Managing Farm Level Stress

भाकृअनुप
ICAR

ICAR-Agricultural Technology Application Research Institute

Zone-VIII, Pune, Maharashtra

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Editors

Ashok K. Singh, DDG (AE), ICAR, New Delhi
Lakhan Singh, Director, ICAR-ATARI, Pune
J.P. Sharma, Joint Director (Extension), ICAR-IARI, New Delhi
Rashmi Singh, Principal Scientist, ICAR-IARI, New Delhi

Contributors

Syed Shakir Ali, Sr. Scientist & Head, KVK, Baramati
M.S. Nain, Principal Scientist, ICAR-IARI, New Delhi
J.R. Mishra, Principal Scientist, ICAR-IARI, New Delhi
D.V. Kolekar, Scientist, ICAR-ATARI, Bengaluru
G. Rajender Reddy, Ex-Sr. Scientist, ICAR-ATARI, Hyderabad
Ravindra Bhandvalkar, SRF, ICAR-ATARI, Pune

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कृषि एवं किसान कल्याण मंत्रालय, कृषि भवन, नई दिल्ली 110 001
Government of India
Department of Agricultural Research & Education
and
Indian Council of Agricultural Research
Ministry of Agriculture & Farmers Welfare
Krishi Bhawan, New Delhi- 110 001
Tel.: 23382629, 23386711 Fax: 91-11-23384773
E-mail: dg.icar@nic.in

त्रिलोचन महापात्र, पीएच.डी.
एफ एन ए, एफ एन ए एस सी, एफ एन ए ए एस
सचिव एवं महानिदेशक

Trilochan Mohapatra, Ph.D.
FNA, FNASc, FNAAS
Secretary & Director General

MESSAGE

India has registered all time highest production of food grains, horticultural crops and pulses during the year 2016-17. Despite, these extra ordinary successes, the farmers of some areas like the states of Maharashtra, Andhra Pradesh and Telangana have been facing recurrent droughts and the farmers many times face the distress and are unable to gain profitable income. However, the best of the commercial models of production of pomegranate, grapes and oranges emerge from the drought affected areas of Maharashtra because of precision farming and sheer commitment of the farmers to innovate to conserve the resources and water and produce profitable and commercially viable commodities. The farmers of these areas have been able to cope with many of the drought situations with the technological and managerial skills at their own level with the support of the ICAR institutes, KVKs and Agricultural Universities.

I am extremely happy to learn that ICAR-ATARI, Pune is bringing out a publication documenting experiences of farm innovators from the states of Maharashtra, Telangana and Andhra Pradesh in respect to managing farm level stress and earning appreciable income. It is praiseworthy that ATARI, Pune and IARI, New Delhi collaborated to organise the Farm Innovators Meet at KVK, Baramati during 7-8 October, 2017 where farm innovators from these three states presented their innovations and interacted with researchers of various research institutes of ICAR. The deliberations have helped in identifying ways to manage critical farm stresses. The judicious use of precious water has also been depicted.

I am sure that this publication will help farmers and other stakeholders in learning from the farmers' perspectives for mitigating stress and earn profits.

I convey my appreciation for the sincere efforts.

Dated the 1st May, 2018
New Delhi

(T . Mohapatra)

भाकृअनुप
ICAR

भारतीय कृषि अनुसंधान परिषद
कृषि अनुसंधान भवन–1, पूसा, नई दिल्ली 110 012
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
Krishi Anusandhan Bhawan, Pusa, New Delhi-110 012
Ph.: 91-11-25843277 (O), Fax: 91-11-25842968
E-mail: aksicar@gmail.com

डा. अशोक कुमार सिंह
उप महानिदेशक (कृषि प्रसार)
Dr. A.K. Singh
DDG (Agricultural Extension)

MESSAGE

Empowering farmers with innovative technologies is the need of the hour. The problems related to climatic variability and stresses; depleting water resources, increasing market competitiveness and rising cost of cultivation have affected the production and profitability. Technologies developed by research institutions have demonstrated the ways to combat the agrarian crises. Similarly, the farmer led innovations have shown potential to address the local level problems.

I am delighted to know that ICAR-ATARI, Pune is bringing out a publication documenting successful experiences of farm level stress management by Innovative Farmers from the three states of Maharashtra, Telangana and Andhra Pradesh. The effort of the team is appreciable for organising the interface of the farmers and preparing the document.

I believe that this publication will be useful for the farmers and the extension officials of the states which face recurrent droughts and other climatic stresses. I congratulate ATARI, Pune and the team for this effort.

Dated: 01.05.2018

(A.K. Singh)

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ICAR-Agricultural Technology
Application Research Institute, Zone-VIII
College of Agriculture Campus, Shivajinagar,
Pune 411005

Dr. Lakhan Singh
Director

PREFACE

Indian farming facing a lot of challenges due to climatic change and agrarian distress. Every day farmers find different problems related to erratic weather condition, crop-soil-microclimate relationship, risk in attaining expected crop yield, ensured economic gain, etc. Price fluctuation is another issue. A lot of farm innovations have been developed over a period of time based on their rich farming experiences and wisdom for combating farm level stress and difficult situations.

Considering above facts in view, a two days ***Farm Innovators Meet*** was organized at KVK, Baramati. In this event, innovative farmers shared their experiences and innovations. Scientists from different research institutions and KVKs also participated and mutual learning was taken place. A publication entitled ***'Managing Farm Level Stress'*** is being brought out as an output of the meet.

I express my sincere gratitude to Dr. Trilochan Mohapatra, Secretary (DARE) & DG (ICAR); Dr. A.K. Singh, DDG (Agril Extension); Dr. V.P. Chahal, ADG (Agril Extension) and Dr. Randhir Singh, ADG (Agril Extension) from ICAR for their kind support and guidance for organizing the programme. I acknowledge the valuable contributions of Dr. J.P. Sharma, Joint Director (Extension), Dr. Rashmi Singh, Dr. M.S. Nain and Dr. J.R. Mishra from IARI, New Delhi; and Dr. Y.G. Prasad, Director, ATARI, Hyderabad for giving platform towards collective farmers wisdom sharing. I appreciate the efforts of all the participating institutes/centres/KVKs. Special thanks is given to Dr. Syed Shakir Ali, Head & Sr. Scientist, KVK, Baramati; Dr. D.V. Kolekar, Scientist and Dr. G. Rajender Reddy for extending their whole hearted support during the programme. Shri Mathew and Shri R.S. Bhatt are always supportive for taking new initiatives in newly created ATARI. I appreciate the support and help of Shri Ravindra Bhandvalkar, Shri Somnath Gadade, Dr. Vishwajit Kokare, Shri Tushar Bhagat and Ms Pallavi Palve for compiling the cases and documenting experiences. I hope this publication will be helpful for different stakeholders.

Dated: 30.04.2018

(Lakhan Singh)

CONTENTS

OVERVIEW

Water is becoming point of contention between countries world over and various states of India as well. The situation is alarming as in India, groundwater table is steadily going down and drinking water is selling almost at the rate of toned milk. Climatic changes have made our farmers vulnerable and agrarian distress and farm level stresses are the issues of concern now. These sudden changes have left our farmers puzzled as traditional technologies and practices are not serving the purpose in present times. It has given feelings of helplessness and vulnerability among our farmers.

Agrarian distress is the perceived intensity of stress in terms of helplessness, uncontrollability and unpredictability experienced by farmers as a result of unexpected situations or events in farming as an occupation as well as in their social life (Dhadwad, 2007).

Though, on one side, relative contribution of agriculture to the GDP has been declining but on another side people dependent on agriculture as their main occupation has not declined proportionately. The distress level is high considering incidences of farmer suicides which account for 11.2% of all suicides in India. All this gets compounded by varied climatic change, natural calamities, unbearable burden of debt and increased competition from imports and exploitation by middlemen which leads to farmer stress.

Maharashtra state of India has experienced recurring severe droughts in past few decades affecting thousands of villages, lakh of cattle and crores of people. The region received lower rainfall during the monsoon season June to September 2012 which resulted in severe drought conditions in 2013. It was one of the worst droughts to hit the region in 40 years, impacting districts like Solapur, Ahmednagar, Sangli, Pune, Satara, Beed, Nashik, Latur, Osmanabad, Nanded, Aurangabad, Jalna, Jalgaon and Dhule.

The agriculture sector was badly affected when people had to migrate from their native places for water, livelihood and fodder for cattle. The loss of crops, cattle and other livestock is a major issue but the most severe issue of concern is enhanced level of farmers' stress.

Despite these dismal situations, some farmers are doing considerably well in similar circumstances by innovating and exhibiting entrepreneurial behaviour. Other farmers can gain from their experiences and best practices for mitigating stressors. In this context, it was planned to conduct two days interaction meet of such innovative farmers with researchers by ICAR-ATARI, Pune and ICAR-Indian Agricultural

Research Institute, New Delhi at KVK Baramati under the leadership of Dr. A.K. Singh, DDG (Agril. Extension), ICAR, New Delhi. Two days deliberations included presentations and explanation of farm innovations and best practices employed by Farm Innovators of Maharashtra, Telangana and Andhra Pradesh. These farm innovators gave details of their innovations and best practices which were successful in getting them farm profits even in challenging natural and climatic situations otherwise, how they applied new ways and means for crop husbandry, animal husbandry and livelihood based enterprises in adverse climatic scenario.

ICAR has taken several initiatives in the past to document farm innovations at different platforms. National Farm Innovators Meet was organized at Mysore in 2010 where innovative farmers were invited to share their experiences. In series of National Conferences on KVK, separate sessions were held for farmers' presentations. At IARI, New Delhi a research project on Farmer Led Innovations was taken up in 2014 to suggest strategies for involving innovative farmers as disseminators of location specific contextual innovations to overcome the challenges posed by climatic vagaries. Innovative Farmer led extension delivery is visualized to take advantage of the experiences of farm innovators and they may act as inspiration or role model to other farmers in the same situations. It was in the direction of forming a networking of farm innovators, research institutes and agri-marketing agencies for dissemination of farmers' innovations and utilizes the farmer innovators as extension agents.

IARI has been involving farmer-innovators in their transfer of technology programmes and two such earlier meets were organized at IARI during 2015 and 2016. The third meet was organized in collaboration with ATARI, Pune so as widen the network of innovative farmers established.

Two days Farm Innovators Meet on ***'Farm Level Stress and Innovations'*** was organized at KVK, Baramati (Pune) during 7-8 October, 2017. Innovative farmers of three states namely Maharashtra (Vidarbha, Marathwada and Western Maharashtra regions), Andhra Pradesh and Telangana were invited to share their innovative interventions towards fighting the farm level stress and enhancing their income. In this event, about 80 participants including innovative farmers, KVK experts, scientists and Farmer Producers Organizations' representatives were participated. Researchers from ICAR-IARI, New Delhi; ICAR-NRCG, Pune; ICAR-NIASM, Baramati; ICAR-NRCP, Solapur; ICAR-DOGR, Pune; ICAR-DFR, Pune; ICAR-ATARI, Pune; ICAR-ATARI, Hyderabad and respective KVKs participated in the programme. This initiative was intended to enhance awareness of the innovative capacities of the farmers, to identify farmer-led innovations having potential to be adopted for larger impact and to share the experiences of farmers-led innovations in the field of agriculture and allied sectors. It was aimed to address the regional issues with regional innovative behaviour exhibited by successful farmers and to upscale and out scale farmer led Innovations to cope with distressing situations in dry areas of the region.

Dr. A. K. Singh, Deputy Director General (Agricultural Extension) and Director, ICAR-IARI, New Delhi during plenary session stressed the need to document and popularize the methodologies developed by innovative farmers to other farmers in the region so as to spread best practices for coping up with the dry spells and to get more farm income by using optimum resources at hand. He announced that the cases of innovative farmers experiences will be documented as videos which may be given to all KVKs for educative purposes and also to be put up on you tube and other social media. This was done to devise a framework for Farmer Led Extension Approach for dissemination of sector specific farm technologies and methodology to mitigate agrarian stress conditions. Certificates were distributed to the innovative farmers by DDG (Agril. Extension).

In his address, he gave more focus to develop farm technologies as per need of the farmers and varied agro-climatic conditions. His concern was for fighting with stress. Farmers are very innovative and they develop different farm technologies to minimize adverse effect of varied climatic conditions and long dry spells. Sharing experiences of innovative farmers/model villages should be documented and up-scaled in other areas. He said that short video clippings of farm innovators may be developed and up-loaded on ICAR website/KVK portal. He appreciated the courage shown by farmers at bad times and highlighted the issues such as sustainable production and happiness.

Dr. N.P. Singh, Director, ICAR-NIASM, Baramati highlighted the coping strategies of abiotic stress in agriculture. Dr. Lakhan Singh, Director, ICAR-ATARI, Pune said that farmers are real scientists as they are 24 hours vigilant and take observations of their crops growth. The innovations of farmers are unnoticed, so documentation and sharing at large scale is necessary. Dr. S.D. Sawant, Director, ICAR-NRC on Grapes, Pune advocated the farmers to adopt practical based solutions in grape cultivation. The grape growers are feared. In rains, the grape crop is infested with powdery mildew. The crop is to be protected from untimely rains. He said that farm level stress is too much. Processing based value addition at growers' level is important for higher return. Dr. Y.G. Prasad, Director, ICAR-ATARI, Hyderabad highlighted the issues of crop diversification, climate resilience, multiple cropping systems, framework for documentation of innovations, etc. Dr. J.P. Sharma, Joint Director, ICAR-IARI, New Delhi highlighted the issues of value addition and processing, quality management, marketing, livestock management, etc. Dr. R.K. Pal, Director, ICAR-NRC on Pomegranate, Solapur suggested the farmers to go for value addition in pomegranate especially for juice and seed oil for higher return.

Presentations were made by various ICAR institutes about best technologies for abiotic stress management, floriculture, grape, pomegranate, onion and garlic cultivation. Cross learning was taken place between farmers and scientists. The farmers of three states viz. Telangana, Andhra Pradesh and Maharashtra especially from Vidarbha, Marathwada and Western Maharashtra presented and shared

their innovations and good agricultural practices. Shri Popatrao Pawar presented a successful model of Hivare Bazar village. In this model, village watershed was developed with active people's involvement. The villagers banned the more water required crops to grow in the area. Social cohesion has been developed. Water budgeting was done. More attention was given on soil and water conservation. Most of the farmers adopted moisture conservation practices, drip irrigation, sprinkler system, water harvesting, crop diversification, contingency planning, weather forecasting, prediction farming, etc.

Dr. Rashmi Singh, Principal Scientist and Dr. Syed Shakir Ali, Head, KVK, Baramati coordinated the event. Smt Sunanda Pawar, Shri Vishnu Pant Hingane, Dr M.S. Nain, Dr J.R. Mishra, Dr G. Rajender Reddy, Dr. G. Mahapatra, Dr. D.V. Kolekar were present at the occasion. 28 Heads of KVKs representing Maharashtra, Andhra Pradesh and Telangana were also present.

Community Led Socio-Economic Transformation through Watershed and Water Budgeting

in Hivare Bazar, Ahmednagar, Maharashtra

Popatrao Baguji Pawar and S.S. Kaushik*
Village Hivare Bazar, Tehsil Nagar, District Ahmednagar
*KVK, Ahmednagar-II, Maharashtra

Hivare Bazar village (977 ha) lies under drought-prone area in district Ahmednagar of Maharashtra receiving an annual rainfall of 250-350 mm.

Thirty years ago, 90% village population lived below poverty line and was plagued by rampant outward migration, high crime rate and severe water scarcity. During 1993-94, Hivare Bazar was selected as potential model village when a project of 5 years was completed in small period of 2 years by the villagers under the leadership of Shri Popatrao Pawar, a youth Sarpanch. Since then transformation of village is exemplary. Transformation undertaken through reforestation of hilly forest area, building trenches along contours, trapping rainwater, taking measures to slow down runoff and watershed development. Farmers switched from the traditional jowar and bajra to cash crops such as onion, potato, tomato and horticulture.

As a result, the groundwater table rose and irrigated area increased consequently enhanced farm income level. Enhanced people's participation, convergence of several departments of Government and active role of the Gram Panchayat, works in different sectors ranging from watershed development, village infrastructure development, agriculture, environment conservation, dairy development, innovative and water budget based crop production planning were undertaken which resulted in complete transformation.

Many farmers used their increased agricultural earnings or borrowed loans to buy cattle. Today dairy farming forms an important mainstay of the village economy. The re-vegetation program undertaken as part of watershed development has increased the availability of good quality grass which in turn has contributed to increased milk yield.

Most families gained in the prosperity, either directly or indirectly. Average income of the village had increased twenty-fold: 50 of the villagers had become millionaires and only 3 families were below the poverty line. The grass harvest increased from 100 tonnes in year 2000 to 6000 tonnes in year 2004, and the milk production rose from 150 litres a day in the mid-1990s to 4000 litres in year 2010.

The initiatives taken by Hivare Bazar, voluntary labour by villagers (one member of each family) or *shramdaan* has formed a critical component of watershed program. Hivare Bazaar's success was based on active involvement of entire village community. Villagers manage their resources by regulating and enforcing norms through community decisions.

Role of Gram Sabha: The gramsabha has all the powers to decide on a range of issues, including identifying sites for water harvesting structures, sharing water and types of crops to be grown. All issues are discussed, resolved and also monitored through gram sabha.

Seven Principles of Social Discipline: Family Planning, Ban on Alcohol, Ban on Tree Cutting, Ban on Free Grazing, Voluntary Donation of Labour, Ban on Open Defecation, Ban on Bore well for Farming were framed and followed in the village.

Role of Children and Women: Children and women play a central role in water management. School children must read rain gauges, measure groundwater levels and present this data to the Gram Sabha. Women collect and manage the monthly water tax during monthly Sujal Mahila meetings.

Water Budgeting and Crop Planning and people's participation through voluntary labour and financial contribution; efforts to change people's mindset; emphasis on maintaining ecological balance; and proactive steps to benefit those who would not gain directly from the watershed program were followed.

Hivare Bazar became the highest GDP village in the Country (per capita Rs. 832 to Rs. 32000. Daily 5500 litres of milk is produced from a village with population of 1300, which is sold outside. Today, in this village out of 226 families, none of the family is in the category of BPL.

Stage Wise Care of Pomegranate Boosts Yield under Climatic Stress

Babasaheb Tukaram Gore and S.D. Nalkar*
Village Rajuri, Tehsil Rahata, District Ahmednagar
*KVK, Ahmednagar-I, Maharashtra

Shri Babasaheb Gore was a farmer turned to agripreneur and pomegranate consultant. He realized the importance of training to the pomegranate farmers and till date has trained over 1.5 lakh farmers and is now using the virtual platform to disseminate knowledge and support to maximum farmers.

At present, he is the Chief Promoter of Agri Academia and the Chief Enterprise Architect of Virtual Agri Services Private Limited (VAS). VAS is meant to connect to maximum farmers the help of experts and provide them the best and latest knowledge using a mobile phone.

Pomegranate production has been split for the first time into five stages. These five stages are Storage stage, Stress stage, Flower and Fruit set stage, Fruit Development stage and Maturity and harvesting stage. He treats each stage separately based on all the parameters and making sure that the plant crosses from one stage to another without any trouble. This entire five stages are part of the 360 day Bahar management which he has been advocating over last several years under environmental stress conditions.

Storage Stage: During this stage, if severe cold or sudden increase in temperature occurs it will affect carbohydrate accumulation. When temperature is more than 42 degree Celsius, due to high transpiration rate, the plants have to spend more energy on survival than storage. In this stage, there is meagre use of pesticides but if unseasonal rains occurs then use of pesticides increases.

Stress Stage: For maintaining carbon-nitrogen ratio in plant and getting female flowers in bigger branches, pomegranate tree requires optimum stress. Due to unseasonal rains in January, the optimum stress period is suddenly broken down as a result of which proper carbon-nitrogen ratio is not maintained in branches. Then, less flower setting, huge new shoots or failure of the crop occurs. Also during November, December and mid-January, if more fog continues then plant does not undergo through the stress and new shoots start emerging which should not ideally happen in this stage. This eventually results in either the Bahar getting delayed or complete failure of the crop.

In the above two stages (Storage and Stress), if unseasonal rains occurs then farmer ignores curative and preventive sprays because of no fruit on the plant. During this time, due to favourable climate for development of some disease, the infection gets initiated on the leaves and the branches. This results in the final fruit in the harvesting stage which will have these diseases on it.

Flower and Fruit Set Stage: This is a very critical stage. Up to 30 days from date of first irrigation, if unseasonal rains occurs then emergence of the flower bud does not take place. Instead of that, new shoots start appearing. This results in delay in flowering and also increase in labor costs as these unnecessary shoots need to be removed manually.

If the maximum and minimum temperature difference is more than 20 degree celsius then flower bud initiation gets delayed and more than normal male flowers start emerging. Recently, during the fourth week of March, it was observed in Ahmednagar district, the minimum temperature was 16 degree celsius and the maximum was 41.1 degree celsius. If maximum temperature is more than 38 degree celsius then the length of the flower bud reduces. Also, the shape of the fruit turns round which results in the size of the final fruit not going above 200 gm. Because of the all these reasons, there is at least a loss of more than 50% in the yield.

To minimize the effect, apply flood irrigation between two beds, provide frequent drip irrigation, organic mulching and sprayed sea-weed extract (400 ml/acre with cost of Rs. 720 per acre for 3 applications).

During the time when the female flower has opened, either rain with lightning or high wind gusts occurs, then female flower drops from the plant. Plant growth regulator like 6BA (4 gram/acre with cost of Rs. 200 for one application) and Homobrassinoloid (100 ml per acre with cost of Rs.125 for one application) helps to reduce the effect. The experience elaborates that before usage of 6BA and Homobrassinoloid there were losses in yield to an extent of 80%.

If unseasonal rain or continuous cloudy weather or high temperature more than 40 degree celsius or temperature less than 10 degree celsius occurs at the time of pollination, the pollinators like honey-bee do not enter the farm. For that reason, it is helpful for pollination to keep one box of honey-bee per acre.

Fruit Development Stage: Due to high temperature and high UV radiation, sunburn affects the green fruits.

When the temperature exceeds 42 degree celsius, the fruit which is exposed to sunlight gets 100% damaged due to sunburn. To avoid this, provide more irrigation, spray Kaolin (800 ml per acre with cost

of Rs. 640 for two application), cover the fruit or the whole plant with newspaper or non-woven UV treated poly-propylene bags or non-woven UV treated poly- propylene sheets.

In Ambe Bahar, when the fruit is green (very susceptible for Bacterial-Blight) if unseasonal rains occurs in summer, around 60% fruit may get damaged due to congenial climatic condition. If this type of climatic condition appears, it is helpful to spray preventive anti-biotic to manage diseases.

In the year 2014-15, a lot of farms were affected by hailstorm. In this stage, due to high temperatures, the color and size of the fruit gets deteriorated. To overcome this, use of sea-weed extract mitigates the climatic stress.

Maturity and Harvesting Stage: If unseasonal rain occurs during this stage, the diseases spread easily. To prevent this, there is an increase in the fungicide sprays as a result of which chemical residue in the fruit increases.

During this stage, if the temperature of the environment increases to more than 40 degree celsius, then the arials in the fruit become white, nutritive value and percentage of juice decreases and fibre percent increases.

Due to continuous rains, water logging happens. This results in infection of phytopthora disease, due to which 100% fruit rot takes place. To reduce the effect of the phytopthora disease, we are forced to use chemicals but during this stage the performance of systemic chemicals is very low. Very good results of keeping grass or weeds on bed are achieved.

During harvesting, if continuous rains takes place then nitrogen level gets increased resulting in increase in new shoots, decoloring of the fruit takes place and size of the fruit gets reduced.

Due to climate change, the normal practices of the farmer get disturbed resulting in high input cost to the farmer. This indirectly affects the final consumer, as he/she gets a low quality fruit, less nutritive fruit and the cost to the consumer also goes up.

The technique has been used consistently on farmers' fields for more than five years where yields have achieved to an extent of 210 to 220 quintals per ha fetching the pomegranate growers a plentiful of Rs. 6.30 lakhs to Rs. 13.20 lakhs per ha as gross income.

Dutch Rose Cultivation under Shade Net House for Higher Economic Gain

Rajabhau Deshmane and Prashant B. Bhosale*
Village Mangrul, Tehsil Manvat, District Parbhani
*KVK, Parbhani, Maharashtra

Use of different plasti-culture application through its precision farming is being promoted.

After economic liberalization, there is rapid urbanization, improved infrastructure and emergence of an urban middle class, creating a demand pull for high value flower crops in India. This provides an opportunity to directly increase the income of farmers with very small land holdings through precision farming technologies.

KVK, Parbhani gave support through capacity building and convergence for evolving a business model by using the protected cultivation for creating sustainable livelihood among small and marginal farm families. Farmers facilitated for raising high value flower crops under Shade net house in the village.

Mangrul, Tq. Manvat is a small village receiving average rainfall of 780 mm with occasional canal irrigation. Crops like cotton, soybean and pulses having major coverage under farming.

Previously Mr. Rajabhau Deshmane earning around Rs. 3,00,000/- from his 15 acres of land by cultivating Cotton, Soybean, Pulses, etc.

Due to varied climatic condition, glut in market price at season, high incidence of pest and diseases on traditional crops, farmers used to get low income, which affects the livelihood security.

Intervention: KVK introduced dutch rose cultivation under shade net house to fetch more income from less area. Group of 15 farmers was created and proposal submitted to the Mission on Integrated Development of Horticulture (MIDH) for subsidy.

10 farmers got sanction from district authority for construction of Shade net house of size 2000 sq.m.

Separate proposal for plating material of high value flower crops was again submitted and also got sanction for the same.

Technological support was provided for site selection, soil preparation, round top shade net house structure, purchasing all inputs together which gives noticeable discount, identification of high value crops like Dutch Rose (Variety - Top Secrete), procurement of seedlings, periodic inspection of the crop, training on handling and package of harvested crop, development of market linkage and contract agreement with buyer for regular purchase, etc.

Dutch Rose (Top Secrete variety) under Shade net House in 2000 sq.m was raised. Drip irrigation system was used.

Economic Gain: Construction cost of Rs. 12,06,719 was computed. Subsidy of Rs. 5,99,000/- was availed. Cost of planting material was Rs. 8,52,000/- and subsidy of Rs. 4,26,000/- was also availed. In total, cost of construction and planting material was Rs. 20,58,719, in which Rs. 10,25,000/- total subsidy was taken up.

In first year, 350000 flowers per year (250000 long stem flowers and 100000 loose flowers) were harvested. Gross income of Rs.850000 was obtained by the farmer in first year.

In second year, 30000 flowers per month were harvested with net income of Rs 48000 per month from 2000 sqm. of land, cumulatively it is Rs. 5,00,000/- per year in just 20 R. which is very high compare with his total land of 15 acre.

Use of protected agriculture technology enhanced crop yield by 3-4 times.

Marketing: Mr. Rajabhau Deshmane harvest 2000 cut flowers one day alternate and marketed with fellow farmers in group manner at Hyderabad, Nagpur, Mumbai & Pune.

The group of Dutch rose cultivator of Mangrul village has made agreement with buyers of above mentioned places for procurement of cut flowers (Long stem flowers). While loose flowers were marketed at Parbhani & Nanded local market.

Horizontal spread: 13 poly houses are presently under construction and prepared plan for growing orchids. All the group members are also involved in sericulture. All of them planted mulberry and constructed rearing house in convergence with state sericulture department which gives more income. All the farmers of the group are now using farm ponds to harvest water and used micro irrigation system.

Outcome and Impact: Income of farmers from shade net house has been raised. Skill of farmers in Shade net house technology and marketing has been developed in the region.

The community protected horticulture project has created awareness in whole district about the Shade net house farming and possibilities of higher income to the farmers with small land holdings.

To make protected agriculture more popular, one must have cluster based approach for creating protected structure hub around nearby village rather than spreading this intervention in isolated locations.

Integrated Fruit Orchard Management Model

Rajendra Todkar and Prashant G. Shete*
Village Savargaon, Tehsil Junnar, District Pune
*KVK, Narayangaon, Pune, Maharashtra

Shri Rajendra Todkar shifted from sole cropping system to intercropping of fruits.

Innovations Done:

- The fruit crops were with different canopy heights. Due to different crop canopy levels, full sunlight was harvested. More income from per unit area was obtained.
- By adopting Zig-Zag method shading effect of other trees was avoided.
- New variety of Jamun, Konkan Bahadoli released by Dr. BSKKV Dapoli was successfully adopted by the farmer in year 2005. Number of Jamun plants-48 with planting distance of 25 feet x 25 feet was raised.
- Ten years old plants were giving 40 kg fruits per year per plant. Presently, 13 years old plants giving yield of 80 kg. Total yield 38 q is obtained. Gross return of Rs. 380000 per year was realized.
- **Intercropping of fruit crops in fruit orchards:** In a row of Jamun, one mango was planted. It grows 12-16 ft height. Total 30 numbers of mango plants are present in same 1 acre area. Nine years old mango plants are giving 10 dozens of fruits per plant per year. Total yield of 300 dozens mango gave Rs. 30000 per year. After 10 years mango plants were removed.
- In same area 100 number of custard apple plants were planted at 10 feet x 10 feet distance, yielded 3 dozens of fruits per plant per year. Total yield 300 dozens of custard apple provided Rs. 30000 per year. After 10 years custard apple plants were removed.
- Along boundaries of this 1 acre area, coconut plants were planted at 12 feet distance. 10 coconut plants yielded 500 numbers of nuts per year, provided Rs. 7500 per year. In total from an area of 1 acre, the farmer is getting Rs. 380000 per year.
- **Innovative diversion to Jamun cropping:** After 12 years, Jamun plants are fully grown. He has removed the mango and custard apple plants. Now the total marketable yield obtained 3800 kg and gave return of Rs 380000. Expenses are about Rs.150000. The net return is of Rs. 230000 per year.

- He is packing the fruits in 1 kg capacity card board boxes. 18 such boxes are packed in big size cartoon box. The fruits are marketed in Pune, Mumbai market and local market as well on road side marketing. Fruits are sold on the farm as well.
- **Pomegranate cultivation:** There was about 4.5 acres sloppy land. The farmer undertook leveling of the area for pomegranate cultivation. He made 3 compartments at different levels.
- He planted 1700 number of pomegranate plants at 12 ft x 9 ft planting distance in year 2013.
- Drip irrigation system and Fertigation system were installed. Raised beds were prepared. He used dried husk as mulching material. After 2 years, he started bahar treatment of Pomegranate plants. Last year, he obtained 30 kg fruits per plant. About 50000 kg fruits were marketed.

- He obtained Rs. 20 lakh from pomegranate. The cost of cultivation was about Rs. 12 lakh. Thus, he obtained net return of Rs. 8 lakh from pomegranate.
- **Farm Pond and Fish Rearing:** He dug up farm pond of size 100 feet x 100 feet having capacity of 22 lakh litres. He lifted water from nearby river and filled the farm pond. He started fish rearing in the farm pond. He prepared the cages for rearing of fingerlings of *Rohu* and *Katala*.
- Due to organic mulching water saving was achieved. Organic carbon in the soil was increased and fertility enhanced.
- He is using tractor drawn shredding machine for making small pieces of pruned away branches of fruit crops. Plant residue is being used as organic mulch in pomegranate orchard. The weeds are cut away by Brush Cutter.
- **Drip irrigation and fertigation techniques:** He is having 30 mango plants of 7 years old of variety Keshar. He gets 10 dozens mango per plant. From mango, he is getting Rs. 30000. He is having other varieties of mango plants like Ratna, Dashhari, Rajapuri and Alphanso. He is having few plants of bullock heart, custard apple and coconut. He has created drip irrigation system for all the plants.
- **Kitchen Gardening:** Vegetables like Beans, Bitter Gourd, Ridge Gourd, Snake Gourd, Chilli, Brinjal, Tomato Okra, Cluster bean, Amaranthus and Sweet potato were grown.

Inspiration to other Farmers: Successful yield performance of new variety of Jamun has motivated other farmers. About 15 farmers have cultivated the new variety of Jamun adopting multistoried cropping system. Farmers should go for multistoried cropping system to obtain more income from available land and harvest more sunlight at different crop canopy levels.

Vegetable Cultivation in Shade Net House in Jalna, Maharashtra

Punjaram Ankushrao Bhutekar and S.S. Mahalle*
Village Hiwardi, District Jalna
*KVK, Jalna, Maharashtra

To mitigate adverse effect of climate change and drought condition, the farmer took initiative to take round the year vegetable cultivation in Shade net house in Jalna district of Maharashtra.

The average annual rainfall of Shivni village is about 650-750 mm. However, the village received about 350 mm, 730 mm and 400 mm rainfall in 2015, 2016 and 2017, respectively. The longest dry spell observed by the village in 2015-16 was of 48 days followed by 35 days and 25 days in current year (2017-18).

He has also adopted protective cultivation, value adding practices, grading, packaging and innovative marketing mechanism.

The farmer has modified the technology. Foggers in Shade net house, capsicum cultivation in open field, etc.

Economic gain from field crops (Rs. 5000), open vegetables (Rs. 70000), goat rearing (Rs. 30000) and shade net house (Rs. 450000) was obtained in 2016-17.

Productivity level of tomato in shade net house was achieved by 300 q/acre in 2016-17.

He expanded the Shade net house from 0.10 ha to 0.40 ha.

Used of foggers and insect net for sustainable productivity. This system helped to maintain humidity in summer season. Used goat manure to improve and maintain the soil fertility. Used neem seed cake and biofertilizers during bed preparation. Honey bees used for enhancing pollination in shade net house. Used poly mulching and IPM technologies to reduce the pest and disease infestation.

Adopted virus resistant IIHR developed tomato variety Arka Rakshak.

New package of practices/management strategies: Cultivation of vegetables in off season, application of water spray at the time of 50% flowering of vegetables for increased fruiting, use of goat

manure to increased organic carbon content of soil, installation of foggers to increase humidity in summer season.

Saving or resources/input: Use of organic manure, soil test based fertilizer application, adoption of fertigation technology, spraying of NSKE, use of drip irrigation helps to save the resources.

Prevention of outbreak of diseases and pests: Use of resistant varieties, use of botanical pesticides, use of yellow sticky traps, use of neem seed powder, use of bio-fertilizers and insect net is used for prevention of diseases and pests outbreaks.

Record production of more than 500 tons of Arka Rakshak tomato in rabi season of year 2016-17, when no tomato crop available in the area, which gave higher rate of Rs. 80-100 per kg. The total income of tomato was about Rs. 7.00 lakh in six months from one acre shade net.

Innovative marketing by grading and packaging accounting for 20% higher rates in the market.

By observing the success of the farmer, 10 farmers of nearby villages adopted vegetable cultivation in shade net house.

Rainwater Harvesting from Polyhouse Roof, Ahmednagar

Uttam Mayanji Gadekar and S.D. Nalkar*
Village Pimpri Lokai, Tehsil Rahata, District Ahmednagar
*KVK, Ahmednagar-I, Maharashtra

Shri Uttam M. Gadekar is having 4 ha rainfed land with 250-350 mm average rainfall and 2 wells and 1 bore-well.

His innovation includes rainwater harvesting by constructing farm pond of size 50x10x3 cu.m having water storage capacity of 35 lakh liters. Harvested rain water from poly house roof with help of pipe and stored in the farm pond.

He also brought water by tankers on payment basis to fill up the farm pond.

Used Water Evaporation Retardant Evaloc @ 1 kg/10 days for 0.1ha size farm pond i.e. 9 kg for 3 month (March, April, May) to reduce evaporation loss. The cost of retardant was Rs. 2700 but water evaporation losses was reduced by 27% and saved about 3 lakh litre water from the farm pond of 0.1 ha area during 3 months. In economic term, he saved about Rs. 1 lakh on cost of water, if purchased from outside.

Poly house of 0.1 ha area was constructed with total cost of Rs. 7.0 lakh (bank loan). Out of this amount, he got subsidy of Rs. 4.25 lakh from State Agricultural Department.

He invested as working capital (1st year) of Rs. 1.25 lakh and gross investment was of Rs 4 lakh.

He started colour capsicum cultivation in poly house on 0.20 ha area. In first year, 15 tons yield was obtained with net return of Rs. 2.90 lakh.

In second year till end of October 2017, eight tons yield harvested with net income of Rs. 3.55 lakh.

Promotion of Custard Apple Farming and Development of New Cultivars

Navnath Malhari Kaspate and L.R. Tambade*
Village Gormale, Tehsil Barshi, District Solapur
*KVK, Solapur-I, Maharashtra

Shri Navnath Malhari Kaspate developed the selections from his Custard Apple Museum viz. Annona-2 and NMK-1 (Golden) for solving the problem of market glut of common custard apple and improving the keeping quality of matured fruit of custard apple and quality of pulp.

Innovations: He promoted 10 ft X 15 ft planting distance in medium soils rather than 16 ft X 16 ft (recommended by SAU) for development of micro-climate in orchard for enhancing pollination.

Practical Utility of Innovation: The cultivars viz. Annona-2 and NMK-1 (Golden) is good for all types of soils for plantation distance of 10 ft X 15 ft. He did thinning operation for getting good number and quality fruits i.e. keeping 100-125 fruits / plant at the age of 8-10 years.

Peculiarities of the Selections: Fruits are very attractive in colour and size. Harvesting time can be adjusted according to market demand and cargo facilities because of the special characteristics of matured fruits. The fruit will remain in good condition (un-ripened) for at least 20-25 days on plant itself.

The number of seeds per fruit are less and berry size is quite big. The harvesting of fruits of NMK-1 Selection can be possible 2-3 times within the period of 20-25 days as per the market convenience.

Due to his effort, the area under custard apple is increased more than 800 ha in Solapur district and about 450 ha area expanded in adjoining district of Solapur during last 8-10 years.

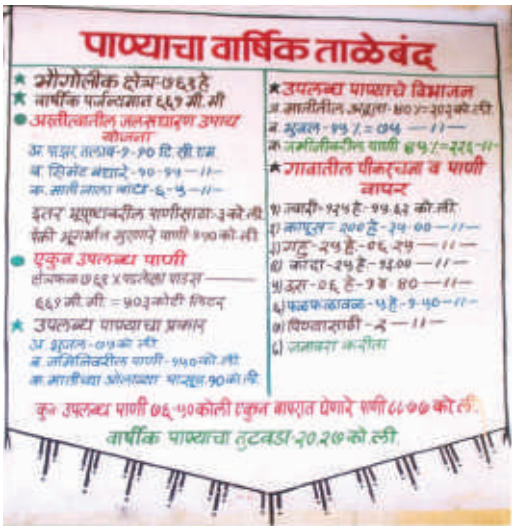
Productivity of new selections was about 15-19 tons/ha with 70-80% Grade-1 fruits while existing varieties provided 10-12 tons/ha. Due to good quality fruits the market rate was 120-150% higher over existing cultivar fruits. Near about 700-800 farmers from 9-10 districts of Maharashtra had gained the benefit of custard apple production technology and new cultivars and diversified their cropping pattern towards dry land fruit farming.

Rain Water Harvesting and Water Budgeting: Using BBF Planter

Uddhav Asaram Khedekar and S.V. Sonune*
Village Shivni, District Jalna
*KVK, Jalna, Maharashtra

Shri Uddhav Asaram Khedekar has exhibited leadership and innovative ways for rain water harvesting and budgeting for mitigating crop stress due to inadequate rainfall, uncertain rains and frequent drought conditions in the area.

In village Shivni having medium to light soils, slope 0-5 %, soil depth < 20 cm, frequent dry spells 48 days (2015-16), 35 days and 25 days in current year (2017). Average rainfall is recorded 660 mm.



Before watershed development, mono cropping was practiced in kharif season, but after transformation the village is cultivating several crops like soybean, pigeonpea, cotton, mungbean, urdbean in kharif and chickpea, onion, sorghum in *rabi* season.

Best Practices:

- Use of BBF planter in soybean, pigeonpea, mungbean, urdbean performed well to reduce farm level stress.
- Maintaining organic carbon by contour cultivation, bunding, minimum tillage and green manuring. Crop planning based on water budgeting technique (daily rainfall recorded and sent on the mobiles of all farmers immediately, based on that drought mitigating strategies are decided).
- Reducing plant population particularly in mungbean, urdbean, rabi sorghum, etc. to reduce the water requirement of crop. It helps particularly in dry spell.

- Adoption of intercropping systems to minimize the climate change risk, for example Cotton + Mungbean (1:1), Pigeonpea + Soybean (2:4), Mungbean + Pigeonpea, etc.
- Opening dead furrows (2-3 times) and use of foliar spray at 8-10 days interval during dry spell.
- Used protective irrigation by sprinkler and drip in case of water availability.
- Low water required and highly remunerative crops like onion and vegetable crops for seed production are being raised and getting higher income with use of less water.
- Adoption of farm bunding and farm ponds as a long term measures.
- Farmer realized higher crop productivity and profitability per unit area. Soybean gave yield 8-10 q/acre, pigeonpea 7-8 q/acre, urdbean/mungbean 3-4 q/acre, chickpea 8-10 q/acre with 20% higher economic gain. Rabi jowar provided 10-12 q/acre yield with grain and ensured food security.
- Innovative management practices are being adopted by other farmers covering > 2000 ha area.
- Joint decision taken by the villagers to give first priority to drinking water, second to animal water and third priority to crop water in the village.

Use of Polythene Mulch for Tomato Cultivation under Drought Condition

Nitin Krishnarao Kadam and Syed Shakir Ali*
Village Sastewadi, Tehsil Baramati, District Pune
*KVK, Baramati, Pune, Maharashtra

The region namely Baramati and Indapur of Pune comes under dry land zone but the farmers grow more vegetable crops. Water scarcity is a major crisis faced by the farmers.

Number of rainy days and average rainfall is reducing every year. In district Pune, Baramati and Indapur tehsils are drought prone. Average rainfall in these tehsils is only 450 mm. From last 3 years, it is observed that average rainfall is received only 200 to 250 mm in the area. Some parts of the region get only 60 to 70 mm rainfall.

Weed growth during continuous rainy days is also a major problem in vegetable growing.

So the plastic mulching is beneficial technology considering the problems to this area. Polythene mulching also increases quality of vegetables by minimizing weed growth and less quantity of water during the drought conditions.

Technology details- Use of 30 microns silver black polythene mulch (4 feet width and 100 m length of bundle) for plantation of tomato.

The gross income obtained from demonstration plot is Rs.309834 per acre whereas in control plot it is Rs. 204593. Thus from above experiment it was observed that there is increase in net profit of Rs. 103029 per acre over control due to application of polythene mulch technology in tomato.

Use of plolythene mulching found very helpful to control weed growth as there is no weeding was required, 7 number of chemical sprays reduced, 5 number of pickings increased.

Average yield (356q/acre) of tomato was obtained which was 24% higher over existing practice. Additional profit of Rs. 1.03 lakh per acre was realized by the farmer by adopting ploythene mulching.

Spread of technology was observed in the area covering 350 acre benefiting 259 farmers of nearby villages.

Low Cost Sprinkler Irrigation Set by Using Waste Plastic Bottles

Shivaji Keshav Navgire and S.L. Suryawanshi*
Village Tuljapur, District Osmanabad
*KVK, Osmanabad, Maharashtra

Shri Shivaji Keshav Navgire was experiencing stress due to drought conditions like other farmers of Osmanabad. Shri Shivaji created an idea to prepare a low cost sprinkler set using waste plastic bottles to overcome regular drought incidents.

He utilized waste plastic bottles to build a sprinkler system. A lot of beverages in the market come in plastic bottles, post consumption, people throw them away carelessly. They are rarely recycled and they lead to a lot of pollution as well.

Discarded plastic bottles were collected and holes were created at the bottom of bottle. The bottle is then connected to a regular sprinkler in up-side down position. The force and the angle of sprinkler allowed the water to cover a wider sphere of the field.

The sprinkler was mounted on a very simple and light tripod, which can be easily lift or shift to other places. All sprinklers on the field were connected to one single output pipe with specific tap on it which regulates the water flow of any given sprinkler from one single point, without going to the field.

The waste plastic bottle sprinkler set (set of 12 nos. of sprinklers) used for vegetables, flowers, nursery and kitchen garden, the cost comes about Rs. 5168.

This innovative technology has been reached to other 150 farmers in nearby villages in the district. Awareness is being created by different ways and means.

Sprinkler set made of used plastic bottles, is supportive, water saving, cost saving and useful for small crops like vegetables, flowers, nursery, kitchen garden, etc. It is also affordable and environment friendly. He wants to convert it into a branded product in order to scale it up further.

Silage Making to Overcome the Effect of Drought on Malnutrition of Animals

Sunil Jagtap and R.S. Jadhav*
Village Jalgaon Supe, Tehsil Baramati, District Pune
*KVK, Baramati, Pune, Maharashtra

Medium soil with 60 cm soil depth, average rainfall in the village is 400-530 mm and under drought situation the annual rainfall is only 350 -400 mm.

Dairy enterprise is a major income generating activity in the Jalgaon Supe village.

Under drought situation, total rainy days are 20-25 days only and out of total rainfall 70 -80 % rains received in the month of July to September.

Inadequate rainfall, uncertain rains, frequent droughts, mostly rainfed area, medium to light soils and frequent dry spells.

Major crops grown specially bajra, pigeonpea, onion, fodder maize in kharif and chickpea, onion seed, jowar in rabi season.

There is shortage of green fodder from March to July that leads to malnutrition, low milk production, repeat breeding and increase in inter calving period and net loss to dairy farmer in the area.

To overcome this challenge KVK, Baramati had demonstrated silage making technology and use of area specific mineral mixture for dairy animals.

Sowing of fodder maize crop variety P-3396, P-3502 and African tall in the month of last week of July. Harvesting of fodder maize in month of October, chopping and silage making by pit method.

Silo pits are opened in the month of February and fed to dairy animals from March to July to overcome the problem of fodder shortage.

Farmer realized higher fodder crop productivity i.e. 16-18 tons per acre in light soil and 20-22 tons in medium soil and increase in milk production by 2 litre per day per cow, fat content increased from 3.6 to 3.8 % in crossbred HF cows. Time saving of 6 hrs and 50% saving on labour.

On an average Rs. 42180 per year was earned by using silage making technology while earlier he was getting only Rs. 22380.

System of Rice Intensification (SRI) with Mat Nursery to Reduce Dry Spell Effect on Paddy

Narayan Dhondiba Salunkhe and Syed Shakir Ali*
Village Natambi, Tehsil Bhor, District Pune
*KVK, Baramati, Pune, Maharashtra

Shri Narayan Dhondiba Salunkhe having 6 acre land with source of water (one well and one farm pond) which provides water till December only. Sometimes, he used to lift the water from nearby water stream. Rainfall is obtained about 900 mm in a year. He usually cultivates rice, turmeric, pea and groundnut as major crops. Chickpea and onion crops are grown on limited area.

Low yield of rice was observed in Bhor tehsil of Pune district due to over maturity of seedlings causes less tillering because of delayed monsoon. It also affects on drying of paddy nursery and required more labourers for transplanting. Earlier the farmer was using higher seed rate and more time to get ready the seedlings.

SRI method with mat nursery for rice cultivation was introduced by the KVK to solve delayed nursery and shortage of labourers for transplanting. In this technique, 3-4 kg seed per acre is required and needed less water. The nursery was grown near to water source and seedlings were ready to get transplant in 14 to 20 days while in farmer's practice 35-45 days needed to get nursery ready.

By using SRI method of rice, tillering of paddy is increased (15.2) than normal seedling transplanting (12.7). Initial cost on seed nursery preparation was reduced and saved Rs. 4000/ha. Cost on seed was also reduced (saved 62.5 kg seed /ha) as compared to normal method.

Seedlings raised by SRI mat nursery technique, seedlings can be used for machine transplanting so that uniform seedling transplanting can be possible and also reduced the labour requirement for transplanting by 50 numbers per hectare.

By adopting SRI method, he got 33.25 q/ha yield which was 28% higher over existing practice. Net return of Rs. 30550 per ha was obtained by the farmer.

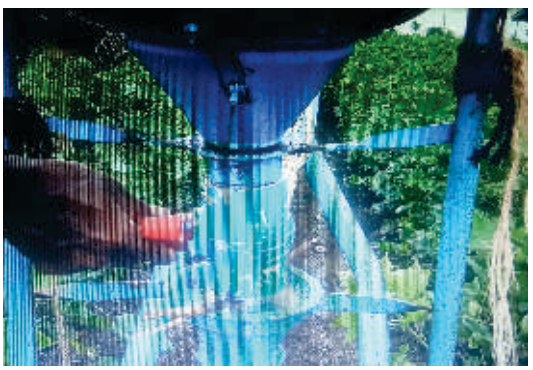
Bullock Drawn Fertilizer Applicator

Namdeo Anandrao Vaidya and A.M. Tayade*
Village Nimbhora Bodkha, Tehsil Dhamangaon, District Amravati
*KVK, Amravati-I, Maharashtra

Shri Namdeo Anandrao Vaidya is applying innovative ideas and technologies for cultivating cotton, soybean, pigeon pea, chickpea and wheat round the year. He started farming in 2005 with 7 acres of land after leaving job as a daily wager in a private company in Pune.

Innovations: Labour shortage in fertilizer application and soil moisture stress problems in cotton cultivation led him to develop ***bullock drawn fertilizer drill cum hoeing implement*** by using locally available low cost material through trial and error. With the help of this implement, one can complete three operations simultaneously (application of fertilizer + hoeing + making furrow for rain water conservation).

The Bullock Drawn Fertilizer Applicator is simple and portable having weight of 25 kg. The field efficiency is 2.4 - 3.2 ha/day and operating cost is Rs. 428/ha where as in traditional practice labour required was 5/ha/day and operating cost was Rs. 1000/ha, hence cost saved of Rs. 572/ha; labour saved 80% and time saved 300%. Another advantage was that fertilizer can be applied near root zone and mixed properly in soil, which increased the fertilizer use efficiency. It was widely popularized by print and other media resulting in its widespread adoption by other farmers in the region and adjoining districts.



Other innovation included use of tractor drawn cotton slasher machine in which cutting of cotton stalk was done and simultaneously incorporated in the field. It enhanced the soil organic matter in the soil and as a result water holding capacity was increased. Used bullock drawn sprayer for spraying weedicides and insecticides towards saving labour, time and cost of operation. Used CRIDA planter for sowing soybean and chickpea at his farm.

Got recognition by electing as Vice Chairman of Farmer Producer Company and having 280 registered farmers from 7 villages. Due to increase in socio-economic status, he bought additional 23 acre land.

In Situ Soil Moisture Conservation Measures through Contour Bunding for Rabi Sorghum

Sandip Rajaram Lonakar and Syed Shakir Ali*
Village Jalgaon KP, Tehsil Baramati, District Pune
*KVK, Baramati, Pune, Maharashtra

Shri Sandip Rajaram Lonakar is having 5 acre land and engaged in crop husbandry with limited water resource (one well). Average rainfall is around 450 mm. Major crops raised by him are: bajra, sorghum, greengram, maize, pigeonpea, marvel grass with sapota fruit plants. Totally dependent on livestock rearing for his livelihood security.

Earlier, he was getting 5-6 q/acre yield in rabi sorghum due to severe moisture stress. The crop growth was also not uniform, as a result the fodder and grain yield got reduced. In kharif, crops could not give good yield, if monsoon delayed.

Alternate Interventions: Due to close contact with KVK experts, he introduced Phule Vasudha and Phule Revati cultivars of rabi sorghum cultivated on 3 acre area. Before sowing he made flat beds of 10 m x 10 m as that area received only 60 mm rainfall in rabi season. Sorghum was sown at 18 inch distance with seed drill and after that no rainfall was received. In spite of that he got 15 q/ha grain yield and 1250 bundles of dry fodder. The technique was resulted in 60 to 70% increase in yield. Earlier, farmers could not harvest even dry fodder (*Kadba*). Due to this practice, moisture is conserved uniformly in the field due to small flat beds. It reduces runoff losses of water and reduces soil erosion which is very relevant dryland farming.

In-Situ Moisture Conservation Technology: Due to uniform moisture conservation the crop growth was uniform. The moisure thus conserved reduces the water stress during critical growth period and ultimately gave assured yield of rainfed crops like sorghum, bajra. Ground water table also increases by adopting this technique.

By adopting all sort of moisture conservation technologies, net profit of Rs. 28114/ha was realised by the farmer. Later on, it was taken as boon by the farmers and adopted at their farm covering about 256 ha area and benefited 252 villages of 7 tehsils.

Sericulture to Fight with Climate Change

Pratapsing Punamchand Marag and A.G. Mitkari*
Village Kadegaon, Tehsil Badnapur, District Jalna
*KVK, Jalna, Maharashtra

Shri Pratapsing Punamchand Marag, age 35 years, is one of the small farmer of Kadegaon village having only 4.5 acres of land. He is having five members in his family including his wife, two children and mother, all depending on agriculture. Soil type is medium black. The farmer with the help of his wife Tarabai and two children started sericulture to fight with changed climatic condition and created a successful case in the area.

Rainfall in the village: The normal rainfall of the village is 634 mm. In 2015, total rain 476 mm was received with 3 dry spells (ranges 10 days to 49 days during June to September). In 2016, rainfall received 791 mm with 3 dry spells (ranges 10 days to 25 days during July to September) and in 2017, total rain 205 mm was received with 2 dry spells (ranges 28 days to 29 days during June to August).

- Mulberry, soybean, Rabi Jowar, chickpea, etc. were grown by the farmer.

Innovativeness: The farmer used to change the cropping pattern by adopting sericulture. He has planted mulberry crop on 1 acre area. He has shifted from cotton to sericulture. The major innovative practices followed by him are listed below:

- Development of single stem mulberry plant for height of 1 foot for good leaf quality and sustain in drought situation.
- Use of gas heater for maintaining temperature at 27 ^{0}C in winter season.
- Use of Chalky worm of Bio-voltine CSR for quality cocoon production.
- He planted mulberry with spacing of 6 feet x 1 foot and adopted drip irrigation system for mulberry.
- Used recommended dose of chemical fertilizer with FYM, skill of moult passing at one time, grading of A grade cocoon for better price, pruning of mulberry plant after every rearing, saving of resources/inputs, labour saving by using shoots method of leaf feeding, using silk worm excreta as compost for field crops and prevention of outbreak of diseases and pests.

- Started goat farming by using waste use of mulberry after cocoon production.
- Sterilization of rearing shed for three times by different disinfectants before each rearing.
- Use of growth hormone spray in silk worm rearing for quality cocoon, maximum yield and uniformity in spinning for cocoon production.
- Dusting of different disinfectants in rearing bed as preventive measure to avoid silk worm diseases.
- Adopted shoot feeding method of leaf feeding to silk worm. Maintaining required temperature and humidity in rearing shed.

Economic Sustainability and Profitability: Due to adoption of climate resilient practices and change in cropping pattern, the productivity of field crops is increased. Profitability per year has been increased by 7 times due to adoption of sericulture, goat farming and improved farming practices.

- Field crops (Soybean, Rabi Jowar, Chickpea): On an average net profit of Rs.69000 per year was obtained in 2017-18.
- Livestock (Goats - 07, Buffalow-01): From livestock, the farmer got average net gain of Rs.31000 in a year.
- **Sericulture:** The farmer attained as net economic gain of Rs 346390 in year 2017-18 from 0.40 ha area. Initially, he started his earning by Rs 61150 in 2015-16 and in 2016-17, he earned income of Rs 200786 in a year.

Horizontal Spread: His sericulture farm is visited by many farmers and other extension functionaries from surrounding villages of Jalna and Aurangabad districts. More than 1500 farmers in Jalna and 35 farmers in Aurangabad district started sericulture.

The technology is adopted by about 40 farmers in his village and out of which 22 farmers have already planted mulberry and started cocoon production.

Onion Seed Production in Stress Condition

Uddhav Asaram Khedekar and S.V. Sonune*
Village Shivni, District Jalna
*KVK, Jalna, Maharashtra

He has grown different crops like rabi jowar, bajra, soybean, green gram, black gram, redgram, chick pea, onion, chilli, capsicum, cucurbits, pomegranate, mango, etc. In livestock, cow and bullocks are reared. On small scale, shade net for vegetables was also created.

Average rainfall was about 400 mm in 2017-18 with dry spell of 29 days.

The farmer selected onion crop for seed production with drip irrigation (discharge 2 litre per hr) for saving of water.

Improved varieties of onion like Bhima Shakti, Bhima Kiran, AFLR, NH Red-3, Fursungi, Bhima Super, AFDR were included under farming for attaining productivity and profitability.

Improved planting methods like strip planting at 4x1x1 cu.ft, use of optimum size seed bulbs (40-60 g) for assured germination and crop stand, use of honey bees and artificial pollination for increasing seed setting and productivity, use of fertigation techniques for increased efficiency of nutrients were adopted.

He also used water budgeting by using information of Automatic Weather Station connected with Automatic Irrigation Switches in the field.

Adoption of plastic lined farm pond of 44 x44 x 6 m size with 1 crore litre water storage capacity to use in scarcity period particularly in March, April and May.

Net return of Rs. 1.20 lakh per ha was obtained from onion seed production. About 40% water saving was observed by using different water saving technologies like drip irrigation, peripheral bunding, etc.

He grows capsicum, cucumber and tomato in shade net. Many farmers got motivated by visiting his farm.

He has been recognized at different platforms. He received ICAR Jagjivan Ram National and Zonal Innovative Farmers Award along with several individual and community awards for his innovative works.

Rain Water Harvesting, Construction of Farm Pond and Grape Exporter

Bharat Eknath Shinde and Y.L. Jagdale*
Village Bori, Tehsil Indapur, District Pune
*KVK, Baramati, Pune, Maharashtra

Shri Bharat Eknath Shinde is grape grower and cultivates grapes on 23 acre land in rainfed situation in Pune district which received only 200 to 250 mm rainfall.

Innovation Developed: From a simple grape cultivator to an exporter his journey included use of drip irrigation system, use of plastic crop cover and constructed farm pond (4000 sq.m having capacity of 2 crore liters of water) for water harvesting.

Use of Improved Varieties: He planted improved varieties of grapes having export qualities and drought tolerance on 7.2 ha area. The improved varieties of grapes are Manikchaman, Sonaka, Nana Saheb purple and Krishna.

Best Practices: Spraying was done by electrostatic sprayer which was supplied to him under PPP Grape Project by KVK, Baramati which reduced the labour and also reduced quantity of insecticides and showed good results. Used bio-fertilizers and bio-pesticides for increasing the resistance level in grape against pest and disease and used weather based crop management software for producing export quality grape.

Impact: Average yield of 8.2 tons/acre was achieved with net economic gain of Rs. 2.27 lakh per acre. By observing farm pond construction made by him, 150 farmers have constructed their own farm ponds having water storage capacity of about 1.5 crore litre and also adopted the insecticides and fungicides spray schedules developed for grape which helped the farmers to increase the quantity and quality of export purpose grapes. By adopting different interventions, he saved his grape crop and reduced the farm level stress.

Dragon Fruit Farming under Rainfed Situation

Bhagwan Shankar Kodag and A.A. Shaikh*
Village Aawandhi, Tehsil Jat, District Sangli
*KVK, Sangli, Maharashtra

Shri Bhagwan Shankar Kodag belonging to Jat tehsil in Sangli district faced regular droughts where crops could not survive well. Shri Bhagwan has 5.20 ha land and usually cultivate rabi sorghum, maize, pomegranate, etc. Soil is light to medium. Limited irrigation source with well and bore well is available.

He started dragon fruit farming on 1.80 ha land with red and white dragon varieties in June 2015. He raised dragon fruit nursery on 500 sq m area. Total 2000 seedlings per acre planted with distance of 11ft x 7ft using 4 plants per pole. Bitter gourd and ridge gourd were taken as mixed crops. He used 2 tons FYM/ha and no use of chemical fertilizer, insecticides, etc. In summer season, once in a month for an hour with drip irrigation was given.

7-8 numbers of fruits per plant were harvested in first year. Average weight of fruit was 250-700 gm. Shelf life of fruit is about one month after harvesting. Orchard life span is about 20-25 years. Average yield of 4.5 tons per ha was obtained in first year, 8.75 tons/ha in second year and in 3rd year dragon fruit yield of 12.5 tons/ha was obtained.

Net income of Rs. 7.55 lakh per ha was attained from dragon fruit cultivation. Marketing was done in Pune, Mumbai and Bengaluru.

Water Budgeting through Low Cost Rain Gauge

Keshav Jadhao and P.P. Shelke*
Village Shivani, Kalamnuri, District Hingoli
*KVK, Hingoli, Maharashtra

Shri Keshav Jadhao developed a low cost rain gauge using plastic bottle and a measuring scale of 30 cm as there is acute water scarcity in the village affecting crop productivity and profitability. He keeps the rain gauge on the roof of his house and measures the rainfall in rainy season since year 2004. Low cost (Rs 120 only) rain gauge is made up of measuring cylinder used commonly in laboratories. Plastic scale is fixed on one side to measure the height of rain received.

Efforts for Community: He records the data and displays it in the village during rainy season for other villagers who used the weather data in crop planning in different crop seasons. Farmers could save the available ground water for crops by planning of area for water demanding crops. It is estimated that about 200 acres of additional area could be brought under sprinkler irrigation. Chickpea crop was benefitted and productivity increased by 15%. About Rs. 9.0 lakh profits per year can be achieved with increase in yield of 15% from 200 acre chickpea area.

People's representatives appreciated the effort of individual farmer for making water budgeting towards effective crop planning.

He has opened a library for other villagers and also acting as resource person in nearby villages.

Quality Seed Production of Soybean in Drought Area

Balasaheb Bhaguram Datal and S.S. Digrase*
Village Bhadgaon, District Latur
*KVK, Latur, Maharashtra

Shri Balasaheb Bhaguram Datal had only 5 ha land with limited water availability (one well and one bore well) growing soybean, chickpea and safflower cover the larger area in district Latur.

In addition to water scarcity, quality seed availability was the major problem.

He took up quality seed production of soybean with group approach.

His farmers' group '*Adhunik Shetkari Gat*' took up quality seed production of soybean following moisture conservation, farm mechanization and resource conservation technologies.

Improved cultivars like MAUS-71, DS-228, MAUS-158 and MAUS-162 were sown by using Broad Bed Furrow (BBF) technique. Integrated nutrient management was adopted. Spray of potassium nitrate was done to avoid transpiration losses during drought.

Om Sai Adhunik Farmers Producer Company was formed with assistance of ATMA, Latur in 2014. Under FPC, seed processing unit was established where 4 tons per hour seed is being processed.

Farmers are getting additional profit of Rs. 12000 per acre. Farmers are getting good quality seed in time with low cost in the district.

Under this producer company, 189 farmers from 11 groups are producing good quality seed (5000 to 6000 q per year) and processed seed sold by the brand name of *Adhunik Seeds*. He earned Rs. 6 to 7 lakh as net income from processing fees and 20% additional income from selling soybean seed bag of 30 kg.

On an average yield (10 q per acre) was obtained. Processing fee of Rs. 550 per q (Rs. 5500 per acre) was given. 70% quality seed was produced.

Chickpea Cultivation by Multi-Crop Ridger Method for Moisture Conservation

Bharat Shivaji Wabale and S.V. Karanje*
Village Jalgaon KP, Tehsil Baramati, District Pune
*KVK, Baramati, Pune, Maharashtra

Shri Bharat Shivaji Wabale is having 2.5 ha land with source of water (one well and one bore well) which provides water for crop husbandry. Rainfall is obtained about 460 mm in a year. In *kharif*, sunflower and onion, in rabi chickpea and sorghum are raised on 1.3 ha area. He also cultivates lucern and fodder maize for cattle on 1.2 ha land. Earlier, he was using traditional drilling flat bed and broadcasting method for chickpea sowing. After taking advice from KVK, he adopted the ridge and furrow method by using multi crop ridger for sowing chickpea.

Innovation Adopted: Ridge and furrow sowing in chickpea by using Multi Crop Ridger (45 cm X 15 cm) resulted increase in yield (12.50 q/ha) which was 25.62% higher as compared to conventional sowing method (9.95 q/ha) in 2015-16.

Chickpea crop exhibits moisture stress during long dry spells and also suffers terminal moisture stress at pod formation stage. Ridge and furrow method not only facilitated moisture conservation but also drainage excess water in black soil.

Enhanced net income (Rs. 31550 per ha) as compared to earlier income of Rs. 21500 per ha realised by the farmer.

Integrated Farming System to Overcome Drought Situation in District Latur

Shrimant Trimbak Kadam and S.B. Salunkhe*
Village Akharwaie, Tehsil and District Latur
*KVK, Latur, Maharashtra

Shri Shrimant Trimbak Kadam, a graduate possessing 8 ha land under rainfed condition.

He has adopted innovative practices to transform his traditional farming of soybean, chickpea, pigeonpea, urdbean and mungbean to integrated farming system and obtained technological support from KVK and state line departments.

His IFS model consists of one ha horticulture crops i.e. mango + tamarind and rose, two ha area under sugarcane as cash crop with intercropping system, one ha area of fodder crops having maize and hybrid Napier grass. He also raised other crops on four ha area and mulberry plantation on one ha area. Different enterprises like sericulture (300 cocoons) and chowki rearing centre (100 eggs), dairy farming with H.F. crossbred cows (08) and backyard poultry farming with improved birds (40 birds) were also taken up.

In addition, best practices of farming like drip and sprinkler irrigation, use of improved seeds, following IPM practices, soil testing, improved technologies, reducing chemical fertilizers by using cow dung and urine, silage making, azolla feeding to animals were adopted.

Now the farm has become training centre on integrated farming system model. More than 300 farmers from adjacent villages have visited the farm. He has developed his own marketing strategy for direct sale of horticulture crops in nearby Latur city with better price realization.

Mr. Kadam said that some of best practices helped to convert the farm in to sustainable model for attaining regular income in drought situation.

From 08 ha of land, presently he earned net profit of Rs. 12.90 lakh in a year. Rs. 3.35 lakh from soybean, chickpea, pigeon pea, sorghum, wheat and mungbean; Rs. 2.75 lakh from sugarcane; Rs. 1.30 lakh from mango, tamarind and rose; Rs. 3.10 lakh from dairy farming; Rs. 2.10 lakh earned from sericulture; poultry farming (Rs. 0.10 lakh).

He is now a role model not only in his village but also for the entire farming community of Latur district. He has inspired various farm families for sericulture and dairy farming. These interventions have proved for providing regular income and sustainable agriculture in drought prone area.

Soil and Water Conservation for Sustainable Agriculture

Ganesh Nanote and U.G. Thakare*
Village Nimbhara, Tehsil Barshitakli, District Akola
*KVK, Akola, Maharashtra

Shri Ganesh Nanote is having 50 acre land and cultivating 15 acre cotton, 5 acre kagzi lime, 30 acre soybean and is recipient of Krishi Ratna award (Lokmat), Krishi Deep Stambh award (Rotary Club).

Sustainable agriculture: Shri Nanote has synchronized traditional agriculture with modern scientific technologies. He has achieved climate resilience through adoption of various farm innovations and administering efficacy in crop rotation, mixed cropping, soil moisture conservation**,** fertilizer application, pest control and use of agriculture intelligence.

Soil Conservation: The farmer adopts soil incorporation of farm waste especially the plant waste of *rabi* wheat. He also follows earthing up to standing crops like cotton, kagzi lime and other intercrops. The application of fertilizers was always based on soil test. The farmer also applied ten trolley FYM per hectare.

Moisture Conservation: The farmer adopts the practice of mulching in every possible way (organic and plastic mulch) for almost all crops including cotton soil incorporation of farm waste especially the plant waste of *rabi* wheat. Regularly follows in-situ moisture conservation practices. The farmer uses drip irrigation for bringing water use efficiency.

Pest Surveillance and Monitoring: The farmer regularly carries pest surveillance and always follows actions based on ETL. Regularly removes alternative host plants of major insects.

Use of Mobile Based Intelligence: The farmer regularly, efficiently and effectively utilizes weather and market intelligence receives through mobile apps.

High Extension Contact: The farmer has high extension contact and high source of agriculture information for updating of required knowledge and acquaintance of needed skills.

Dragon Fruit under Drought Condition Performed Better for Higher Return

D. R. Nene and L.R. Tambade*
Village Bhose, Tehsil Mangalwedha, District Solapur
*KVK, Solapur-I, Maharashtra

Shri D. R. Nene has 12.8 ha land in rainfed condition where he used to cultivate grapes, pomegranate and vegetables earlier but due to the problem of more cost of cultivation and shortage of water, he introduced dragon fruit especially *Hylosereus undatus* and *Selonosereus costarisesis* at his farm.

The crop required less intensive inputs whereas started giving high profits and could survive in the extreme waterless conditions. During March to May no water was required, in June to September 4 litre water/plant and in October to February 2 litre water per plant applied through drip irrigation system.

Average yield (4-5 tons/ha) of dragon fruit in 2nd year; 15-20 tons/ha in 3rd and 4th year; and 25-32 tons/ha yield was obtained by the farmers with net economic gain of Rs. 14.58 lakh/ha in 5th year.

Farmer attained at least 70% yield under water stress condition which was economically comfortable, if compared to his earlier risky situation/threat with heavy loss even up to 100% under grape and pomegranate cultivation.

Vegetable Raised with Moisture Conservation Practices

Vaibhav Kailash Murade and Bharat G. Temkar*
Village Rohakadi, Tehsil Junnar, District Pune
*KVK, Narayangaon, Pune, Maharashtra

Shri Vaibhav Kailash Murade having 4 acre land with irrigation facility of canal, dug well and tube well. Different vegetable crops like tomato, brinjal, chilli, cabbage and cauliflower are cultivated round the year in the village. The farmers tend to take more than three crops in the same field per year to get fulfilled their monthly livelihood expenses.

After completion of diploma in engineering, he worked with private company for two years. He left the job and decided to enter in the farming sector full time.

Initially he faced lot of problems, but he learnt different micro aspects of commercial vegetable farming and also technologically backstopped from KVK.

During 2016-17, annual rainfall was received with less than 500 mm in the area. There was less water availability for summer season. Mr. Vaibhav searched for information regarding the technology for growing vegetables with less water.

He came to know about some products available in the market which are having capacity to hold water for more duration.

The hydogel, starch material derived from maize seeds were some products which were beneficial for increasing water holding capacity of the soil. He also came to know that by using more quantity of organic manure, the water retention capacity of the soil can be increased.

Tomato is being taken in summer season on large scale in Junnar tehsil. In February 2017, he decided to grow tomato on 1 acre area. He used well decomposed organic manure 9 tons per acre. He adopted the recommendations of KVK regarding raised bed cultivation, drip irrigation and fertigation, use of polythene mulching. While applying basal dose of chemical fertilizers along with 10:26:26 (NPK), micronutrients, neem-cake. He decided to use the product of starch derived from maize grain and added 5 kg of starch powder per acre along with basal dose of fertilizers.

The starch material of maize is having property of holding water 400 times of its weight. After transplanting of seedlings adequate moisture was maintained which resulted in less mortality of seedlings.

It resulted in vigorous vegetative growth of plants. Uniform size of fruits was obtained from the treatment plots. By use of maize starch product, tomato yield was increased by 30%.

Fruit quality with 60% A grade fruits, drip irrigation used twice in a week with 50 tons per acre yield was attained. The net return of Rs. 7.78 lakh was achieved.

Mr. Vaibhav tried the maize starch for growing cauliflower in summer season. He observed that the use of starch powder @ 5 kg per acre has reduced the number of irrigations. Flood irrigation interval in the treatment plot was 6 to 7 days where as in the control plot, it was at 5 days. In all, 2 irrigations were saved by use of starch product.

In treatment plot the curd size was quiet uniform. About 90% curds were harvested in first harvesting. In control plot only 60% curds were harvested. The prevailing market prices were quiet low, so he got less return.

The farmer is quite confident about the benefits of the product and said that the starch material will be highly useful in mitigating drought situation. It can be used in dry land fruit crops like pomegranate, rainfed agronomical and horticultural crops. Such interventions reduced the agrarian distress and risk.

Diversified Farming in Rainfed Condition for Higher Return

Mohan Tejrao Jagtap and C.P. Jaybhaye*
Village Walti, Tehsil Chikhali, District Buldhana
*KVK, Buldhana-II, Maharashtra

He is having 3.6 ha of land in which 1.6 ha area brought under irrigation by constructing a farm pond (20m x 25m x 8m). The farm pond is the only source of irrigation on his field for protective irrigation to the plantation crops as well as field crops.

On 2.0 ha area, he cultivated crops like soybean, pigeonpea, mungbean, urdbean in kharif season and chickpea during rabi season. On 1.60 ha, he has developed guava (high density), custard apple (high density) and apple ber orchards.

He has used micro irrigation techniques viz., drip irrigation, mini sprinkler, wobblers and inverted sprinklers along with various mulch techniques.

Pruning techniques have been used in maintaining high density in guava, custard apple and apple ber plantations.

In 2017, he earned Rs. 8.0 lakh from fruit orchards including guava, custard apple, mango and drumstick.

He has started vegetable seed production (tomato) in his shade net house.

He has developed a unit "Jagtap Agriculture Development Unit" at Walti village in district Buldhana. The farm is popularly known as JADU farm and other villagers get their advices from him about latest farm technologies.

Measures to Cope with Climate Change

Ravindra Bhanudas Devarwade and C.S. Tripathi*
Village Devala, Tehsil Ambajogai, District Beed
*KVK, Beed-I, Maharashtra

Shri Ravindra Devarwade, a graduate engaged in farming from last 15 years with 5 ha of land where he was growing soybean, pigeonpea, chickpea, sorghum and sugarcane as main crops.

He is actively associated in community work through *'Shramkari Group'* Devala. His active involvement in attending extension programmes has shown a feature of early adopter.

Innovative technologies for drought mitigation

He has installed micro-irrigation system for crop production especially drip, sprinkler, rain gun.

Used BBF for kharif and rabi crops and farm mechanization with tractor, bullock drawn implements.

He has linked allied enterprises with agriculture dairy, poultry and fishery which gave him additional income.

He has adopted trash mulching in sugarcane to reduce irrigation frequency.

Developed vermi-compost unit and using it regularly in the field due to which water holding capacity of soil increased.

He had made trench in field to drain excess runoff of precipitation during monsoon.

He is using tube well recharge technology and increased protective irrigation period for 30-45 days.

Intercropping with short duration crops to opt out drought condition followed by him.

In severe drought, he completed his farm operations with bullocks due to which he assumes escape severe drought situation.

By adopting integrated farming system and advanced technologies, he reduced the adverse effect of climate change especially drought.

Pigeon Pea Drought Resilient Technology and In Situ Soil Moisture Conservation

Sachchitanand Bhagwan Doifode and A.B. Shastri*
Village Surdi, Tehsil Barshi, District Solapur
*KVK, Solapur-I, Maharashtra

He is small farmer having 6 acre land under varied agro-ecology. Average rainfall 535 mm received during June to October. A dry spell of 21 days was observed during month of July and only 14% rainfall was received during this month. Chickpea, onion, pigeon pea, sorghum were cultivated.

Low yield of pigeonpea under dry land situation due to low, uneven distribution of rain was realized by the farmers.

With technological support of KVK, Solapur, short duration variety BDN-711 was demonstrated and in situ soil moisture conservation technique i.e. preparation of dead furrow 45 days after sowing. The farmers in cluster were trained to follow full package practices along with resource conservation technologies. Fortnightly visit of KVK experts and mobile based advisory was given as per their need.

Average yield of 35.50 q/ha was obtained which was superior over local practice (12.50 q/ha) and net return of Rs .1.08 lakh/ha was achieved by the farmer.

Preparation of dead furrow makes it possible to thrive the crop during dry spell of 21 days during July 2017.

Due to dead furrow preparation, earthing up was done and crop stand was better than local practice.

Dead furrow also helped to drain excess moisture due to heavy rains during month of September and October month.

Distress Reduction through Crop Diversification

Vishnu Shivaji Khadse and N.B. Patil*
Village Sellu Khadse, Tehsil Risod, District Washim
*KVK, Washim, Maharashtra

Shri Vishnu Shivaji Khadse having 5 acres land following micro irrigation, well and bore well as source of limited irrigation.

Traditional cropping pattern – jowar, cotton, green gram, black gram and in rabi, if soil moisture is there, may go for safflower crop. Overall income of Rs. 80-90 thousand in ideal situation and net profit was around Rs. 15-20 thousand only.

Due to such crisis, family has to go for labour wage to fulfill their daily requirement and Mr. Vishnu left the school and started farming.

Use of advance practices like year round vegetable cultivation, use of improved varieties, mulching, drip, bed system, fertigation, different traps, insect net house and biodynamic composting was started. Direct marketing of vegetables was done.

Plantation of fruit crops like orange, guava, papaya was also introduced. Came into close contact to KVK and attended 5 days training at HTC, Talegaon on shade net production technology. Started hybrid seed production of tomato and other vegetable crops on contract basis with private companies. Generated Rs.1.20 lakh from 0.10 ha area. Started raising kharif and late kharif onion as per market demand.

Guava, kagzi lime, drumstick, dairy were also adopted to face adverse situations.

Hybrid seed production of tomato was taken up on area of 0.10 ha in October, 2016. Major attention was given on contract with company, shade net, drip, mulching, traps, focus on organic inputs, use of PGR, cross pollination, etc. 13 kg seed produced and sold @ Rs. 14000/kg and attained net profit of Rs. 1.12 lakh from 0.10 ha.

Late kharif onion was raised on 1 acre area with variety Bhima Super in August 2016. Seedling in nursery, BBF technology, drip irrigation, organic composting, integrated pest and disease management, etc. were followed. Selling of green onion through thinning was done.

Average yield of 145 q/acre was obtained and net profit of about Rs 201500 per acre in 2015 and Rs. 85500 per acre in 2016 was realized. The economic gain was varied with selling rate.

Onion seed production was taken up on one acre area with variety AFLR in November 2016. Contract with private company was done. More focus on drip irrigation, fertigation, INM and IPM, focus on protection of Honey bee hives was given.

Yielded 4.5 q/acre and sold @ Rs. 25000/q and farmer got a net profit of Rs. 77000 per acre.

Tomato was cultivated on 0.10 ha area with variety Vedant in June 2017. Seedling production in tray and cocopeat, bamboo staking, yellow and blue sticky trap, drip and mulching techniques were adopted. Average yield of 30 q was taken up and obtained net profit of Rs. 82500 from 0.1 ha area.

Brinjal was grown on area of 0.1 ha with variety Manjari in November 2016. Tray method for seedling production, drip, pheromone trap, sticky trap techniques was followed. Average yield of 26 q was taken up and economic gain of Rs. 34000 from 0.1 ha was obtained.

Castor Cultivation under Rainfed Situation in Anantapur, Andhra Pradesh

K. Ramachandra Reddy and P. Laxmi Reddy*
Village Akuledu, District Anantapur
*KVK, Anantapur, Andhra Pradesh

Castor was included in place of groundnut under rainfed condition. Main soil types are red and sandy black soils.

Castor- 15 acre, groundnut-15 acre, Bajra- 15 acre, Red gram-10 acre and sapota and mango-16 acre were cultivated.

Even under below average rainfall in the district, Castor cultivation is highly profitable by this method. 5 to 6 q per acre yield was taken under rainfed condition with net income of Rs. 20000 per acre from castor.

Almost 1200 farmers were motivated in the district and diversified from groundnut to castor under rainfed conditions and achieved higher yield.

The efficiency of castor thresher was tested at farmer's fields. Its cost to use thresher was Rs. 400/- per acre as compared to farmer practice (Rs. 1200/acre) and saved an amount of Rs. 800 per acre.

Conservation Measures for Mitigating the Drought in District Wardha, Maharashtra

Dilip Nanaji Pohane and P.S. Umbarkar*
Village Daroda, Tehsil Hinganghat, District Wardha
*KVK, Wardha, Maharashtra

In Maharashtra Vidarbha region is recognized mostly for farm level stress due to drought.

Shri Dilip Nanaji Pohane holds 9 acres land and most of land depends on rainfall. He also faced other problems in farming such as labour shortage, uneven rainfall, electricity load shading problem, fluctuation in market rate, etc. He consistently sustained in his crop husbandry for mere survival.

Raised major crops i.e. cotton(4 acre), soybean and pigeon pea(5 acre).

Got motivated to develop his knowledge and skill for adopting conservation measures to combat with severe water scarcity in the area.

Raised pigeonpea on beds at a distance of 2.5 m and three rows of soybean sown as intercrop. Soybean and pigeonpea sown by dibbling method.

Soybean + Pigeonpea intercropping system helped in conservation of moisture through leaf fall during maturity phase of soybean. These fallen leaves used as mulch for pigeonpea crop.

Opened the furrow in cotton at 45 days after sowing by using *desi plough*. Opening of furrow in cotton during dry spell provided earthing up to the cotton rows helped the plants to conserve moisture during dry spell.

Other crop management practices like maintaining optimal plant population that promotes uniform and rapid development of crop canopy without any competition for growth resources like water.

Under rainfed condition, by using these moisture conservation technologies this farmer had taken 7 q/acre yield of soybean, 7 q/acre of cotton and 3 q/acre pigeon pea during last year.

Cultivation of *Lucanea lucacephala* in Light Soil and Barren Land to Overcome Fodder Shortage in Rainfed Area

Sandip Pisal and R.S. Jadhav*
Village Jalgaon Supe, Baramati, District Pune
*KVK, Baramati, Pune, Maharashtra

Average rainfall in the village is 400-530 mm and under stress condition the rainfall received about 350-400 mm.

Dairy enterprise is a major income generating activity in the Jalgaon Supe village.

Under drought situation, total rainy days are 20-25 days only and out of total rainfall 70 -80 % rainfall is being received in the month of July to September.

Major crops grown specially bajra, pigeonpea, onion, fodder maize in kharif and chickpea, onion seed, jowar in rabi season

There is shortage of green fodder from March to July this is leading to malnutrition in Osmanabadi goats, low milk production, low growth rate in kids and kid mortality.

To overcome this problem, KVK, Baramati had demonstrated cultivation of *Lucanea lucocephala* (var. Nari Neerbija) in barren land and light soil.

Plantation of *Lucanea lucocephala* in month of August at the distance of 10 ft x 6ft in barren land and light soil for fodder purpose having 1815 plants per ha. Lucanea Lucocephala leave are available round the year for feeding to goats.

Sustainable, once the *Lucanea lucocephala* trees planted, it can give tree leaves for 15-20 years and suitable for drought situation and dry spells.

Net return of Rs. 90125 was obtained by cultivation of *Lucanea lucocephala* while Rs. 51500 was realized under cultivation of sorghum.

Organic Farming Performed Well in Drought Situation

Vidya Rudraksha and C.S. Tripathi*
Village Digholamba, District Beed
*KVK, Beed-I, Maharashtra

Mrs. Vidya Rudraksha, a graduate in B.Sc. Microbiology, developed as organic farm of 15 acres and is having two children studying in IIT. Her husband Shri Baburao Rudraksha worked as Agriculture Supervisor in state department of agriculture and got voluntary retirement.

Organic Farm and Dairy: Established dairy unit of Red Kandhari and Deoni local breed for dual purpose and biogas unit. Biogas completely utilized for fuel and power for 5-6 years and never purchased LPG. Slurry was applied in the field. Vermi compost, vermi wash and other composting units were established. Neem powder making unit was also started. Focus on processing and value addition was given. She used green manuring crops like Sesbania (Dhaincha) to increase the organic carbon content in soil.

Cropping pattern: Cotton, sugarcane, turmeric, soybean are main crops along with intercrops of green gram, sesame and black gram. Turmeric + Chilli, Green leafy vegetable mixed with main crops were raised.

Impact: Every year, she applied bio compost, vermi-compost behind plough which improved the water holding capacity in soil. During drought spell in standing crop, spray of cow urine, vermi-wash and other important product of vermi composting was done after 10-15 days interval. It is realized that her farm never affected by minor drought. In horticulture crop, mulching of wheat straw, plant leaves with *matka sinchan* and spray of organic material prepared by her was practiced.

Sugarcane trash is used for mulching to reduce irrigation frequency up to 50%.

Bunding of farm was done. Rain water harvesting saved each drop of water in each field. By applying techniques of soil moisture conservation, sowing across the slope after 4-5 rows one row left for irrigation or drainage of excess rain.

Three years ago, she purchased sprinkler, rain pipe and drip irrigation at her farm for applying the water at crucial stage with efficient utilization.

She got this prestigious Jijamata Krishi Bhushan award of Maharashtra for her outstanding work during drought situation and motivated large number of farmers.

Drip Irrigation Technology by Using Brick to Mitigate Drought in Sweet Orange

Nayum Patel and Deepti C. Patgaonkar*
Village Dhawalapuri, Tehsil and District Aurangabad
*KVK, Aurangabad-I, Maharashtra

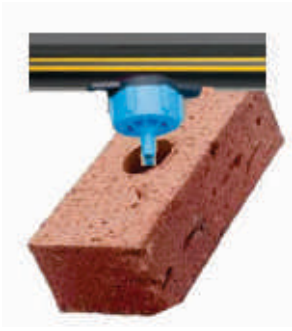
Shri Nayum Patel manages his sweet orange orchard in totally rainfed situation and dry spells of long duration many a times with rainfall of only 239 mm (20 rainy days in a year).

Shri Patel got motivated by special campaign to mitigate drought situation where moisture conservation technologies like mulching were highlighted. He got inspired and decided to do something innovative to save his orchard from severe drought and manage mental stress. Finally he developed an innovative technology of drip irrigation by using brick to survive his newly established sweet orange orchard (2 acre).

Innovation Developed: He applied water saving technology – drip irrigation. He took brick and made a hole at centre of brick. Single dripper (compensating dripper) having discharge of 8 litre/hr and inserted into the hole. Such type of two bricks putted (inserted) below 5 to 6 inch below the soil surface where the active roots are present. He irrigates his orchard for half an hour with every alternate day or two days. Main concept behind this technology was that bricks can hold water and water regime may be available for long period.

Economics: Bricks cost for dripper comes about Rs. 3200 for 2 acre. Drip irrigation system established through 100% subsidy from state agricultural department. Labour cost was counted Rs. 2400. So, total expenditure of innovative technology was Rs. 5600.

Annual fruits production was obtained 12 tons from 2 acres and annual income the farmer realized was Rs 2.40 lakh from 2 acres in severe drought condition.



Sustainable Income under Drought Situation through Crop Diversification

Bhagwat Balkrushna Doiphode and P.A. Gonjari*
Village Surdi, Tehsil Barshi, District Solapur
*KVK, Solapur-I, Maharashtra

Shri Bhagwat Balkrushna Doiphode possessed 15 acre land under rainfed condition with 535 mm rainfall in a year, growing crops like grape, onion, french bean, chickpea, sorghum, etc. Desi cow and buffaloes were also being reared. Earlier he was cultivating the crops like soybean, green gram, black gram in *kharif* season with cost of cultivation of Rs. 20000 to Rs. 25000 per ha and getting net return of Rs. 30000 to Rs. 35000 per ha.

Stress Management: He started drumstick farming since last 4 years. He selected drumstick because it can be grown in drought prone condition and in alternate year drought situation. This crop requires very less water in hot summer season. There is less infestation of insect and pest. He has grown KDM-01 Bhagya variety planted with 8 ft x 8 ft spacing in very light soil. Technological orientation was done by the KVK. He has promoted group farming through farmers club constituted by the KVK.

Use of drip irrigation system, fertilizer application through drip and foliar application was followed for higher production of pods of drumstick.

Average yield of 11.8 tons/ha was attained and net profit of Rs. 1.21 lakh/ha was realized by the farmer, which was additional of Rs 88000 in one ha area.

This crop is very excellent in the area where receives very low rainfall. Drumstick gave pod yield of 18 to 20 tons per ha with best practices. The pods of drumstick fetched good market rates i.e. Rs.20 to 70 per kg variable with season throughout the year. The crop is very responsive to the organic fertilizers with special reference to FYM. In case of water requirement, it requires irrigation for 10 to 15 minutes in light soil.

Seed was provided to 25 farmers and they grow drumstick. More than 100 farmers have visited his drumstick crop and benefitted.

Adoption of Integrated Farm Management for Enhancing Productivity of Small Land Holding Farmer

Satish Shankarrao Bhusari and A.T. Gabhane*
Village Asalgaon, Tehsil Jalgaon Jamod, District Buldhana
*KVK, Buldhana-I, Maharashtra

Limited source of water, unable to earn sufficient income to meet family requirement, adverse effect of climate change, drought, agriculture distress, high cost of cultivation, etc.

To face adverse effect of climate change, dry land horticulture was started in year 2010-11 and planted custard apple cv. Balanar (140 plants on 0.30 ha area).

Minimized expenditure on use of chemical fertilizer and pesticides by adopting organic inputs. Bio pesticides and neem seed extract for management of insect pest was adopted.

Soil moisture conservation measures like sowing across slope, vegetative mulching, irrigation ditches, nala widening and deepening, farm bunding, drip irrigation, etc. were followed.

Soil enrichment through several measures like soil testing based fertilizer application, bio dynamic compost, vermi composting, addition of soil humus, crop residue management, etc. were practiced.

Marketing challenges of fruits was faced. Started loose selling of custard apple fruit in 2014-15 by opening fruit sale counter.

To get higher economic gain, started selling custard apple fruit processed products.

Started fresh fruit and sugarcane juice centre in 2016.

By adopting selling counter for loose selling, he earned Rs. 25000 and from Juice centre got income of Rs. 26000.

Other horticultural plants like fig, apple ber and drumstick were planted in 2015-16.

Taken initiative to start subsidiary business – Sericulture in 2015-16 and planted mulberry as an inter-crop in custard apple in 1.1 ha area.

Worked as a Group Leader in sericulture and promoted sericulture in six villages benefitting 201 farmers.

The major challenges are weather and marketing- distant market increases cost of transport and loss in weight of cocoons.

Shade net farming was started in June 2017. Bitter gourd was cultivated and income of Rs. 50000 was realized.

More than Rs 2.00 lakh as net profit is being earned by the farmer through custard apple+ mulberry + fig + apple ber + shade net farming under limited water resource and farm level stress condition.

Organic Farming for Sustainable Agriculture

G.V.S. Prasad and E. Karunasree*
Village Sagipadu, District West Godavari
*KVK, West Godavari, Andhra Pradesh

He has 10 ha land and growing Coconut + Cocoa- 3.6 ha, Oilpalm + Cocoa-1.6 ha, Citrus + Coconut- 2.1 ha, Banana + Coconut-1 ha, Citrus- 0.8 ha, Vegetables- 0.4 ha and fodder crops- 0.5 ha.

Major crops grown are like Cashew, Rice, Maize, Watermelon+ Sweet corn, Spine guard and Red banana in the area.

Before organic farming, total area was cultivated by Mango (var.Banesan) with net income Rs.10000/- per acre.

After mango cultivation shifted to plantation crops viz. oil palm, coconut, cocoa, sweet orange, etc. by inorganically up to year 2004.

To reduce cost of cultivation, improving the soil health and achieve the sustainability in cultivation of various crops, complete organic farming was adopted since last 14 years in 10 ha area.

Farm waste converted into manure, vermi compost, Jeevamrutham were used in different crops.

Bio fertilizers, bio control agents multiplied in own lab.

Green manuring and legume rotation were followed.

Pitting in horticultural crops (75%) of the total tree canopy and filling these pits with farm residue has extracted rainwater and completely reduced the water requirement in acid lime crops. Good result has been achieved on sustainable basis.

Used booster motor for existing submersible motor to increase the efficiency of the motor and also micro irrigation (50%).

Intercropping of cocoa in oil palm gardens was first assessed and grown which proved the cocoa as promising intercrop in oil palm.

Acid lime garden maintained with pitting concept of providing 4 pits covering about 75% of the plant canopy, filled with farm waste could be maintained without any external input and irrigation and the yield obtained was sustainable. Received a net income of Rs. 3.0 lakh during 2015-16. The yield was on par in the year 2016-17 but due to low market price the net income was only Rs.1.50 lakh but it was profitable as there was no external input cost. The fellow farmers uprooted their gardens and left with debts.

Promoting the concept of using bio-control agents and bio-fertilizers, being trained in NIPHM, Hyderabad and mother cultures are being multiplied and used for the self and also provided to the fellow farmers.

Chaff cutters are used not only to cut the fodder but also to make the farm waste such as oil palm leaves, coconut leaves, acid lime waste, etc. to make into small pieces and incorporating into the pits and trenches for adding as organic manure to the plants.

Preparation of amino acids by using eggs and acid lime juice for spraying to the plants has added the additional nutrition to the plants.

His farm has become the model farm for farmers in the district.

He has recognition by electing as President of Oil palm Growers Association at national level. He is also acting as resource person in the area and trained 60 farmers.

Integrated Farming System Model through Convergence

Machindra Annasaheb Shete and P.B. Kharde*
Village Chinchvihire, Tehsil Rahuri, District Ahmednagar
*MPKV, Rahuri, Ahmednagar, Maharashtra

Farmer's Profile and Problems: Shri Machindra Annasaheb Shete is a graduate farmer having 8 acres of land under rainfed area. Chinchvihire village falls in low rainfall area and receives average rainfall of 500 mm per year with ill distribution. Majority of the soils are light to medium and low in organic carbon content. He used to cultivate bajra crop in kharif season followed by rabi sorghum. The land used to remain fallow in summer due to unavailability of water.

Convergence Led Success: With this cropping pattern and low yield of crops, Shri Shete was not satisfied due to unremunerated returns. With support of National Horticulture Mission, ATMA and Farmer FIRST program, the farmer constructed water harvesting pond; started raising of pomegranate (*Bhagwa variety*) on 6 acres land (2400 no. of plants); and fishery in integrated way.

Technology Interventions

- Shri Machindra Shete cultivated the pomegranate orchard at a spacing of 12 x 8 feet. The size of his farm pond is 33 x 30 m with a depth of 30 feet having water holding capacity of 45 lakh litre water. Seeing the water scarcity, he has established a pipeline at a distance of 6 km from the Mula canal and stored this water in farm pond for protective irrigation to pomegranate orchard.
- He has incurred a total cost of Rs.12.83 lakh for establishing pipeline to fill the farm pond, mulching paper and fencing of pond. He is confident to recover the investment within two to

three years from pomegranate cultivation. He has also installed micro-irrigation for this orchard which would save irrigation by 50%. He has also used liquid bio-fertilizers like Azatobacter, Phosphorus Solubilizing Bacteria, Potash Solubilizing Bacteria fruit crop.

- He has started fishery in farm pond to earn an additional income. Thus, fish fingerlings (6000 numbers) of Rohu and Cypernus breed were introduced in his pond.
- Dairy business plays an important role in the rural economy. Shri Shete owns six cows of HF breed on his farm. He has gone for the artificial semen straws of HF breed for higher milk yield in successive generation. Besides, he has planted the MPKV developed *Phule Jaywant* fodder which has high protein content.

Expected Economic Gain: Shri Shete has implemented all these interventions in IFS mode through the ICAR Farmer FIRST project. Now, he is expecting good returns in 2018-19. His pomegranate orchard is in fruit initiation stage. He is expecting minimum gross returns of Rs. 25 to 30 lakh from six acres pomegranate orchard. The expected income from fishery would be around Rs. 0.50 lakh by August 2018.

Way Forward

Based on Innovative Farmers Meet and experiences shared about fighting with drought situation and combating farm level stress, the following way outs were emerged:

1. It was decided to have similar subject matter specific meets at the regional level in collaboration with ATARIs regularly for exchange of information and sharing of experiences.

2. ATARIs will document the success stories of innovative farmers. To start with 15 farmers' success stories were video recorded on the day itself.

3. Innovative farmers stand involved in IARI extension programmes, it was decided that more number of such awardee-farmers should be involved in IARI extension programmes as well as respective ATARI programmes for speedy transfer of technologies.

4. Every innovative farmer should also adopt at least ten farmers for mentoring and transforming by effective transfer of relevant technologies. The concerned farmers may provide a list of such 10 farmers being groomed by them to ATARI. A workshop of all these innovative farmers may be held in 2019.

5. Adequate coverage in Doordarshan and other media must be given to the significant contribution of Innovative Farmers. Video recording of such successful cases must be done and for this purpose, adequate facilities may be developed at KVKs and ATARI.

6. There is information paucity among farmers which must be catered to by IARI and ATARI scientists. A library "*Krishi Pustakalaya*" consisting of relevant literature may be made available at adopted villages. This aspect has to be explored further.

7. ICT use including social media need to be utilized to have a strong network of Innovative Farmers/Federation of Innovative Farmers for the purpose of learning exchange.

8. Cases of innovative farmers experiences may be documented as videos which may be given to all KVKs for educative purposes and also to be put up on you tube and other social media.

9. Informal discussion and participant observations for identifying innovative ways utilized to fight with farm level stresses created through adverse climate change. There is need to go beyond documentation and work for enhancing farmers' income.

10. Realized the need for tailor made technologies and contingency planning under drought or other weather related aberration.

11. Framework for out scaling of farmers' innovations for coping with stressful situations should be developed with involvement of all KVKs through respective ATARIs and sharing of experiences

by innovative farmers/model villages be encouraged through such meets regularly. The innovations should be documented and up-scaled in other areas. Arrangement to learn from these innovative farmers on site of their farms must be arranged by respective KVKs and ATARIs for dissemination to other farmers in the region.

12. There is need to document and popularize the methodologies developed by innovative farmers to other farmers in the region so as to spread best practices for coping up with the dry spells and to get more farm income by using optimum resources at hand. These videos and success stories may be shared and popularized widely utilizing not only print media but also TV, internet and other social media.

13. More focus should be given to develop farm technologies as per need of the farmers and varied agro-climatic conditions.

14. At district level, KVK can play very specific role for mitigating drought and reducing farm level stresses. They can organize different activities like awareness camps, diagnostic and advisory services, field visits and interaction with the farmers, preparing block level contingency plan, providing technological backstopping and inputs mainly seeds and planting materials, identification of relevant crops and varieties, conducting technology week at the centre for showing the performance of technologies under drought conditions, etc.

15. Successful village watershed and water budgeting models like Hivare Bazar should be replicated and may be used as learning centre. Hivare Bazar's success was based on active involvement of entire village community. Villagers manage their resources by regulating and enforcing norms through community decisions typically made in Gram Sabha meetings attended by entire village people.

16. Rain water should be harvested and utilized by adopting micro irrigation system for minimizing adverse effect of water scarcity and reducing farm level stress. Innovative ideas and scientific methods of resource conservation technologies should be applied for efficient use of resources and ensured sustainable yield and farmer's income.

17. Personalized advisory through mobile on climate resilient related technologies will make a difference in reducing farm level stress and getting ready to follow alternate plan.

Acronyms

ADT	:	Agricultural Development Trust
AFDR	:	Agri Found Dark Red
ATARI	:	Agricultural Technology Application Research Institute
ATMA	:	Agricultural Technology Management Agency
BBF	:	Broad Bed Furrow
BPL	:	Below Poverty Line
BSKKV	:	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli
CRIDA	:	Central Research Institute for Dryland Agriculture, Hyderabad
CSRTI	:	Central Sericulture Research & Training Institute
DARE	:	Department of Agricultural Research and Education
DDG	:	Deputy Director General
DEE	:	Director of Extension Education
DFR	:	Directorate of Floricultural Research, Pune
DG	:	Director General
DKMA	:	Directorate of Knowledge Management in Agriculture
DOGR	:	Directorate of Onion and Garlic Research, Rajgurunagar, Pune
ETL	:	Economic Threshold Level
FPC	:	Farmer Producer Company
FPO	:	Farmer Producer Organization
FYM	:	Farm Yard Manure
GDP	:	Gross Domestic Product
HF	:	Holstein Friesen
HTC	:	Horticultural Training Centre, Talegaon Dabhade, Pune
IARI	:	Indian Agricultural Research Institute, New Delhi
ICAR	:	Indian Council of Agricultural Research, New Delhi
ICT	:	Information and Communications Technology

IFS	:	Integrated Farming System
IIHR	:	Indian Institute of Horticulture Research, Bengaluru
INM	:	Integrated Nutrient Management
IPM	:	Integrated Pest Management
KVK	:	Krishi Vigyan Kendra
LPG	:	Liquefied Petroleum Gas
MPKV	:	Mahatma Phule Krishi Vidyapeeth, Rahuri
NARS	:	National Agricultural Research System
NIASM	:	National Institute of Abiotic Stress Management, Baramati, Pune
NIPHM	:	National Institute of Plant Health Management, Hyderabad
NRCG	:	National Research Centre on Grapes, Pune
NRCP	:	National Research Centre on Pomegranate, Solapur
NSKE	:	Neem Seed Kernel Extract
PDKV	:	Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola
PGR	:	Plant Growth Regulator
PPP	:	Public Private Partnership
SAU	:	State Agricultural University
SRI	:	System of Rice Intensification
VNMKV	:	Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani

भाकृअनुप
ICAR

ICAR-Agricultural Technology Application Research Institute
Zone-VIII, Pune, Maharashtra