been reported whereas, in the states of Haryana, Madhya Pradesh, Maharashtra, Uttar Pradesh and Uttarakhand have enumerated the crop loss in the area of 6520 ha, 4400 ha, 806 ha, 488 ha, and 267 ha respectively (Press Information Bureau (PIB), 2020). To control the devastation caused by locust swarms, Locust Warning Organization was set up in 1939 in India, later merged with DPPQ&S in 1946, where it was established to monitor, forewarn and control of desert locust mainly in affected

"Scheduled Desert Areas (DSA)" like Rajasthan, Gujarat and borders of Punjab and Haryana. Besides Application of Malathion, the other chemicals approved by the Central Insecticides Board & Registration Committee for control of the desert locust are Chlorpyriphos, Deltamethrin, Lambdacyhalothrin, Fipronil, Fenvalrate and Quinalphos. Noteworthy, the Union Agriculture Ministry issued a draft notification titled "Banning of Insecticides order 2020" that listed Malathion, Chlorpyriphos, Deltamethrin and Quinalphos among 27 crop protection chemicals whose use issuggested to be banned (Damodaran and Biswas, 2020).Recently, the Civil Aviation ministryprovided conditional exemption for use of drones by the Directorate of Plant Protection, Quarantine & Storage for aerial monitoring and spraying infected areas with insecticides using ultra low volume sprayers(Raja and Ranganathan, 2020). Above all, Emphasis should be given to increase the adoption of Integrated Pest Management (IPM) practices such as use of biological control, use of Sex pheromone *i.e.*phenylacetonitrile (PAN), that affects gregarization behaviourof locusts(Hassanali *et al*. 2005, Simpson *et al*. 2005), biopesticides like *Metarhizium anisopliae* var. *acridum* (Green muscle)(Lecoq, 2010) and use of remote sensing techniques applicable to early pest detection (Luedeling *et al.*, 2009) is used for preventive control of desert locust. Therefore, there is a need for applied implementation research, as well as farm-scale and area-wide evaluation of the biological and socio-economic impacts of new management tactics to control the wrath of desert locust in agricultural system in India.

## CONCLUSION:

Since, the evolution of crop species that are subjected to a plenitude of multiple stresses arising from environmental changes or biotic agents like pathogens and insects. Furthermore, the human desire to achieve absolute control over nature such as human action directed against weeds, pests and pathogens (e.g. pesticide applications) directly or indirectly influences above- and belowground food chains (e.g. predation and parasitism) and affects the functions of the soil food web (e.g. nutrient release, antagonism). Thus, we need a new paradigm and a transformative approach that integrates scientific knowledge of ecological relationships within a complex sociological and values framework toward the general goal of protecting native ecosystem integrity over the long-term. In fact, various Integrated pest management strategies such as proper monitoring, scouting and surveillance; timely and need oriented application of environmentally safe and low risk associated synthetic pesticides; preservation of natural enemies and biological control methods; implementation of resistant varieties; adaptation of cultural practices; and habitat management approaches *etc* has proved to be a powerful tool in decreasing domination by a few invasive alien species that form the real-time management of the crop during the growing season.

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# Agronomic Management of Saline Soils

*V. Hariharasudhan, A.Vijayaprabhakar and P.M.Shanmugam

*Institute of Agriculture, Kumulur, Trichy District – 621712*

**Corresponding author: tnauhari@gmail.com*

In India agricultural scenario is rapidly changing in response to various stresses experienced by cultivated lands. Agriculture sector cannot wait and must respond to manage the change and to meet the growing and diversified needs in the production to consumption chain. Nearly 7.0mha of agricultural land is affected by varying degrees of salt problems in the country. By 2025 area projected under salt affected soils in India is about 13.0 m ha. Agronomists have to play a crucial role to managing such lands and increase productivity through agronomic management by developing comprehensive understanding and better contingency plans based on resource efficient, socio-economically viable and environmentally safe technologies to deal with salt affected soils in changing climatic scenario.

## SCENARIO OF SALT AFFECTED SOIL

Globally, about 1128 m ha area is affected by salinity and sodicity stresses. The regions with preponderance of salt affected in India, the area under salt-affected soils is about 6.73 m ha with states of Gujarat (2.23 m ha), Uttar Pradesh (1.37 m ha), Maharashtra (0.61 m ha), West Bengal (0.44 m ha) and Rajasthan (0.38 m ha) together accounting for almost 75% of saline and sodic soils in the country. In most of the salt-affected environments, prevalence of poor quality (saline and sodic) waters is also noted. The states of Rajasthan, Haryana and Punjab, lying in the north-western arid part of the country, greatly suffer from the problem of marginal quality waters (Singh, 2009).

## SOIL RELATED CONSTRAINTS

A constraint free soil environment is very important for achieving higher food production. The major soil chemical constraints affecting the crop production are salinity, sodicity and nutrient toxicities. Based pH, electrical conductivity (EC) and Exchangeable sodium percentage saline - sodic soils are classified as follows.

| | EC(dsm$^{1}$) | ESP | pH |
|---|---|---|---|
| Saline soil | > 4.0 | < 15 | < 8.5 |
| Sodic soil | < 4.0 | > 15 | > 8.5 |

| | | | |
|---|---|---|---|
| Saline-sodic soil | > 4.0 | >15 | < 8.5 or > 8.5 |

From reclamation and management point of view, the salt affected soils in India are broadly placed into two categories as alkali or sodic soils and saline soils. Alkali soils in general are characterized by high soil pH (up to 10.8), high exchangeable sodium per cent (ESP) up to 90, low organic carbon, poor infiltration and poor fertility status. These soils are dominated by sodium carbonate and sodium bi-carbonate salts. On the other hand, saline soils have higher electrical conductivity (> 4dS/m), low ESP (<15%) and low pH (<8.5). The dominant salts in saline soils include chlorides and sulphates of Na, Ca and Mg.

## SALINE SOILS

Saline soils are characterized by higher amount of water soluble salt, due to which the crop growth is affected. For these soils with electrical conductivity of more than 4 dS $m^{-1}$, provision of lateral and main drainage channels of 60 cm deep and 45 cm wide and leaching of salts could reclaim the soils. Application of farm yard manure at 5 t $ha^{-1}$ at 10 - 15 days before transplanting in the case of paddy crop and before sowing in the case of garden land crops can alleviate the problems of salinity.

## AGRONOMIC APPROACHES FOR MANAGEMENT OF SALINE SOIL

### *Irrigation management*

Proportional mixing of good quality (if available) water with saline water and then using for irrigation reduces the effect of salinity. Alternate furrow irrigation favours growth of plant than flooding. Drip, sprinkler and pitcher irrigation have been found to be more efficient than the conventional flood irrigation method since relatively lesser amount of water is used under these improved methods.

Fig 1. Drip irrigation system for mitigating salinity hazards

## FERTILIZER MANAGEMENT

Addition of extra dose of nitrogen to the tune of 20-25% of recommended level will compensate the low availability of N in these soils. Addition of organic manures like, FYM, compost, etc helps in reducing the ill effect of salinity due to release of organic

acids produced during decomposition. Green manuring (Sunhemp, Daincha, Kolingi) and or green leaf manuring also counteracts the effects of salinity.

## SOIL / CULTURAL MANAGEMENT

Planting the seed in the centre of the raised bed / ridge may affect the germination as it is the spot of greatest salt accumulation. A better salinity control can be achieved by using sloping beds with seeds planted on the sloping side just above the water line. Alternate furrow irrigation is advantageous as the salts can be displaced beyond the single seed row. Application of straw mulch had been found to curtail the evaporation from soil surface resulting in the reduced salt concentration in the root zone profile within 30 days.

## ORGANIC MANURE APPLICATION

The productivity of saline soils can be improved by organic matter management to provide adequate nutrients, together with proper tillage practices by the usage of organic manures. In saline soil, the formation of sodium-organic matter complexes contributes to a higher solubility of the organic matter content, which can be rapidly leached from the soil, consequently causing the soil to become infertile and unproductive. Because of the importance of soil organic matter as a source of nutrients, organic matter supply assures a sustainable productive soil, and acts as a soil conditioner and buffer.

Soil organic matter governs physico-chemical and biological properties of soils. Thus addition of organic manures to soil containing low levels of organic matter will improve the soil's physical properties as impact by increasing the water content, water retention, improved aggregation, increased soil aeration, greater permeability, increased water infiltration, and decreased surface crusting by the application organic manures (Farm Yard Manure, Vermicompost, pressmud).

Field experiments conducted at Coastal Saline Research Centre, Tamil Nadu Agricultural University, Ramanathapuram, Tamil Nadu revealed that application of organic waste materials such as pressmud @ 12.5 t $ha^{-1}$ is beneficial in improving soil quality due to increased soil organic carbon and nutrient availability and substantial reduction in the electrical conductivity of coastal saline soils.

## GREEN MANURING

Green manuring is defined as plant material incorporated into the soil while still green, or soon after maturity, for soil improvement (Soil Science Society of America, 1965). Green manure crops can be leguminous as well as non-leguminous. Green manure is suitable for managing salt-affected soils, as a source of plant nutrients, and to supply energy to soil microorganisms. Application of green manure can improve soil physical properties such as texture and bulk density. These result in increasing exchangeable Na+ leaching capacity. Due to the increase in the price of chemical fertilizer and its environmental effects, the use of organic fertilizer has become feasible and more extensive, with more attention being given to green manuring in particular. Organic fertilizers include compost, farm yard manure and green manure, as N-sources.

Residual effects on salinity and acidity are found after extended use of fertilizer. Some chemical fertilizer, especially N fertilizer, has poor efficiency and high N loss. An organic N source such as green manuring is a cheap nitrogen source to increase crop yield and improve soil fertility. It is well recognized that legume crops grown in a cropping system will increase growth and yield of the main crop. Nutrients such as N, P, K, Ca, Mg and micronutrients will be released after incorporation. Utilization of green manure results in increase adsorption capacity and nutrient availability, and improved soil physical properties. However, suitable species of green manure varied with agro-climatic, soil and water conditions, for example green manure planted in saline soil must be tolerant of salinity and also to acidity and water logging. Numerous research indicate that one leguminous plant, namely *Sesbania rostrata,* shows high potential as a green manure crop in saline soils for rainfed lowland rice systems.

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# Impact of Climate Change on Water Resources

**Hina Bhatu, Jaypalsinh Chavda and Nirav Pampaniya**

*Assistant Professor, Department of Agricultural Engineering, School of Engineering, RK University, Rajkot, Gujrat, India*
*Assistant Professor, C.P college of Agriculture, SDAU, Dantiwada, Gujrat, India*
*Research Associate, Department of Natural Resource Management, College of Forestry NAU, Navsari, Gujrat, India*

**Corresponding author:*

In ancient time, there was a proverb 'don't waste money like water'. But with the water scarcity, now it is time to say 'use water like money. The total quantum of available water may be presently enough for our requirements, but its availability is highly in context to time and space. It is not available in places where we want, at the time when we want and in quantities in which we want.Rainfall is primary source of water and its contribution to the world's water supply.

In India, Rainfall is principal source for ground water Recharge.When rain falls, a portion of it soon evaporates or the vegetation that may intercept it, another portion infiltrates and rest of it flows as surface runoffonly little portion of the rainfall is stored as soil moisture and stored as groundwater. Additionally,to irregularity or variability of rainfall, the change in life style, population explosion, rapid industrialization, rapid urbanization, irrigated agriculture and inefficient water management plan are the main factor which has led to present water shortage problem.

The oceans occupy about 70.8% of the earth's surface and only 29.2% is land. About 97.3% of the world water resources is in the oceans and is saline; the remaining 2.7% of the global fresh water resource, about 75.2% is in ice caps and glaciers and is not available for the requirements of mankind.The amount of water available for development by human beings is mainly the water in the streams, rivers, fresh water lakes and about 44% of the quantity of groundwater which occurs at depths less than 800 m from ground surface (Michael, A.M. 2010).The water availability is the biggest constraint for the agricultural development in the region. The water harvesting at massive scale and its efficient utilization and management can be the only solution for the agricultural development.

## CLIMATE CHANGE AND ITS IMPACT

Climate change is one of the threats among several other impacting on water resources. Scarcity of water resources, pollution and climate change will be the major

emerging issues in the next century. Climate change and global warming is the result of a build-up of greenhouse gases (GHG), chiefly carbon dioxide, in the atmosphere.Sunlight, either direct from the sun or reflected back from the shiny parts of the earth, can pass straight through. But sunlight absorbed by the earth and then reemitted as thermal energy - such as from a tarmac road on a sunny day - is absorbed. As carbon emission build up in the atmosphere, so the amount of heat they trap and send back to the surface increases. This steadily increases the temperature of the earth's surface and drives global warming. The United Nations Intergovernmental Panel on Climate Change (IPCC) predicts the global temperatures to rise an additional 3 to 10 degrees Fahrenheit (1.6 to 5.5 degree Celsius) by the centurie's end (Chandhiok, 2009).

However, when the concentration of GHGs gets too large, and the earth's equilibrium goes out of balance, the people experiences a dangerous rise in temperatures, which can result in sever and extreme weather conditions. In effect, earth's blanket thickens and the atmosphere absorbs and holds more heat than it radiates back. This could directly affect rainfall, flooding and droughts, in turn effecting agriculture, economy, health and bio-security.

The effects of climate change are expected to be (i) Changes in weather patterns. Many areas are expected to become drier but a few areas may become wetter. (ii) Changes in the intensity of rainfall and storm events, largely as a result of the extra energy in the atmosphere. (iii) Rise in sea level (iv) Retreat of glaciers and ice areas (v) Changes in agricultural production (vi) Species extinctions (vii) "Tropical" diseases occurring in areas where they are previously unknown and (viii) Increase in number, duration and intensity of bushfires.

The repercussions of even a small increase in global temperature are wide reaching as it affects the hydrological cycle which alters the natural frequencies of floods and droughts. The result is an impact on the availability of water, and even though developed and industrialized nations are primarily responsible for the causes of climate change, it is those in the poorest nations who will be affected the most. In poor nations some of the most important jobs are connected to farming and agriculture and a change in the availability and quality of water will have a significant impact on the population. These nations have very limited resources and are unable to adapt to climate change compared to wealthier nations who can import water if required. A rise in global temperatures means an increased risk of extreme and frequent floods during the rainy season and the possibility of longer droughts during the dry season. A rise of five degrees Celsius could result in the disappearance of large glaciers in the Himalayas which would affect one quarter of China's population and millions of people in India. The effect of climate change is also having an impact on water supplies in developed nations including the United States. Annual water flow in three Californian river basins is expected to decline by as much as 8-14% over the next four decades as a result of climate change. In Australia the average temperatures have increased by 0.9ºC since 1910 and because of the variable amount of annual rainfall the country is already facing challenges with managing its water resources. The UK has also been affected and floods across many areas in 2007 are believed to have been caused by climate change. India

has also experienced severe droughts and floods in recent past like severe drought in Maharashtra and Gujarat during 2012 and heavy floods in Uttarakhand and Gujarat during 2013. These all might be the climate change impacts. Climate model simulations and other analysis suggest all natural sources of water could be significantly affected over the coming decades. Countries all over the world need to begin planning for these changes by implementing water conservation techniques and a sustainable system for water management to combat potential floods and extreme droughts.

## CONCLUSION

The water utilization in the agriculture for the irrigation has a major share (70%). The water resource planning, development and management requires quantification of different components of water resources system like runoff, ground water resource and evapotranspiration from crop field, forest, grassland/pasture and evaporation from wasteland, bare field and free water bodies.The assessment of climate change impact on water resources will help to prepare a future plan for the water resources development and management for the basin. It will also be helpful for agricultural as well other resources planning. The required shift in cropping pattern can also be judged. The quantity predictions can be achieved to aid managerial and policy action directed towards natural resources management.

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