SYMBOLS OF SUCCESS
PATHWAYS TO PROSPERITY

Division of Agricultural Extension
Indian Council of Agricultural Research
New Deihi

Symbols of Success

Pathways to Prosperity

Division of Agricultural Extension
Indian Council of Agricultural Research
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CONTENTS

Sl.	Title	Page
1	Variety TS-3R enhances pigeonpea productivity	01
2	Rice high yielding variety CO-51 spreads across states	05
3	Blackgram variety enhances profitability	07
4	Groundnut increases cropping intensity in laterite soils	09
5	Pulse seed production enhances profitability	11
6	Planting material production in polyhouse expands vegetable area	13
7	Onion seed production for self reliance and higher returns	15
8	Quality seed and good agricultural practices boost turmeric production	17
9	Drum seeding in hybrid paddy: More crop per drop	21
10	Direct seeded rice: A successful technology in command area	25
11	Direct sowing saves water and labour	27
12	Direct seeded rice: A boon for the changing climate	29
13	Plastic mulching increases net returns from melons	31
14	Micronutrient mixture boosts banana production	35
15	IPM technology – A boon for eco-friendly pest management in brinjal	39
16	Pheromone trap gains popularity among cucurbit farmers	41
17	Fruit fly trap – An eco-friendly tool to enhance the quality of mango	45
18	Foxtail millet (*Setaria italica*) as an alternate crop to cotton	49
19	Elephant foot yam cultivation made profitable	51
20	Dryland mango ensures income in drought-prone areas	53
21	Improved floriculture practices usher prosperity to farmers	57
22	Protectedion cultivation: A success in Sirmour	59
23	Economic empowerment of tribal through disease free vegetable nursery raising	63
24	Diversification to off-season vegetable production supports livelihood	65
25	Multi-tier vegetable cropping for efficient resource utilization and profitability	69
26	Enhanced livelihood security through improved jasmine production and collective marketing	71
27	Rain water harvesting and micro irrigation system improves livelihoods	73
28	Land shaping/*Ail* cultivation for enhanced profitability and nutritional security	77
29	Success story on cultivation of oyster mushroom	81
30	Production and up-scaling of fodder promotes entrepreneurship	85
31	Silage makes dairy farming sustainable	87
32	Empowering women in dairy enterprise through self help group	89
33	Rural entrepreneurs benefit from scientific pig farming	91
34	Success story on rice-fish culture	93
35	Drudgery reduction tools improved health of women farm labourers	95
36	Nutritional garden saves money for schools	97
37	Empowering women through small scale entrepreneurship	99
38	Lac cultivation improves tribal livelihoods	101

राधा मोहन सिंह
RADHA MOHAN SINGH

कृषि एवं किसान कल्याण मंत्री
भारत सरकार
MINISTER OF AGRICULTURE
& FARMER WELFARE
GOVERNMENT OF INDIA

12 JUL 2017

संदेश

भारत सरकार किसानों के कल्याण हेतु पूर्णतया समर्पित है और स्वतंत्रता के 75 वर्ष पूरे होने पर वर्ष 2022 तक किसानों की आय को दोगुना करने के मिशन को साकार करने की दिशा में अग्रसर है। कृषि क्षेत्र में तनाव को कम करने और लाभप्रदता को बढ़ाने की दिशा में सरकार द्वारा अनेक पहल की गई हैं। प्रधान मंत्री कृषि सिंचाई योजना के माध्यम से जल उपयोग प्रभावशीलता को बढ़ाना, व्यापक स्तरीय जागरूकता का सृजन करके और मृदा स्वास्थ्य कार्ड का वितरण करके मृदा स्वास्थ में सुधार लाना और प्रधान मंत्री फसल बीमा योजना के माध्यम से कृषि से जुड़े जोखिम में कमी लाना जैसे पहलुओं पर बल देना किसानों की आय को दोगुना करने की दिशा में उठाए गए कुछ महत्वपूर्ण प्रयास हैं। इसके अलावा, कृषि में नई प्रौद्योगिकियों का अनुप्रयोग करना एक सतत प्रक्रिया है जिसकी जिम्मेदारी कृषि विज्ञान केन्द्रों पर है। कृषि विज्ञान केन्द्रों द्वारा जिला स्तर पर स्थान विशिष्ट समस्याओं का समाधान एवं अग्रिम पंक्ति प्रसार शिक्षा प्रदान की जाती है। जहां कृषि विज्ञान केन्द्र नई प्रौद्योगिकियों के बारे में अवगत कराने के लिए अग्रिम पंक्ति प्रसार शिक्षा प्रदान करते हैं वहीं राज्य कृषि विभाग इन्हें बड़ी संख्या में किसानों तक ले जाते हैं जिससे एक उल्लेखनीय प्रभाव उत्पन्न होता है। प्रौद्योगिकी आकलन, प्रदर्शन और प्रसार में कृषि विज्ञान केन्द्रों द्वारा निभाई जा रही भूमिका उल्लेखनीय एवं प्रशंसनीय है। कृषि विज्ञान केन्द्र, कृषि विश्वविद्यालयों और भारतीय कृषि अनुसंधान परिषद संस्थानों के प्रौद्योगिकीय अनुसमर्थन के साथ अनूठे संस्थान हैं जिनके द्वारा अनुसंधान प्रणाली और विकसित स्थानीय इनोवेशनों तथा मॉडल्स का अनुप्रयोग करने के बारे में किसानों की प्रतिक्रिया सुनिश्चित की जाती है।

मुझे यह जानकार प्रसन्नता हुई है कि कृषि विस्तार प्रभाग, भारतीय कृषि अनुसंधान परिषद द्वारा कृषि प्रौद्योगिकियों का प्रसार करने में कृषि विज्ञान केन्द्रों के प्रयासों को प्रस्तुत करने हेतु "Symbols of Success – Pathways to Prosperity" शीर्षक प्रकाशन जारी किया गया है।

(राधा मोहन सिंह)

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त्रिलोचन महापात्र, पीएच.डी.
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सचिव एवं महानिदेशक
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FOREWORD

Indian agriculture has historical relevance, as farmers have been cultivating land and producing crops for over 5000 years. Owing to very high pressure on land, there is widespread degradation of land, decline in water table and drop in profitability of farming in the last few decades. Besides this, increased climatic variability has been posing great challenge to sustain production and productivity of major crops. Inadequate availability of quality seeds and insufficient infrastructure for processing and value addition to agricultural produce and poor market linkage are a few of the major causes leading to decline in profitability in farming sector. Further, there is a widespread concern about the distress in farming because of declining income of farm families.

Indian agriculture has moved from shortage to surplus ensuring food security to one and all in the country, due mainly to the R&D interventions and farmers adoption. A record production of 273.38 MT foodgrains during the year 2016-17 is an evidence to this effect. In the process of agricultural development, the role of Krishi Vigyan Kendras (KVKs) cannot be ignored as this is the only institution which has district-level presence in all the States. The KVKs have demonstrated the significance of adoption of new technologies in farming and developed models that can be replicated in similar agro-ecological conditions. These models have not only shown there is a tremendous potential and scope for increasing productivity but also enhancing profitability in farming enterprise. The case studies documented as "Symbols of Success - Pathways to Prosperity" is a testimony to the pivotal role being played by KVKs in the arena of frontline extension. I am sure, such documents will encourage many farmers to emulate and achieve sustainability in production and also livelihoods.

(T. MOHAPATRA)

Dated the 12th July, 2017
New Delhi

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Deputy Director General (Agricultural Extension)

PREFACE

The Division of Agricultural Extension with its vast network of 679 KVKs across the country is striving to provide leadership to the frontline extension education system of the nation. Several flagship projects such as Farmers FIRST, Attracting and Retaining Youth in Agriculture (ARYA), Mera Gaon Mera Gaurava, Pulses and Oilseeds cluster demonstrations and Skill Development in agriculture, etc. are being implemented in association with KVKs, State Agricultural Universities and ICAR Research Institutes. These programmes have been making a very significant impact in realising the production potential of pulses, oilseeds in particular and many other cereals, horticultural and plantation crops in general. KVKs are addressing location specific-problems and providing need-based solutions to farmers in their respective districts. However, there is still a lot of emphasis that is required in the area of primary processing, value addition and marketing which will ensure better price for farmers' produce and higher income. These two areas also have high potential for generating employment at a large scale in rural areas.

KVKs generate several success stories from the field and a compilation entitled "Symbols of Success – Pathways to Prosperity" is being brought out to build confidence among farmers who wish to earn more from farming. The cases show how KVKs have played an important role in not only introducing new technologies to farmers but also in providing required support through skill development and capacity building in the spread of new technologies. We hope that this publication will encourage many other KVKs to develop and share such successes with farmers to improve their socio-economic conditions.

Dated 12.07.2017

(A. K. Singh)

Variety TS-3R Enhances Pigeonpea Productivity

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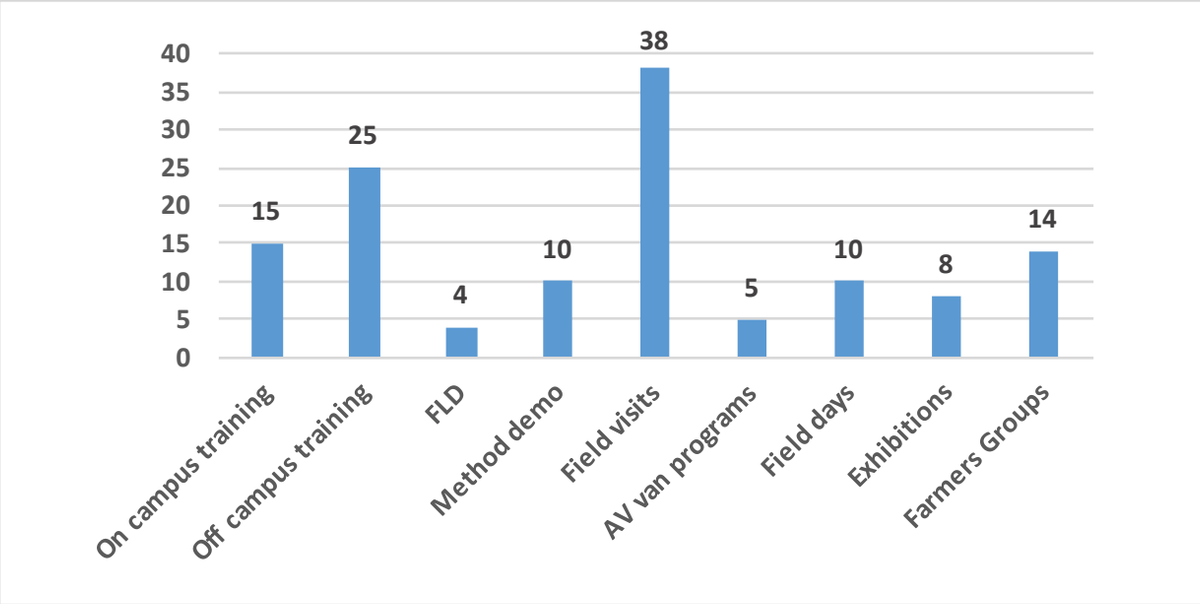
Situation Analysis

Kalaburagi (Gulbarga) district, the "Pulse Bowl of Karnataka" ranks first in pulse area and production. It occupies 60 per cent area and contributes to 45 per cent production of the state. The productivity of pigeonpea in Gulbarga district (543 kg/ha) is far below the average productivity of India (640 kg/ha) and world (848 kg/ha). The annual average rainfall of the district is 720 mm, but the rainfall is erratic with uneven distribution. The terminal moisture stress is the major constraint for low productivity of pigeon pea accompanied by local cultivars and *Fusarium* wilt. Farmers grow many varieties viz., Maruthi (ICP 8863), Asha (ICPL–87119) and BSMR-736 which are of long duration and local varieties viz., Gulyal, Benur, Rudrawadi, Jamadar Katti which are of short duration but susceptible to *Fusarium* wilt.

Technology, Implementation and Support

To tackle the problems causing low productivity in pigeonpea, frontline demonstrations (FLD) were planned at Gudur cluster of Afzalpur of Kalaburagi district which includes Gudur station, Ganagapur, Koganoor and Goudgaon villages. The Krishi Vigyan Kendra (KVK) demonstrated TS-3R, which is a short duration and wilt resistant variety recommended for all type of soils, released during 2009-10 by University of Agricultural Sciences, Raichur, Karnataka.

The demonstrations were laid out in an area of 75 acres with one acre demonstration on each farm. The farmers were selected based on different soil types so as to check the performance of new variety and its productivity. Accordingly the selected farmers were trained about integrated crop management practices along with seed production techniques. The local pigeonpea cultivars viz. Gulyal, Benur and others served as check to compare the yield potential and wilt resistance. During different stages of crop, branching, flowering, wilt resistance and pod characters were explained to the farmers and the rouging of off-types was also practiced. To teach seed production aspects and to obtain pure seeds the expert team comprising of breeders and other scientists visited the demonstration plots and interacted with farmers about suitability of TS-3R variety. The detailed information on activities carried out by KVK Kalaburagi and support in building the farmers' skills in adoption of technology is depicted below.



Uptake, Spread and Benefits

The average yield of TS-3R variety in frontline demonstration was 4.96 q/ha compared to 4.04 q/ha in local varieties. A total of ₹ 32000 was earned by each FLD farmer by selling TS-3R seeds. Nearly ₹ 24 lakh income was earned by 75 FLD farmers during 2009-10. All the 75 FLD farmers provided seeds to fellow farmers of the district and neighboring districts like Bidar, Bijapur and Raichur during 2010-11. The area covered by TS-3R variety was 2800 ha in the subsequent year of demonstration, mainly out of the seeds supplied by FLD farmers. The farmers who participated in technology demonstration produced 375kg of TS-3R seeds during the first year of demonstration and sold to the fellow farmers @₹ 80/kg as against ₹ 50/kg for the commercial grain by which each farmer got ₹ 3000/q as additional income. During 2010-11, these farmers along with the fellow farmers cultivated TS-3R variety under farmers group entitled "ANNADATA FARMERS GROUP".

The TS-3R variety could spread to 3000 ha by 2010-11. With the formation of farmers' groups in 2011-12 involving 7000 farmers, mini dhal mills and processing units were established in 2012-13. The variety spread to 1.35 lakh ha in Gulbarga district covering 38% of pigeonpea area and productivity increased in 2013-14. Further in 2014-15, the area spread to 2.25 lakh ha, covering 60% of pigeonpea area in the district.

Besides self-sufficiency in seeds, the district pigeonpea productivity increased from 460 kg/ha to 790 kg/ha by 2016-17. The farmers' groups involved in seed production of TS-3R variety purchased centrifugal graders and established three mini dhal mills and five custom hiring centres. They formed five commodity groups and established a federation involving 20000 farmers. The farmers have become economically sustainable by selling TS-3R seeds through farmers groups/ federation. Farmers groups started input centres (quality seeds, fertilizers, pesticides etc.) as well. The social status of farmers increased since the groups are facilitating linkage with KVK / Development Departments for transfer of technology. The computed value of benefits from TS-3R pigeonpea variety has been worked out at ₹ 178 crore to the farmers of Gulbarga district.

Rice High Yielding Variety Co-51 Spreads Across States

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Situation Analysis

Cauvery Delta zone is known for paddy cultivation throughout the year since time immemorial. Almost all farmers' are raising paddy crop either in one or two seasons. The predominant paddy varieties grown during Kuruvai season (short duration) are ADT 36, ADT 37, ADT 42, ADT 43, ADT 45, ADT 47, ADT 48, ASD 16, TKM 9. These varieties are cultivated since last several years and prone to pest and disease attacks resulted in yield loss. Hence, farmers are desperately wanted to cultivate the new high yielding varieties.

Technology, Implementation and Support

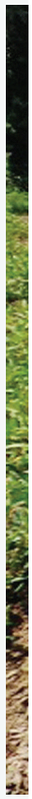
KVK Thiruvarur ***introduced Co51, a new rice variety*** developed by Tamil Nadu Agricultural University to enhance paddy productivity. The KVK conducted frontline demonstration and farmers participatory seed production of the improved rice variety during ***Kuruvai*** season of 2013-14 at 10 locations in Kudavasal and Mannarkudi Taluks of Thiruvarur District. The new variety recorded 6.75 t/ha with net return of ₹ 77250 as compared to farmers practice, which produced net return of ₹ 66540. There was no incidence of blast in Co 51 variety whereas incidence was observed in check variety. Co-51

matured in 103 days, one week earlier than check variety. As Co 51 is a semi dwarf variety, the lodging was less than 3% while check variety recorded up to 10 % lodging and eventual yield loss.

Uptake, Spread and Benefits

The seeds produced in the demonstration plots and in KVK farm has been supplied to farmers as well as State Department of Agriculture for area expansion under this variety. The efforts of KVK Thiruvarur resulted in spread of the new variety within and outside the district. With the help of seeds produced through participatory approaches and the support provided by the State Department of Agriculture, the new variety replaced 19.3 percent of the area within a span of three years. In Tiruvarur district, 350 t seeds of Co51 variety was produced and provided during 2016. Out of 30310 ha area under rice in the district, about 6000 ha was covered by the new variety by 2016-17.

The area under Co 51 variety has grown in an exponential manner in Thiruvarur and Kancheepuram districts and in other districts in Tamil Nadu with the support of government departments and private agencies besides efforts of KVK. The Co 51 rice variety has been notified in 13 states namely Uttarkhand, Haryana, Uttar Pradesh, Madya Pradesh, Andra Pradesh, West Bengal, Bihar, Maharastra, Gujarat, Tamil Nadu, Kerala and Karnataka. Variety Co 51 is the only rice variety for which higher breeder seed indent was placed from various stakeholders, leading to its quicker spread. In the year 2017, more than 15000 kg of breeder seeds was produced by the Tamil Nadu Agricultural University and distributed for seed multiplication and distribution.



Blackgram Variety Enhances Profitability

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Situation Analysis

Blackgram is one of the preferred pulse crops of the farmers of Netrang, Valia and Jhagadia blocks of Bharuch district which have less fertile, hilly, upland and marginal soils. The productivity in Bharuch district (734 kg/ha) is lower than most of the major blackgram producing districts in Gujarat. In Bharuch, blackgram is cultivated in an area of 2510 ha with production of 1900 MT. Farmers generally use seeds of old varieties or cultivars which are prone to Yellow Mosaic Virus (YMV) leading to low productivity. Area under blackgram cultivation in Bharuch district was much higher before the widespread occurrence of the disease. The decline in overall yield and area in the district was attributed to high incidence of the disease.

Technology, Implementation and Support

KVK Bharuch, while assessing the productivity of various crops in the district, found that the major cause of wide spread of YMV in blackgram was due to cultivation of old local varieties continuously year after year. KVK Bharuch demonstrated Gujarat Urad-1, a yellow mosaic resistant variety during 2016-17. Variety GU-1 is of short duration (75-80 days) and its harvesting coincides with rainy season. To overcome this, the KVK demonstrated sowing of GU-1 during last week of July to first week of August. Postponing

the date of sowing helped farmers to overcome the problem of early maturity in GU-1 and realized higher crop yield.

Uptake, Spread and Benefits

It was observed that in frontline demonstrations of the improved YMV resistant variety GU-1 recorded higher seed yield (1005 kg/ha) when compared to farmers practices (725 kg/ha). The increase in the yield over local check was 38.62 %. It is evident from the results that the yield of improved YVM resistance variety was found better than the local check under same environmental conditions.

Yield obtained in the frontline demonstration was compared with potential yield of the crop to estimate the yield gaps. The yield gap between potential yield and demonstration yield (Yield Gap –I) was 16.25%. However, the gap between demonstration yield and farmers yield (Yield Gap –II) was 38.62 % which can be bridged by adopting improved production technology. The gross expenditure in recommended practices was higher than the farmers' practices by 20.42%. But, farmers recorded higher gross returns (₹ 47235/ ha) and net return (₹ 29502/ha). Under frontline demonstrations the Benefit Cost ratio of demonstration plot (2.66) was also more than the farmer's practice. At an additional cost of ₹ 3008/ha, an additional net return of 52.46 % was realized in GU-1 variety.

The results obtained from FLDs have conclusively proved the gains from the new variety and improved production technology over the farmers' practices. The existing average productivity of blackgram in Gujarat is 620 kg/ha which showed that there exists a commercially exploitable yield reservoir, which can be achieved through adoption of improved crop production technology. With full adoption of the available production technologies, 0.99 Lakh MT of blackgram production could be achieved, which is almost adequate to meet the requirement of black gram in the state.

Exploitable yield reservoir in black gram in Gujarat

Average Demonstration yield under FLD (kg/ha)	Gujarat State Average Productivity (kg/ha)	Gujarat State Average Production (Lakh MT)	Expected production (Lakh MT) if yield gap is bridged through complete adoption of improved practices
1005	620	0.61	0.99

Farmers have been motivated by the performance of technological package applied in the FLD and majority of the farmers of the selected villages have committed to follow good agricultural practices in the coming season. The farmers have accepted GU-1 as the best variety for upland under rainfed farming situation.

Groundnut increases cropping intensity in lateritic soils

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Situation Analysis

Red and lateritic zone of West Bengal is characterized by sub-tropical climate with average annual precipitation of 1000-1200 mm (80% of rainfall received during June-September) and temperature range from 16-42^{0}C. Land being undulated in nature, tends to erosion of top soil leading to poor status of N, P, K and organic matter. Soil texture is sandy to sandy loam, rich in iron and aluminium but deficient in Ca, Mg, B and Mo. Water retention capacity of soil is poor and pH varies from 5 to 5.5. The area is dominated by cultivation of boro rice in rabi-summer and aman rice in kharif season. Area under boro rice cultivation is decreasing day by day as ground water level is going down every year due to erratic, uneven and scanty rainfall. Still the major cropping pattern of the zone is paddy-paddy-fallow.

A large tract of West Midnapore district comes under such red and lateritic zone where the cropping system is gradually turning into paddy-fallow-fallow. The farmers badly needed a viable option to substantiate the loss due to decrease in area under boro rice cultivation. Sporadically a few farmers tried

several other crops and vegetables, but the success of sustainable crop cultivation to replenish boro rice eluded them. A group of farmers from four villages namely Jamrasuli, Dhuliapur, Asthapara and Tura of West Medinipur approached the KVK during 2005-06 seeking advice to find an alternate crop for this area which provided an assured return in terms of productivity and marketability. Realizing the magnitude of the problem, the KVK opted for agro-ecosystem analysis through PRA in the villages to characterize the present agricultural situation and identify the opportunity to introduce a new crop as per the need of the practicing farmers. Visit, interaction and detailed survey helped the KVK to identify such a crop that would suit the existing climate. Finally, the KVK decided to introduce 'groundnut' in the selected villages as an alternate crop for that area. Detailed meteorological information on humidity, sunlight, cloudy days etc. was also collected from the concerned Department before actually implementing the programme of groundnut cultivation.

Technology, Implementation and Support

In the initial years, the KVK assessed the performance of four varieties of groundnut namely, TPG-41, TG-26, TG-38 B and TAG-24 in a number of locations of those villages to find out the best suited variety for this identified agro-climatic condition. Varietal evaluation followed the demonstration of measures against seed borne diseases and pest control. Extension functionaries of line departments were involved in the standardization of cultivation process. Finally the KVK came up with the recommendation of complete package for the cultivation of ***TAG-24 variety with seed treatment of Rhizobium @ 750/ha, soil application of gypsum @ 500 kg/ha after 30 days of sowing and boric acid @2.0 g/l of water after 15 and 30 days of sowing followed by foliar application of neem-based liquid 50,000 ppm @0.75 ml/l of water*** and management of aphid. The package was further demonstrated by KVK through conducting frontline demonstrations in 10 ha area during rabi-summer season with TAG-24 variety. The farmers harvested 20 q/ha average yield with net return of ₹ 25000/ha. The success prompted the KVK to conduct FLD during next kharif season where 12 q/ha and ₹ 16000/ha net return could be realized.

Uptake, Spread and Benefits

Gradually horizontal spread of the technology started taking place and within next three years about 150 ha of area could be brought under groundnut cultivation. Requirement of 50-60 acre-inch water through 16-20 irrigation for Boro rice cultivation was a severe problem for the farmers. However, cultivation of groundnut was possible only with 10-12 acre-inch water (4-5 irrigations) which was affordable for the farmers. Moreover, cultivation of groundnut has positive impact on soil health, created more man-days and ultimately led to less migration of labour from rural to urban areas. The analysis of soil indicates that pH has been changed to 5.6 from 4.8 followed by increase in available Nitrogen in soil to 210 kg/ha from 180kg/ha and available organic matter from 0.5% to 0.75%. During the period, additional mandays created was to the tune of 10500 numbers which has resulted in 30% reduced migration of labour. Groundnut has a good market in West Medinipur as well as neighboring districts also which enabled the farmers to get instant return and encouragement for groundnut cultivation. Cultivation of groundnut has not confined to West Medinipur district. Farmers of identical agro-climatic situations in Purulia and Bankura districts also have started adopting groundnut in place of boro rice.

Pulse Seed Production Enhances Profitability

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Situation Analysis

Gujarat produces more than 133100 tonnes of chickpea from an area of about 136100 ha. Chickpea yield of Gujarat state is about 978 kg/ha(2012-13) which is lower than the national average of 1014 kg/ha. In Surendranagar district, area under chick pea was 12300 ha with production of 9100 MT and productivity of 739 kg/ha, which is 28.66% and 24.75% lower than national and state yield respectively. More than 60% area in the district is covered under cotton cultivation, followed by groundnut, wheat, cumin, castor, funnel, pearl millet etc. In Karmad village of Chuda taluka of Surendranagar district, major crops grown in Kharif are cotton, sesamum and bajra, while in rabi season, wheat, cumin and chickpea crops. When KVK started working in Karmad village, status of crop cultivation and productivity was no different from district. Most of the farmers opt for cotton crop (more than 75% area was under cotton crop). Only 10-12 ha area was under chickpea cultivation with the yield of 750 to 800 kg/ha. Farmers generally cultivated chickpea using their own seed of old varieties, infested by wilt and root rot disease resulting in low yield

and prices. In the last decade, they grew gram crop mainly for home consumption. However, in the last five years, there was high demand of green chickpea in the markets of Gujarat for vegetable purpose, then farmers started cultivation of chickpea as a profitable crop within a short span of time in limited area.

Technology, Implementation and Support

The PRA studies of Karmad village revealed that chickpea is not profitable because of low yield and non availability of wilt and root rot resistant variety. The KVK, JAU, Surendranagar conducted FLDs of improved chickpea ***variety GJG - 3*** under NFSM cluster FLD on 20 ha area covering 50 farmers. They were also provided *Trichoderma harzianum*, liquid bio fertilizers *Rhizobium* culture and PSB as critical inputs to famers alongwith the improved variety. The farmers were trained on package of practices and application of critical inputs. The KVK scientists monitored the demonstrations frequently and issued advisories to the farmers. The field day was organized in the demonstration plots.

Uptake, Spread and Benefits

The performance of GJG-3 variety along with all other components found good and yield of demonstration was 19.90 q/ha compared to 16.31 q/ha in the local check. This resulted in net return of ₹ 63595 which was ₹ 14607 more than the local check (₹ 48988). On an average yield of improved variety was 22 percent higher over the local check (3.59 q/ha more yield). This variety is rated as bold seeded and hence the farmers demand is increasing. Looking into possible demand in future, scientists advised villagers to keep the seeds of this variety to supply to other farmers.

This intervention not only fetched good income due to higher yield and quality but also made seed locally available to make the crop more popular in the village as rabi crop. After seeing the performance of this variety, 65 farmers of 15 villages of Surendranagar district and 50 farmers from 10-12 villages of Bhal area of Ahmedabad district purchased chickpea seeds from demonstrator farmers for the next season as seed. They sold their chickpea seed @Rs. 11000/- to 13000/- per quintal. Approximately 6000 kg seed material was sold by 143 farmers, wherein, both the seller and buyer farmers got benefited.

The area under chickpea crop in the village Karmad increased from 10 ha in 2014-15 to 105 ha in the year 2016-17 and expected to increase to 120 ha in 2017-18. Farmers keep seed of this variety for selling to other farmers of their own village and nearby village and also farmers of Ahmedabad district. In the year, 2015-16, 20 farmers sold their seed and got additional income of ₹ 9000 per farmer (it is difference of rates in seed and grain) apart from their regular selling as grain. In the year 2016-17, 35 farmers sold their product as seed and fetched additional ₹ 6000/- per farmer. They still have 835 q seed quantity with them which is to be sold before rabi season 2017-18 as seed and expected even more price difference realization as seed compared to grain. They really enjoy the good profit from selling seed of chick pea and happy with this. Even small children of this village knew that this is the intervention which brought happiness and joy in the community due to support from KVK, JAU, Surendranagar. Within a short span of time, Karmad village became popular for having good quality of seed of chickpea.

Planting Material Production in Polyhouse Expands Vegetable Area

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Situation Analysis

Badwani district has medium black cotton soils with temperature ranging between 10^0 C (min) and 48^0 C (max) and average annual rainfall of 760 mm. Chilli (*Capsicum annuam* sp)is a major spice crop grown in the area. In chilli crop, hybrid varieties covered an area of 8277 ha during 2014-15 with a total production of 135221 tonnes. The area under other vegetable crops was 3910 ha with an annual production 90713 tonnes. Despite large area under vegetable cultivation and chilli crop, farmers had no access to quality planting material. The seedlings in nursery stage are affected by many biotic/abiotic stresses to the extent of 40%.

Technology, Implementation and Support

The KVK, Badwani took initiative to provide technical support and guidance to farmers for production of ***quality planting material/seedlings in seedling trays filled with coco-peat under natural ventilated polyhouse or insect-proof net house***. The performance of this technology under stress condition *viz*

dry spell, delayed monsoon/excessive rainfall is better compared to conventional. The technology helps farmers to get quality seedlings at right time for transplanting. The quality seedlings ensure minimum mortality and faster establishment. Nursery also serves as an entrepreneurship to rural youth. Training and extension programs were organized for the large and medium farmers to take up this technology. After on farm trials, demonstrations were conducted at farmers fields and field days were organized at demonstration sites to convince the farmers as well as extension workers to upscale the technology. Production of seedlings under naturally ventilated poly house increased the production approximately by 30-40%. With the raising of seedlings in protrays, the cost is reduced by 20-25% due to higher germination with better longevity and crop standing in field. The planting material is also free from insect & disease.

Uptake, Spread and Benefits

The measurable indicators used for judging the performance of technology includes germination percentage (99-100%), seedlings free from insect and diseases and prepared in trays filled with coco peat under natural ventilated polyhouse and/or insect proof net house. This technology could save 25-30% seed and pesticides due to protected structure. The seeds took 3-6 days less to germinate than the conventional method and seedlings were also vigorous.

Economic analysis of seedlings production

Crop	Seedlings produced (No. Lakh)			Income (Rs.Lakh/annum)		
	2014-15	2015-16	2016-17	2014-15	2015-16	2016-17
Chilli	25.0	50.0	80.0	12.5	35.0	56.0
Tomato	2.0	30.0	41.0	1.0	21.0	28.2
Papaya	0.0	2.0	3.0	0.0	12.0	18.0

Production of quality planting material under polyhouses in seedling tray/pro-tray helped in employment generation (approximately 1500 man days/400 m^2 unit/year). Additional employment was generated in all the nurseries through filling of seedling trays, shifting of seedling, spraying of insecticide/pesticide, irrigation etc. There is a shift in cropping pattern due to adoption of protected nurseries. Farmers utilize the extra time on planning and execution of production of other crops seedlings. Farmers received the following benefits from the production of seedlings under polyhouse.

- Production of quality planting material under protected cultivation provided assured return, the beneficiaries base is increasing continuously. The area under vegetable crops is also increasing annually, so the requirement of seedlings also increasing. Farmers initially adopted this technology, in pro-tray under insect proof net house and at present, they are using polyhouse.
- Overall production enhancement with reduced dependency on import of good quality flowers from adjoining district. Due to adoption of vegetable cultivation, the area under mono cropping has decreased and soil health is improving with the use of biofertilizer.
- Labour employment increased directly due to the more seedlings produced and increase in area under vegetable, the employment increased to 1500 mandays/unit of 4000m^2 year.
- Farmers renovated their houses and increased expenditure on children education, vehicle, health, etc after adopting the intervention.
- This technology could sustain for a long time due to continuous rising demand of seedlings of chilli and other vegetable crops.

Onion Seed Production for Self Reliance and Higher Returns

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Situation Analysis

Chitradurga district is located in the Central Dry Zone of Karnataka with average rainfall of 450-500 mm. The major crops of the district are finger millet, maize, pigeonpea, groundnut, cotton, onion, coconut, banana, arecanut and millets. The area of onion in kharif is around 19193 ha accounting for around 2 lakh kg seed requirement. Seed is the major input for which farmers are dependent on Satara Dist. of Maharastra. But quality is not assured and there are many instances of susceptibility of the variety for pest and diseases. Hence, it was felt necessary to train the farmers on scientific seed production technology to ensure self-reliance in terms of seed availability in the district. The district average yield of onion is 19.50 t/ha but, potential yield is around 30 t/ha, which indicates that there is a large scope for increasing the productivity and returns. The reasons for lower productivity are poor quality seed material, imbalanced nutrient management and lack of awareness on plant protection measures.

Technology, Implementation and Support

Based on the problems observed, KVK Chitradurga started conducting on farm testing on nutrient management for addressing the issues related to leaf twisting which was one of the major problems for yield decline. Later, large scale frontline demonstrations were conducted on integrated crop management in onion in Chitradurga district followed by several seminars and trainings conducted to create awareness and spread the technology. From past five years the KVK started seed production activity in onion through farmer's participation. Since, it is mainly grown for commercial bulb production during Kharif, very less number of farmers growing seed production during Rabi season with local varieties. In this context, KVK planned for technical interventions on scientific seed production and self reliance for quality seeds in the district.

The assessment of suitable technologies for correcting the leaf twisting problem during 2008 -09 by the KVK revealed that application of zinc, boron and gypsum reduced the percentage of leaf twisting in onion. In the succeeding years demonstrations were conducted on integrated crop management to improve the bulb yield. During 2012-13 onwards, more emphasis was given on seed production activity in major onion growing areas of Chitradurga. Apart from this, farmers were convinced through district level seminars, workshops and krishi melas. The training programmes on ICM, nutrient management, weed management and scientific ways of seed production activity were conducted through FLD's and Farmers Field School. Varietal assessment was made to know the performance of different varieties during 2013-14 and 2014-15. Among the varieties assessed Bhima super and Arka Kalyan were found to be promising, and this outcome helped to take up large scale seed production programme during 2016-17. FLD's on integrated crop management in onion were conducted in, 2012-13 and 2013-14 by covering 10 ha in 25 farmer's field. After that, to ensure quality seeds in onion cultivation, KVK started seed production activity of improved varieties viz., Arka Kalyan and Bhima Super through farmer's participation involving 15 farmers. In order to ensure quality seed availability in the district, seed production activity was expanded to Muddapura village. This seed was spread to neighbouring districts viz., Bellary, Chikkamagaluru and Tumkur.

Uptake, Spread and Benefits

Comprehensive interventions of KVK through awareness programmes, training activities, frontline demonstrations, advisory services, seed production and convergence with line departments has resulted into a positive outcome in terms of adoption of onion variety Arka Kalyan by the farmers of the district. Currently, there has been a significant increase in area under onion variety Arka Kalyan.

Onion variety Arka Kalyan cultivation is economically viable for the farmers as compared to local variety which is mainly cultivated in Chitradurga district. Onion variety Arka Kalyan gives returns even during agricultural drought years and resistant to purple blotch. This is in contrast to the local varieties cultivated by the farmers. The comparison of economics between commercial seed and bulb production of Arka Kalyan variety revealed that commercial seed production activity gave high net returns of ₹ 7,10,000 as compared to commercial bulb production with ₹ 2,05,000.

The production of onion gave higher net returns compared to commercial bulb production and also provides additional employment to the family members of farmers. It is helping farmers of Chitradurga district to achieve self-reliance on quality seeds and timely availability in their local region. This has greatly reduced the risks and uncertainties involved in purchase of seeds from neighbouring state.

Quality Seed and Good Agricultural Practices Boost Turmeric Production

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Situation Analysis

Turmeric is an important crop of Chamarajanagar district which occupies an area of 8,220 ha. However, its productivity of 4.38 t/ha is comparatively low (State productivity is 6.34 t/ha). In recent years the area under turmeric has increased resulting in higher production. Majority of the turmeric growers were using local varieties viz, Kadapa, Salem, Chamarajanagar local etc., which are long duration (270 to 280 days for harvesting), low in fresh rhizome yield (15 to 20 t/ha), curcuminoids (2 to 3%) and curing percentage i.e., approximately 16 to 18%. Farmers used higher seed rate (800 to 1000 kg/acre) which comprises 30% of the total production cost. Besides, handling of bulky seed material is also a problem (transportation and labour). About 15 to 20% of the harvested rhizome is retained by the farmer as seed.

Technology, Implementation and Support

Keeping above constraints in view, KVK initiated efforts to improve turmeric production and productivity and to fetch higher income to the farmers. Krishi Vigyan Kendra, Chamarajanagara made

concerted efforts through different extension approaches viz on farm test (04), frontline demonstrations (4), method demonstrations (10), training programmes (14), field days (04), seed production activity of improved varieties (PPP mode) and training programmes with other line departments (35 occasions) and utilized these opportunities sine 2011 to create awareness among farming community of the district with regard to the ***improved varieties, quality planting material and Good Agricultural Practices (GAP) in turmeric production***. Under the PPP mode, KVK took up production of seed material of improved varieties. A total of 55,948 kg seed rhizomes of improved turmeric varieties was produced in collaboration with different agencies and farmers. During the year 2012-13, a commodity based association Kamadhenu Arishina Belagarara Sangha, Haradanahalli was formed with the support of KVK. Technology backstopping was provided to the members on scientific cultivation and post harvest. During 2013-14, members were taken to exposure visit to CFTRI Mysore, to learn new technologies of hygienic and quality processing, branding, packing and marketing aspects of turmeric.

Uptake, Spread and Benefits

KVK activities resulted in substantial impact on knowledge, adoption and income of the beneficiary farmers. Farmers got convinced and accepted Alleppy supreme and Pratibha varieties compared to other varieties. Pratibha variety was found superior with respect to fresh rhizome yield (37.48 t/ha), cured rhizome yield (7.57%) and duration (228 days), followed by Allepy supreme (32.36t/ha fresh rhizome yield, 7.16t/ha cured rhizome yield in 232 days.). Curing percentage was higher in Allepy supreme (22.15%). By adopting rapid multiplication method of propagation in turmeric, the seed rhizome requirement was reduced by 75% per unit area and the yield increased by 20% as compared to conventional method of propagation. Water was saved during initial months as the seedlings of 45 days old were transplanted, besides getting disease-free healthy seedlings for transplanting. Use of mulching materials at different stages of the crop found superior with respect to the weed control efficiency, and yield of the rhizomes. Grassy weeds and sedges were found minimum in the plots covered with mulching materials.

As a result of on farm testing, Allepy supreme emerged as a superior variety in terms of performance and acceptance by farmer. This variety was upscaled through frontline demonstrations. For all the three years Allepy supreme performed better with an average 47.60% increase in yield over farmers' variety. The average net income from the demonstration ranged from Rs. 2.7 lakh to 3.12 lakh per ha.

The seed production activity has shown an increasing trend over the years. From 170 kg seed rhizomes of improve varieties in the first year, the cumulative seed production is 55.94 tonnes. As a result of this technology backstopping five farmers are exclusively involved in quality seed rhizome production of the introduced improved varieties.

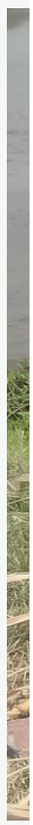
Out of 55948 kg seed rhizomes, Alleppy Supreme (29,900 kg) was the major variety, followed by Pratibha (17506 kg). Other varieties like Prabha, Suguna, Chaithanya etc. contributed the remaining quantity of 8542 kg. Rapid multiplication propagation technique is being adopted for commercial production by local nursery men and interested farmers. Demand for turmeric harvester has increased as evident by the fact that the harvester has been used in about 24 ha area in each year.

Seed production by different agencies during 2011-12 to 2016-17

Seed Production Centre/Agency	Quantity (kg)
KVK Farm	9748
OFT Farmers	8500
FLD farmers	7500
Other farmers	1000
Kamadhenu Arishina Belegarara Sangha, Haradanahalli	5000
Farmers-Scientist participatory seed production	24200
Total	**55948**

After KVK interventions, turmeric growers from other villages have approached KVK for seed rhizomes and these farmers are being directed to seed producer farmers. Farmers organizations (FPO) of the district have placed a demand for seed rhizomes of improved varieties for their own seed production and supply among the growers of their locality. Owing to the advantages derived out of turmeric harvester, these FPO's and few farmers have come forward to procure turmeric harvester for their own use.

Farmers from Mysore district (Nanjangud & Hunsur) and neighbouring KVK Mysuru have procured seeds from our seed producers for their own production and expansion. Apart from this, they have adopted rapid multiplication propagation technique with improved varieties. As a result of all technological interventions, *Kamadhenu Arishina Belegarara Sangha*, Hardanahalli has come farward to set up a post harvest turmeric processing unit for producing, branding and marketing of the turmeric products. At present they have submitted a project to NABARD for establishing the unit and land acquisition for the unit establishment is in progress.



Drum Seeding in Hybrid Paddy: More Crop Per Drop

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Situation Analysis

Paddy is an important food crop of Cauvery command area in Mandya district cultivated mainly by small and marginal farmers. The paddy is cultivated in an area of 58,487 ha in the district having total production of 1,73,548 t with an average productivity of 3635 kg/ha. Use of available varieties, mono cropping, faulty cultivation practices and submerged condition are leading to low yield and deterioration of soil quality. Non availability of skilled and efficient labours at critical stages of farm operations like transplanting, weeding etc., and delayed planting, reduced plant population and inefficient weed control are also affecting the crop yield.

Technology, Implementation and Support

In this backdrop KVK, Mandya introduced basket of technologies like ***drum seeding, paddy hybrid KRH-4 along with cono weeder (manually as well as power operated weeder) and recommended package*** of practice. Initially, both the technologies were not compatible as the drum seeder needed 40-50 kg paddy to cover an hectare area where as the recommended seed rate for hybrid paddy is 20 kg/ha. To make these

two interventions compatible, on farm test was designed and conducted for three years from 2009-10 to 2011-12 in Sampalli, Kattedoddi, Hemmanahally villages and KVK farm. Successful technology was demonstrated in larger area as frontline demonstration (FLD) for three years from 2012-13 to 2014-15 in Chandagalu, Kurikoppalu, Kannahatti and Mallanayakana katte villages of Mandya taluk, Devarahalli of Maddur taluk with 21 farmers in 11 ha area. A total of 112 extension activities were conducted by involving 3288 farmers for effective implementation of the technology.

Demonstrations were conducted in association with Water Technology Center, V.C.Farm, Mandya which spared the drum seeder to the farmers at no cost. Collaborative efforts were required to convince the farmers on the drum seeding technology which was not eye-catching initially due to slow growth in early stages. Secondly, non-availability of drum seeder in time is also a reason for slow spread of the technology. Inspired by the success of drum seeder, farmers co-operative societies acquired 1-2 drum seeders for use by its members. Many farmers owned drum seeder as it was available with 50 per cent subsidy through Agriculture Department and many others hired it from custom hiring centres. Indian Farmers Fertilizer Cooperative, Mandya provided drum seeder to selected farmers societies and a Commodity Based Association on Paddy (*Sri Harihareshwara Bhatta Belegarara Sangha*) in Maddur besides providing drum seeder on hire basis along with guidance to the farmers on drum seeding. There are about 650 drum seeders available in the district at present.

Uptake, Spread and Benefits

The district average productivity of paddy with existing varieties is 36.35 q/ha and with the introduction of hybrid paddy (KRH-2) it increased to 61.05 q/ha with recommended planting method (i.e. raising nursery and transplanting single seedling per hill). Further, with drum seeding the yield realised was higher by 13.5 percent (69.29 q/ha) under on farm testing (2009-10 to 2011-12). The paddy hybrid KRH -4 introduction under demonstrations further enhanced the yield to 75.6 q/ha and drum seeding of hybrid paddy yielded 10.12 per cent higher yield with higher benefit-cost ratio of 3.56 compared to hand transplanting.

Yield and economics of demonstration on drum seeding in hybrid paddy

Year	Yield (q/ha)			Demonstration (₹ /ha)			Farmers Practice (₹ /ha)		
	Demo	Check	% Increase	Gross Cost	Net Return	BCR	Gross Cost	Net Return	BCR
2012-13	67.2	62.26	7.93	24953.0	71267.0	3.85	31453.0	57598.0	2.83
2013-14	76.25	67	13.81	29004.5	79570.5	3.74	36159.5	58900.5	2.63
2014-15	83.3	76.7	8.63	32003.0	99477.0	3.10	37050.0	83687.5	2.25
Average	**75.6**	**68.7**	**10.12**	**28653.5**	**83438.2**	**3.56**	**34887.5**	**66728.7**	**2.57**

Drum seeding technique decreased the labour requirement i.e 37.5 mandays/ha and reduced the dependency on labour considerably. The pest and disease incidence was found lesser in drum seeded crop. The reason could be micro climate in the crop canopy was not much favourable for multiplication and sustenance of insect and pathogens as there is free movement of air due to line planting compared to random planting widely practiced.

Parameters influenced by drum seeding in hybrid paddy

Treatments	Plant population (No./m^2)	Tillers (No./plant)	Grains / panicle (No.)	Labour saving (No./ ha)
Drum seeding	41.67	21.67	330.67	37.5
Manual transplanting	34.67	17.67	292.33	0

The results of knowledge test indicated 79% increase in the knowledge level of farmers on the drum seeding practices. In case of skill on drum seeding of paddy, land preparation, soaking and incubation of seeds for germination, water and weed management in the initial stages are the important skills and it was found that there was 90 per cent gain in the skill of the farmers. The overall impact of technology in the district can be summarised as follows:

- The technology has been accepted and included in the package of practice in field crops of UAS (B). KVK conducted large scale demonstrations on drum seeding in 115 ha in association with RKVY- Water Technology Centre and in 8 ha in collaboration with Karnataka State Department of Agriculture.
- Later the technology spread to neighbouring farmers and the whole village Chandagalu/ Kurikoppalu villages were known as "Drum Seeder villages". Further spread to surrounding villages like Holalu, M.N.Katte, Hadya, Sampalli, Goravale, Maddur, Malavalli S.R.Patna & Pandavpura talukas of the district in an area of 3360 ha by nearly 8125 farmer over three years.
- The additional yield realised by this technology was 1.32 lakh quintal and the additional income was ₹ 18.48 crore towards district agricultural economy.
- Ten societies are involved in drum seeding in hybrid paddy a part from KVK efforts covering 3360 ha by involving 8125 farmers belonging to 7 taluks of the district.

Taluk wise drum seeder area adopted, agencies involved and farmers benefitted

Taluk	Area covered (ha.)	No. of societies/KVK involved	No. of farmers benefited
Mandya	2050	5 Societies	4670
Maddur	715	1Farmers Organization	1985
Srirangapatna	280	KVK	638
K.R.Pet	210	4 Societies	552
Malavalli	85	KVK	217
Pandavapura	10	KVK	35
Nagamangala	10	KVK	28
Total	**3360**		**8125**

Direct Seeded Rice: A Successful Technology in Command Area

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Situation analysis

Rice (*Oryza sativa* L.) is a staple food of most of the people in India and occupies the highest area among the cereal crops. In Karnataka, rice is cultivated in an area of 13.26 lakh ha with a productivity of 3195kg/ha where most of the rice cultivation is under transplanting method. Tungabhadra project (TBP) covers part of Koppal district mainly Gangavathi and Koppal taluks, where in rice is the predominant crop in both Kharif and Rabi seasons and hence rightly called as "Rice Bowl of Karnataka". In TBP command area, tail end farmers do not get sufficient water at right time and they have to complete transplanting within a short time of water availability. Under late onset of monsoon conditions and insufficient water in barrages, canal water may become erratic and untimely leading to delayed transplanting. Rice growers are facing water crisis and increasing labour cost challenges. To overcome these problems, direct seeding could be an attractive and alternative to the conventional transplanting method.

Technology, Implementation and Support

KVK Koppal conducted frontline demonstrations on Direct Seeded Rice (DSR) at Gangavathi taluk in ten farmers' fields during 2014, 2015 and 2016. Initially, villages were selected for conducting demonstrations compared with conventional transplanting method. During the crop growing period regular visits to demonstration fields were made by KVK scientists to tackle the problems and given

advice to farmers. Meanwhile, literatures on DSR technology were published and also distributed to farmers. Consultancies over phone, information through short mobile messages were also given on DSR technology. At the harvesting stage, field days were organised on a large scale to show the performance of DSR technology over conventional transplanting method.

Uptake, Spread and Benefits

DSR recorded the highest yield (65.90 q/ha) as compared to transplanting method (62.58 q/ha). Total cost of cultivation was ₹ 54198/ha in DSR and ₹ 63180/ha in transplanting method, indicating that ₹ 8000-12000/ha could be saved towards cost of cultivation in DSR. Higher net return (₹ 60356/ha) was thus recorded in DSR compared to transplanting method (₹ 47687/ha).

Comparison of yield and economics of DSR and transplanting method

Particulars	DSR	Transplanting
Yield (q/ha)	65.90	62.58
Cost of cultivation (₹ /ha)	54198	63180
Gross returns (₹ /ha)	114583	110759
Net returns (₹ /ha)	60356	47687
B:C ratio	2.11	1.75

Further, higher resource use efficiency was observed in DSR method as compared to transplanting method at farmers' field of operational area.

By the intervention of Krishi Vigyan Kendra, Koppal, DSR technology has spread in an area of 450 ha (380ha, 60ha and 10ha in Gangavathi, Koppal and Kustagi taluks, respectively) which has helped around 500-600 paddy cultivating farmers of the district. In particular to this district, DSR technology increased the production of rice around 150 tonnes, saved ₹ 40.42 lakh on account of cultivation cost and contributed to higher net returns of around ₹ 57 lakh in comparison to transplanting method. This technology saved inputs like seed, nutrients, water etc. compared to transplanting method in Koppal district. Moreover, DSR technology could save approximately 22050 lakh litres of water from 450 ha. The saved water could be used to cultivate additional 242.30 ha of paddy under DSR. Besides the existing 40000 ha area under paddy crop in Koppal district, by adopting DSR technology, additional area of around 16000 ha can be brought under paddy cultivation with saved water from DSR. Hence, there is a large scope for increasing the area under DSR technology in Koppal district.

Quantity of inputs saved due to DSR technology in Koppal district (450 ha area)

Inputs	Quantity saved compared to transplanting (q)
Seed	131.3
Nitrogen	405.0
Phosphorus	63.18
Potassium	67.50
Water	22050 (lakh litres)

Direct Sowing Saves Water and Labour

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Situation Analysis

Village Nacharam situated in Khammam district in Northern Telangana has 749 households with a population of 3246. The village receives an annual rainfall of 1054 mm with uneven distribution. The total cultivated area is about 1382 ha. Paddy, cotton, chilli and sugarcane are the major crops grown in the village. The major soil types are black and red soils. Major sources of irrigation include streams and bore wells. Farmers are facing water shortage due to deficit rainfall and late and limited release of irrigation water from canals. Most of the farmers are following transplanting method of rice in both irrigated and rainfed areas despite it requires copious amount of water and labour for nursery raising and subsequent transplanting.

Matsyapuri of Veeravarsam sub-block in West Godavari district, Andhra Pradesh is a tail end area of Mentepudi channel covering 400 ha and Veeravarsam canal covering 240 ha. The soils are deep black and this area receives an annual average rainfall of 1077 mm. It has 776 ha of cultivated area with paddy (616 ha) as major crop in kharif and rabi followed by coconut (14 ha) and aquaculture (146 ha). Due to late

release of canal water, sowing of paddy gets delayed, as a result the grain filling and maturity stages coincide with cyclones and heavy rains causing lodging of the harvest-ready crop and resultant losses. Further, the rabi sowings are also delayed forcing the farmers to forego the summer pulse cultivation which otherwise used to be a common practice in this area. Thus, the paddy yields in recent times had drastically reduced in both the villages and paddy cultivation has become non-remunerative to the farmers.

Technology, Implementation and Support

To make the paddy cultivation more remunerative, KVKs in Khammam and West Godavari districts conducted field demonstrations in and around the target villages on direct seeding with drum seeder. Drum seeding method has advantages of water and labour saving which were highlighted during training courses on improved rice cultivation. The results of field demonstrations were encouraging and many farmers started showing interest in the drum seeder. Farmers found the drum seeder particularly convenient as it does not require water and labour in nursery raising, pulling, transporting and transplanting as the pre-germinated seeds are used for sowing in a well puddled and leveled field.

Uptake, Spread and Benefits

The drum-seeder demonstrations could clearly show the advantages to farmers. Farmers appreciated the advantages as the seeder required low pulling force to operate and gives a labour high turnout with one hectare in 5-6 hours compared to three to four days of labour by over 30 workers in the case of traditional transplanting method. The need for hand weeding was reduced by the use of pre-emergence herbicides followed by post emergence herbicides applied at 15-30 days after sowing.

Flooded conditions are provided from panicle initiation stage, similar to that in transplanted rice and irrigation is stopped 10 days before harvest. As a whole, direct seeding technology has been preferred due to less time and labour requirement, low cost of cultivation due to skipping of nursery raising and transplanting, maintaining recommended plant population and also due to early crop maturity by 10-15 days. The yield was 15.4 percent more than transplanted paddy and the cost of cultivation was reduced by ₹ 6250 /ha in west Godavari.

- The cost of cultivation is reduced by about ₹ 10000 per ha in Khammam and by ₹ 6500/ha in West Godvari due to direct seeding method
- Improved productivity due to wider spacing of 20 cm between rows and reduced crop duration by 7 to 10 days
- Two irrigations saved with direct seeding method compared to conventional method.
- Higher income was generated by adopting this method on account of increased yields and reduced labour.
- Direct sowing in paddy spread to around 128 ha in West Godavari district and 290 ha in Khammam district.

Direct Seeded Rice: A Boon for the Changing Climate

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Situation Analysis

Agriculture in Jamui district of Bihar comprises kharif rice followed by wheat in rabi season. The average annual precipitation is 1100 mm but due to its erratic nature, farmers are not able to utilize most of it. During last five years, the pattern of monsoon has drastically changed with late and receding rainfall affecting the paddy cultivation as well as delaying wheat cultivation resulting into low productivity. Moreover, in the last two consecutive years, the farmers had to keep almost 75-80% of cultivable land fallow owing to drought. Sensing the alarming situation of vagaries of rainfall, Krishi Vigyan Kendra, Jamui was searching for such an alternative which could avoid the present-day condition to some extent and cultivation of paddy be carried out at an affordable cost by the resource poor farmers. Also the rabi crop (wheat) could be taken up in time to harvest up to its potential from unit area of land.

Technology, Implementation and Support

The KVK Jamui demonstrated various resource conservation technologies to enhance productivity of crops at a lower cost. The KVK grabbed the opportunity to demonstrate direct seeded rice and zero tillage technology for promotion of resource conservation means and conservation agriculture in the district. Resource conservation technologies are the means to enhance productivity of crops and profitability of

farmers through efficient utilization of production resources and inputs, to increase yield per unit of scarce resources and inputs. Conservation agriculture, in long run, contributes to both enhanced productivity and environmental conservation on a sustained basis. *Technology components include* ***minimum soil tillage (minimum tillage, direct drill seeding), retention of soil cover (crop residue) and appropriate as well as economic crop rotations*** to sustain high yield and to prevent disease and pest problems.

Uptake, Spread and Benefits

Modest beginning was made by the KVK in 2005-06 with demonstration on direct seed rice (DSR) in 2 ha area during kharif and zero till drill in rabi for wheat. Simultaneous training programme was conducted for the farmers to make them acquainted with the technology. Success achieved in other states was highlighted through a number of means to arouse interest among the farmers. 'Not to give up' principle of the KVK staff finally started paying dividend and during 2006-07, 27 farmers from Jamui and Khaira block decided to give the new technologies a try in 8 ha area. Besides enhancement of paddy yield by 13 per cent, the cost of cultivation was reduced by ₹ 5000/ha besides ample scope for timely sowing of wheat in rabi. In the first year of demonstration, the farmers could not get the benefit as recorded in the KVK farm. Again an effort was made by KVK to train the farmers on the associated practices followed by KVK in its farm and as well as farmers participatory trials were conducted in the farmers' field with effective method of herbicide application, sesbania-rice co-culture and use of bio fertilizer in rice field. The farmers harvested rice yield in the next kharif season more than that of KVK farm. Most importantly, the farmers could save water as nursery raising was stopped followed by no puddling, laddering and transplanting in standing water. Instead, the farmers could provide one additional irrigation in wheat utilizing the saved water from the direct seed rice crop during kharif season.

Farmer to farmer transfer of technology helped in popularizing the technology at a faster rate and farmers from other villages paid visit to the demonstrated fields. The KVK also used various media and help of line department to bring more and more farmers in the ambit of this technology. From 2007 onwards, the demand for ZT machine started increasing and in the same year KVK had to arrange for 42 zero tillage machines in collaboration with ICAR, New Delhi and CIMMYT-India . The State Govt. also provided subsidy for the purchase of machine which made it much more popular among the farmers. The coverage of ZT machine and involvement of farmers increased steadily and in 2009-10, an area of 346 ha has been brought under DSR for the benefit of 209 farmers of the district and the number is fast increasing.

Resource conservation technology as an alternative to traditional rain-dependent agriculture has been proved effective in Jamui district both in terms of enhanced yield in rice and wheat as well as reduced cost of cultivation. As per the farmers, the technology (DSR in particular) came as a boon to them as they could avoid acute labour crisis by about 15% during peak crop cultivation stage like transplanting and weeding. Alongside, the sowing of wheat in time has been assured which has ultimately enhanced the overall production and productivity of two major crops.

Plastic Mulching Increases Net Returns from Melons

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Situation Analysis

Cultivation of melons in Dharmapuri district is concentrated in Morappur and Pappireddipatti blocks with an area of about 590 ha. Cultivation of melons is farmers' first choice as more profit can be obtained in 65-70 days. However, the productivity of melons was affected by 30-80 % reduction in yield due to scarcity of irrigation associated with soil borne diseases, fruit flies and pumpkin beetles.

Technology, Implementation and Support

KVK Dharmapuri demonstrated the use of plastic mulching for melons in drought prone Morappur block during the year 2013-14 under frontline demonstration programme on the fields of farmers who were already cultivating melons and installed drip system. Plastic mulch (40 micron polyethylene LDPE) was introduced to save water and prevent weed infestation. Farmers were trained on the technology components like spreading of plastic mulch, making holes, planting of seedlings etc. Plastic mulching sheet along with ICM technologies viz., drip irrigation, spacing 150 x 45 cm, application of *Pseudomonas fluorescens and Trichoderma viride* each @ 2.5 kg /ha and basal dose of fertilizers, fertigation as per recommended schedule (20 : 25: 100 kg

NPK /ha), fruit fly trap @ 12 /ha, yellow sticky trap @ 12 /ha and need based plant protection spray for foliar diseases were the technologies demonstrated. Plastic mulching either directly or indirectly reduces the incidences of pest and diseases, irrigation water, weed canopy, electric power consumption, working hours of human labour and helps to cultivate crops continuously for thrice in the same field and thereby reduces the cost of cultivation.

Uptake, Spread and Benefits

Strategy followed by KVK for up scaling plastic mulching is given below:

- Skill training was provided to the farmers of Karimangalam and Pappireddipatti blocks
- Farmers Field school was conducted in association with ATMA
- Plastic mulching was demonstrated on fields of 200 farmers under IAMWARM scheme in Morappur, Karimangalam, Nallampalli and Palacode blocks in Kambainallur sub-basin area
- Plastic mulch was further demonstrated under NHM in all blocks of Dharmapuri district.
- Spreading of mulching sheet involves drudgery to the labours and to avoid it mulch sheet spreader was recommended. The machine simultaneously does formation of raised bed, laying drip laterals at the center of the raised bed, spreading of mulch sheet, earthing up and application of basal dose of fertilizer.

Farmers involved in the demonstrations gained the knowledge and skill on use of plastic mulching indicated the following observations:

- About 15-20 % yield increase in melons.
- Fruits with plastic mulching showed no discolouration and uniform colour that increased the market price @ Rs. 1 -1.50 per kilogram.
- Crop was ready for harvest 6-8 days early than the crop without plastic mulching.
- Incidence of *Fusarium* wilt reduced to the tune of 80 % and other pest and diseases were only about 5 - 8 % as against 30 – 75 % in the fields without plastic mulching.
- Plastic mulching was retained for three crops in the sequence of watermelon-muskmelon-watermelon in the same field.
- Melon group crops were continuously cultivated for thrice in the same field without incidence of soil borne diseases.
- Frequency and time of irrigation was reduced to 3 days interval with plastic of mulching than the plots without plastic mulching receiving irrigation daily.
- Yield obtained with plastic mulching was 48.5 t as against famers practice without plastic mulching (39 t) with an additional net returns of ₹ 79000/ha.
- BCR with plastic mulching was 6.4 as against 4.6 with farmers practice without plastic mulching.

The plastic mulching is being adopted in all the eight blocks of the Dharmapuri district. The crops under plastic mulching are not only melons (200 ha water melon & 180 ha muskmelon), but the farmers are also adopting the plastic mulching for other crops like tuberose (200 ha), chrysanthemum (20 ha) and brinjal (15 ha).

Further, a total of 184 farmers belonging to Morappur (85), Pappireddipatti (50), Harur(28), Karimangalam (15), Palacode (4) and Nallampalli (2) are presently using mulch sheet spreader on custom hiring basis from KVK, Dharmapuri.

Details of plastic mulching adoption in various crops in Dharmapuri district

Crop	Total area cultivated (ha)	Area under plastic mulching (ha)	Area under plastic mulching (%)
Tuberose	1400	200	14.30
Watermelons	390	320	82.05
Muskmelon	200	180	90.00
Chrysanthemum	2000	20	1.00
Brinjal	2500	15	0.60
Source: Deputy Director of Horticulture, Dharmapuri district, Tamilnadu			

Area under plastic mulching in various blocks of Dharmapuri district

Block	Crops	Area (ha)
Dharmapuri	Tuberose	75
Nallampalli	Tuberose, Brinjal	50
Pappireddipatti	Melons	125
Morappur	Melons	260
Harur	Melons	105
Palacode	Tuberose	75
Karimangalam	Brinjal, Chrysanthemum	45

Source : Deputy Director of Horticulture, Dharmapuri district, Tamilnadu

Micronutrient Mixture Boosts Banana Production

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Situation Analysis

Banana being an important fruit crop, its cultivation is continuously increasing due to Comprehensive Horticulture Development Programme (CHD) and other schemes. However, productivity was still not up to the potential level. Micronutrient deficiency symptoms like reduction in crop growth, yellowing of leaves, leaf crinkling, uneven fruit size, fruit cracking etc., were commonly noticed in banana crop. Research studies on trend in soil fertility status indicated that the micro nutrient status is below the optimum level. Farmers emphasis on macro nutrients for enhancing the production has led to higher cost of production as well as lower productivity. Farmers needed to be educated and convinced on the vital role of micro nutrients in enhancing the quality and yield of banana.

Technology, Implementation and Support

During the period from 2008-09 to 2015-16, four KVKs *viz.,* Erode, Mysuru, Davanagere and Hassan made efforts in promoting micronutrient application. The micronutrient formulation technology standardised by ICAR Indian Institute of Horticulture Research (IIHR), Bangalore and branded as "Banana Special" was tested and demonstrated by the KVKs. Successful demonstration created sudden demand for the micronutrient formulation from the farmers not only around KVKs but also at distant places. Realizing the need for large quantity of the product, all the KVKs purchased the technology from IIHR along with necessary training to the technical staff and started multiplying at their level. Each KVK established a production unit and conducted extension activities to provide publicity to the product. Farm advisories were supplemented by extension literature and mass media coverage to spread the technology

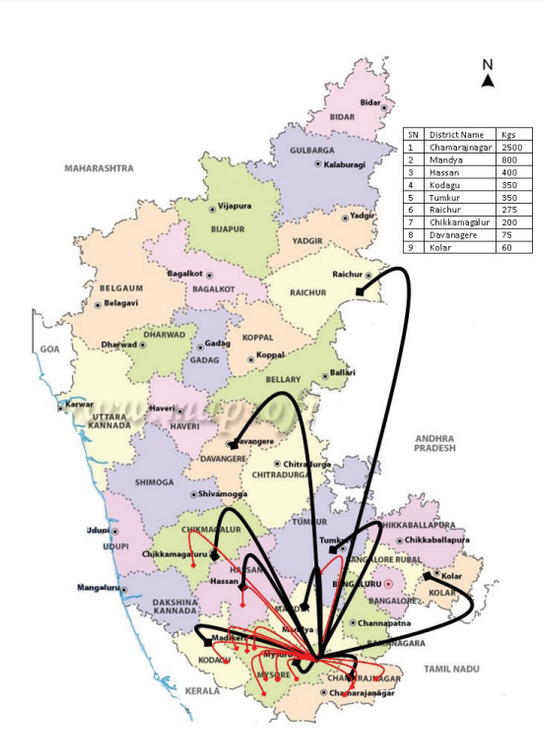
Strategy followed by KVKs viz., Erode, Mysuru, Davanagere and Hassan for up scaling IIHR Banana Special is given below:

KVK Erode signed an agreement with IIHR and started production of the **"banana special"** in KVK itself from the year 2011-12. A total of 13962 kg of banana special was produced so far and provided to 2328 farmers covering 116 villages. Community Managed Resource Centre (CMRC) established by KVK which is functioning in TN Palayam, Anthiyur and Bargur have actively involved in the scaling up of technology. KVK trained 5 SHGs and 13 Krishi Mitras for promoting IIHR Banana Special at Door steps of the banana growers, regular monitoring and for obtaining feed-back to the KVK. On an average 60 man day's employment opportunity was created for SHG members and Krishi Mitras. Total revenue of ₹ 9.07 lakh was added to the revolving fund of KVK by production and sale of 13.96 t Banana Special.

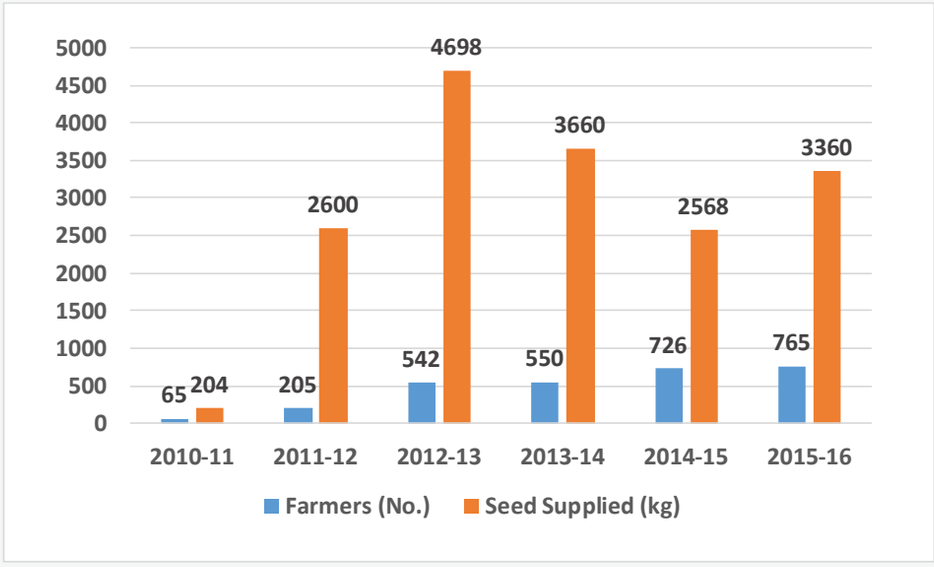
Production and supply of Banana Special by KVK Erode (2011-12 to 2015-16)

Year	Banana Special (kg)	Farmers (No.)	Villages (No.)
2011-12	2763	461	19
2012-13	2709	452	25
2013-14	1973	329	21
2014-15	3128	521	24
2015-16	3389	565	27
Total	13962	2328	116

KVK Mysuru procured the technology in October 2010 and got its staff trained. A total of 28780 kg of banana special was produced so far and provided to 3000 farmers covering 1217.6 ha. Agri Clinic was established in July 2013 that gave fillip to the spread of banana special technology. Total revenue of ₹ 19.50 lakh was added to the revolving fund of KVK by production and sale of banana special. The product has moved beyond the district to other districts in the state, as indicated in the Map.



KVK Davanagere bought the technology in the year 2010 and started producing the product as per IIHR standards. A total of 17090 kg of banana special was produced so far and provided to 2853 farmers of the district (Fig.1). A total of 432 kg of banana special was supplied to other districts viz., Chikkamagalur, Haveri, Gadag, Bellary, Dharwad and Bengaluru Rural.



KVK Hassan started the producing the product later than the other KVKs but has already produced 2200 kg so far. KVK has established an effective convergence with State Horticulture Department and other line departments for promotion of banana special.

Uptake, Spread and Benefits

- Micronutrient deficiency symptoms rectified and obtained an average yield increase of 13.75% from 40 demonstrations (FLD) conducted by KVK Erode during 2011-12 and 2012-13 with an average yield of 39.47 t/ha and BCR of 3.11 as against farmers practice with 34.70 t/ha and 2.62 BCR.
- It was observed by KVK Mysuru that the application of Banana Special was directly contributing to healthier banana plants leading to an average 10 per cent yield improvement, uniform and good quality fruits and bunches.
- The year wise results of FLDs conducted on Banana Special by KVK Davanagere during 2008-9 to 2012-13 show a significant increase in yield levels of banana (in both *yelakki* and Grandnaine varieties) compared to farmers practice. It was observed that the application of Banana Special obtained an average yield increase of 36.10% from 63 FLDs in 17.40 ha with an average yield of 34.04 t/ha with average BCR of 2.73 as against farmers practice 25.66 t/ha with 2.21 BCR.
- Data from 50 FLDs on Banana Special conducted by KVK Hassan in 20 ha during 2012-13 to 2016-17 showed an average yield increase of 11.98% with an average yield of 39.34 t/ha.
- Over the years, application of Banana Special along with integrated Nutrient Management practices minimised the micronutrient deficiencies and enhanced the yield levels and thereby gave farmers an additional income of ₹ 40000 to 45000/ha.
- Application of 5-6 kg/ha of chemical fungicides has been reduced due to the application of Banana Special.
- Increased the market price from ₹ 3-5/kg due to the shining appearance of banana bunch.

The spread of Banana Special technology was noticed year after year and the technology has been adopted by many banana growers and details are given below:

- In Mysuru district, 25% of banana growers of Nanjangud, Mysuru, T.N.Pura, K.R.Nagar, Hunsur, H.D.Kote, Periyapatana using a total of 15450 kg of Banana Special per year.
- Arakere cluster of Honnali taluk in Davanagere district formed banana growers group comprising of 120 farmers under Comprehensive Horticulture Development programme (CHDP) and they are using banana special.
- Siddanur Banana Growers Association with 15 members formed from Siddanuru village of Davanagere taluk in order to help themselves in production and marketing of banana.
- A total of 3500 farmers in Hassan district have adopted banana special in an area of 2500 ha and thereby the area under banana increased from 3019 ha (2012) to 3339 ha (2016).
- From Erode, Mysuru, Davanagere and Hassan KVKs, Banana Special has spread to other districts viz., Namakkal, Salem, Krishnagiri, Theni, Cuddalore and Madurai districts of Tamil Nadu, Palakkad and Idukki districts of Kerala, and Chamarajanagar, Mandya, Kodagu, Tumkur, Raichur, Chikkamagalur, Kolar, Haveri, Gadag, Bellary, Dharwad and Bengaluru Rural, Shimoga, Kodagu and Mandya districts of Karnataka

IPM Technology - A Boon for Ecofriendly Pest Management in Brinjal

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Situation Analysis

In view of growing concern among the public for pesticide contamination along with gaining popularity of organic farming, adoption of eco-friendly methods of pest management in vegetable crops like brinjal has become very important. This becomes more relevant in brinjal where harvesting or picking is done at weekly or shorter interval. This would also enable less or no insecticide residue in farm produce above detectable level. Keeping this in consideration, role of Integrated Pest Management (IPM) becomes more relevant particularly in brinjal. During the PRA, it was found that farmers were solely dependent upon chemical pesticides for management of insect pests of brinjal. They were not aware of different pests of brinjal, their life cycle, nature of damage etc. It was also noticed that most of the vegetables (okra & brinjal) grown by farmers were for sale and not for home consumption.

Technology, Implementation and Support

Krishi Vigyan Kendra, Tapi disseminated IPM technology through various extension activities in different villages of Tapi district. Several training programmes (on/off campus) were conducted to impart knowledge

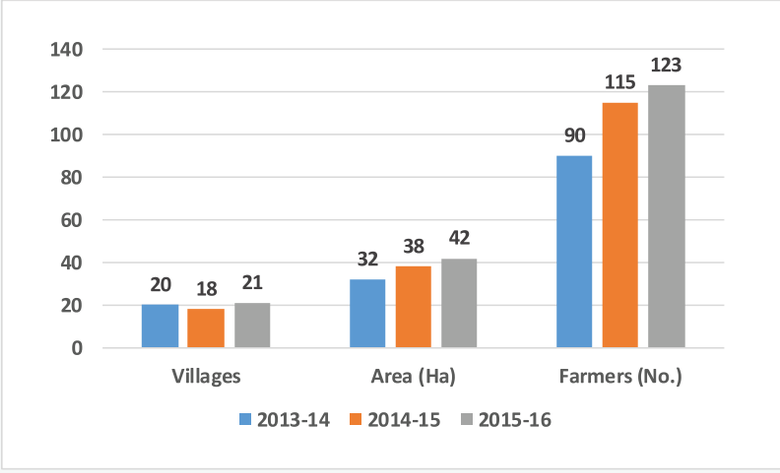
and skills for IPM among farmers. During training programmes, emphasis was given on 'Pesticide Residues' in crops and different components of IPM viz., ***cultural practices, mechanical and physical practices; use of botanical pesticides, biological agents and need-based application of chemical pesticides. IPM kit comprising of yellow sticky traps, pheromone traps with Leucinelure, Azadirachtin 1500 ppm and Trichocards*** were demonstrated at each selected farmer's field. Consequently, method demonstrations were also carried out for operation and installation of yellow sticky traps, pheromone traps, Trichocards etc. Moreover, the other non-pesticidal practices such as clean cultivation, collection and destruction of infested shoots and fruits, growing marigold as trap crops, ecological engineering in pest management were also carried out with active involvement of farmers. Constant follow up visits, meetings, field days and other extension activities were organized. The advice about need based pesticide usage (based on the ETL level) were also given during field visit. Initially, farmers were hesitating to apply need based application of single pesticides and other IPM components but with constant encouragement by KVK scientists farmers are successfully adopting IPM measures. Farmers were also trained in identification of insect pests, bioagents and their life cycles.

Moreover, dissemination of IPM technology in vegetables was also carried out in association with ATMA project, District Agricultural Departments through various extension activities [Sponsored training, Farmers Field Schools (FFS) visit, diagnostic visit, method demonstration, distribution of literature, mega events viz, Krishi Mahotsav, Krishi Melas, Khedut Shibir etc.]

Uptake, Spread and Benefits

The average yield obtained from demonstrated plot was 22 t/ha as compared to local check with19 t/ha. The B:C ratio obtained from demonstrated plot was also found higher (3.24, 2.90 and 2.95) than local check (2.42, 2.19 and 2.17) during the three consecutive years. Increased benefit was due to reduction in cost of plant protection as well as increased yield. In addition to reduced cost of plant protection, the demonstration plots recorded lesser pest population.

The successful demonstration of IPM technology in terms of pest control, reduced cost of plant protection, increased yield and income realized has in turn influenced more than 20 neighboring villages to adopt the IPM practices.



Pheromone Trap Gains Popularity Among Cucurbit Farmers

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Situation analysis

Cucurbits *viz.,* cucumber, bottle gourd, pumpkin and bitter gourd, etc. with an area of 2443 ha and production of 54237 tonnes are important cash crops grown in Himachal Pradesh. Tephritid fruit fly (Diptera: Tephritidae) in particular is one of the most diverse group of insects in the country in general and hill state in particular taking heavy toll of these vegetable & fruits causing huge economic losses to farmers to the tune of 35 – 80% in different areas of the state. The hidden or concealed maggots mostly escape the insecticides applied for its management. The effective management of the pest was possible through mass trapping of male fruit flies (male annihilation technique- MAT) followed by need based bait application technique (BAT).

Technology, Implementation and support

KVK Mandi assessed different technological options from 2009-10 to 2011-12 and standardized the technology of pheromone traps. The technology was included in the package of the practices of the University for fruit fly management, and was demonstrated through frontline demonstrations (FLD),

2012-13 onwards. Department of Agriculture, Govt. of Himachal Pradesh took up this technology for large scale demonstration. KVK took up capacity building of extension functionaries and farmers besides providing literature, advisory services, SMS services, TV/ radio talks, print media, local magazines and pamphlets etc. Farmers were educated about the integrated management options for fruit flies viz. ***field sanitation, Bait Application Technology (BAT) and Male Annihilation Techniques (MAT)***. Posters and pamphlets were distributed among farmers, State Agricultural Department officials, Block Technology Managers (BTM), and NGOs in Himachal Pradesh to create large scale awareness.

Details of training and supply of traps by KVK Mandi

Year	Persons trained (No.) by KVK			Traps supplied by KVK (No.)
	Extension Personnel	Rural Youth	Farmers	
2010	72	167	416	2500
2011	118	243	652	3500
2012	83	307	321	4070
2013	69	82	189	4800
2014	15	89	347	1200
2015	0	36	197	1200
2016	0	29	128	2000
Total	**357**	**953**	**2250**	**19270**

Uptake, Spread and Benefits

The cost of Palam trap (Rs 55/-) is significantly less as compared to other traps available in the market (Rs 135/-). In each block, identified farmers groups under ATMA/ KVK were trained in preparation of bottle traps by recycling/ using the empty plastic bottles available in each household. Being a farmer friendly technology, farmers immediately learned to prepare the bottle traps. This resulted in saving of ₹ 40/trap for the farmers and higher efficacy owing to need based usage.

The recommendation of fruit fly traps @ 25 traps per hectare + Bait Application Technique (BAT) not only reduced fruit infestation but also reduced fruit fly numbers with passage of time as males are trapped and unmated females either do not lay eggs or lay unfertilized eggs. Installation of fruit fly traps reduced the number of insecticidal applications, consequently minimizing input costs and environmental pollution. Fruit fly bottle traps are effective for 6-8 weeks and one trap covers an area of around 400 sq. meters and requires no labour for installation.

As the trap installation has reduced the number of pesticide applications, the chances health hazards for women have also reduced. The trap has become very popular among the farmers within a short span of three years and KVK has sold nearly 20,000 traps earning revenues to the tune of ₹ 15 lakh. Thus, this technology has now been widely adopted in the district. The technology resulted in additional revenue of ₹ 24000/ha (based on results of FLDs and farmers feedback) owing to additional marketable yield and reduction of pesticide applications (at least 2-3 applications) apart from intangible benefits on account of reduced pesticide load on the environment. The efforts of KVK on pheromone technology haver resulted in the following changes:

- The technology horizontally spread in about 1500 ha area in the state and about 50000 traps (30000 from the Department of Entomology, CSK HPKV Palampur and 20000 from KVK Mandi have been supplied to the farmers.
- Farmers visits to KVK increased by 15-20% particularly for procurement of the trap in the ensuing season.
- All the KVKs are procuring the traps from the Department of Entomology/ KVK Mandi for providing it to the farmers in their districts
- The traps have also been supplied to the neighbouring states Punjab (500 traps) and Haryana (1500 traps).
- Overall, the technology has been adopted in about 250 ha of cucurbit area in the district, resulting in direct additional returns to the tune of ₹ 60,00,000 (250 ha x ₹ 24000) per annum. This apart, benefit of about ₹ 1000000 was realized on account of reduction in pesticide applications (2 application @ ₹ 2000/ ha i.e. 250x2000x2).

Fruit Fly Trap - An Eco-Friendly Tool to Enhance the Quality of Mango

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Situation Analysis

Situated in south eastern part of Gujarat, Valsad district, predominantly a tribal district is famous for its quality horticultural produce like mango, sapota and banana. Gujarat has been known for producing high quality Alphanso and Kesar variety of mango, particularly in Valsad district. Keeping this in view, the Government of Gujarat has declared this region as Agri Export Zone (AEZ). The district accounts for 46 % of the total area under mango cultivation i.e. 26250 ha, with total production of 157500 t with a productivity of 6000 kg/ha. The area under mango cultivation shows increasing trend but the productivity has remained static. Quality of the mango is another aspect which needs to be addressed. Valsad district falls under Agro climatic zone I (South Gujarat heavy rainfall zone) of Gujarat which consists of two distinct agro-ecological situations viz; AES I and II. AES-I comprises of Dharampur and Kaprada talukas, while AES-II comprises of Valsad, Pardi, Umargam and Vapi talukas of Valsad district. The soils are shallow to medium black with poor fertility status and low moisture retention capacity. The average annual rainfall

of the district ranges between 2000 to 2200 mm, spread over an average of 87 rainy days in a year. The maximum temperature ranges between 35˚ to 41˚ C during April – May. The lowest temp (8.1˚ to 8.6˚ C) observed during December-January.

Fruit fly infestation is the major cause affecting the quality of mangoes in the district. In Gujarat, *Bactrocera* and *Dacus* are the main genera of fruit fly. In South Gujarat, mango is mainly damaged by *Bactrocera correctus* and *Bactrocera dorsalis*. The population of fruitfly is found more during April to August. Thus, it does not only reduce the volume of produce but also deteriorates fruit quality resulting into great economic loss to the mango growers. Use of chemicals for the control of fruit fly creates problem of residual effect of chemicals on fruit. Even exporters /importers do not allow farmers to use such chemicals. Hence, sex pheromones are very useful, eco-friendly and cheaper alternative for management fruit fly in mango orchards.

Technology, Implementation and Support

The Navsari Agriculture University has developed a ***low cost and eco-friendly technology of fruit fly trap*** which is an easy and safe method to check the population of fruit fly in mango orchard. Keeping these traps @ 10 traps per ha during fruit development stage will considerably reduces the population of fruit flies.

- The cost of a trap is only ₹ 30-35.
- It reduces the use of pesticides and spraying hence, eco friendly.
- Trap can be prepared from locally available resources such as plastic bottle and sponge by the farmers.
- Very easy to handle and can be used repeatedly.

The KVK initiated a participatory programme through large-scale demonstrations of the technology on farmers' field in adopted villages. Different extension teaching methods such as field demonstration, training, farmer-scientist interface, group discussion, diagnostic surveys etc. were used to transfer and promote the technology. The KVK also published a colourful pamphlet describing technology with illustration and distributed them to farmers. Besides, farmers were trained to prepare the traps from locally available resources like empty plastic water bottle, cotton plug etc.

In order to provide wide publicity to the technology, selected resource persons and village level workers (VLWs) and other district functionaries were also trained by KVK regarding preparation and use of trap in fruit crops. Several trainings and demonstrations were also conducted in collaboration with State Department of Horticulture and Navsari Agricultural University.

Uptake, Spread and Benefits

Because of large scale demonstration and trainings, farmers could realize the importance of cheaper, low cost, eco-friendly technology and adopted it. Owing to the growing demand of fruit fly traps by the mango growers, pesticides dealers have started selling of the same and thus it is now becoming

easily available in the local market. Looking at the success of the technology in the field condition, state department has allocated special scheme for the popularization of this technology through KVK in the district. SAU has also supplied about 8000 such traps for wider adoption amongst the tribal mango growers of the district. In order to fulfill the increasing demand of farmers, KVK has started the production of fruit fly traps and supplying to the mango growers at reasonable rate.

Production and supply of Fruit fly (*Methyl Euginol*) traps in Mango by KVK

Year	Traps (No.)	Area (ha)	Farmers (No.)
2012-13	1439	144	86
2013-14	1973	197	146
2014-15	1824	182	123
2015-16	1973	197	135
2016-17	1810	181	124
Total	**9019**	**901**	**614**

Fruit fly trap is an important technology for organic farming. Looking to the benefits of this easy, eco-friendly and cheaper technology, many farmers of Valsad district have adopted this technology. The survey conducted by the KVK shows that 32 % farmers of the selected villages of the district have fully adopted this technology in their orchards. It is also estimated that 12 % of the total area in the district under mango cultivation has been brought under this technology.

Foxtail Millet (*Setaria italica*) as an Alternate Crop to Cotton

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Situation Analysis

Yagantipalle village is 4 km away from Banaganapalle Panchayat of Kurnool district, Andhra Pradesh. Over 70% of agriculture in this village is rainfed and hence it is highly prone for frequent droughts. The village has 361 households with total cultivated area of 640 ha. The major soil types are sandy loam to medium black soils and the normal annual rainfall is 633 mm. Kharif sowings were generally delayed in the recent past due to delay in the onset of south west monsoon and the sowing of most of the rainfed crops was possible only by the last week of July. Among the kharif crops, foxtail millet, redgram and castor performed well with reasonable yield levels. Rabi sowing of bengalgram was taken up with rainfall received during 2nd week of October. The crop suffered acute moisture stress as there was dearth of stored soil moisture in the early stages of crop growth.

Technology, Implementation and Support

Cotton and pigeonpea were the main crops grown during kharif and sorghum & sunflower during rabi. Most of the crops get affected with late onset of monsoon, followed by dry spells during critical

stages of crop growth, which in turn is severely affecting the crop yields. The KVK Kurnool, after initial assessment through on farm trials, organized the frontline demonstrations to convince the farmers about short duration foxtail millet variety SIA 3085, (Suryanandi) of 70-75 days duration with tolerance to drought and downy mildew in place of jowar and cotton in 10 ha in 2011 Kharif. The farmers were trained on package of practices followed by advisories to the farmers to popularize the crops.

Uptake, Spread and Benefits

Foxtail millet recorded higher yield and net returns compared to cotton. Due to late onset of monsoon (third week of July) the crops experienced prolonged dry spells during grand growth period. Cotton could not be taken up due to late onset of monsoon. Jowar was sown but it was affected with terminal moisture stress. However, these varieties of foxtail millet could escape drought due to their shorter duration.

In view of drought tolerance, short duration and less requirement of water, foxtail millet was introduced as an alternate crop to cotton which is of long duration and more water demanding. Due to its superior performance, area under the crop increased from 16 ha to 480 ha in the villages by kharif 2015. Further area expansion under this crop is expected, as more and more farmers are finding it as an excellent alternative under delayed monsoon conditions and better marker price. With the availability of good quality seed in sufficient quantity due to the seed banks established by KVK, Kurnool; seed farmers and Regional Agricultural Research Station of Acharya NG Ranga Agricultural University the crop was taken up in surrounding villages and sub-blocks as delay in the onset of monsoon has become a usual phenomenon in the recent years.

Consistent performance of foxtail millet under delayed monsoon conditions coupled with better market price is attracting the rainfed farmers of the neighboring districts like Prakasham, Kadapa, Anantapur and Kurnool in Andhra Pradesh. These districts are also facing similar problems due to delay in the monsoon as agriculture is predominantly rainfed here as well.

Elephant Foot Yam Cultivation made Profitable

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Situation Analysis

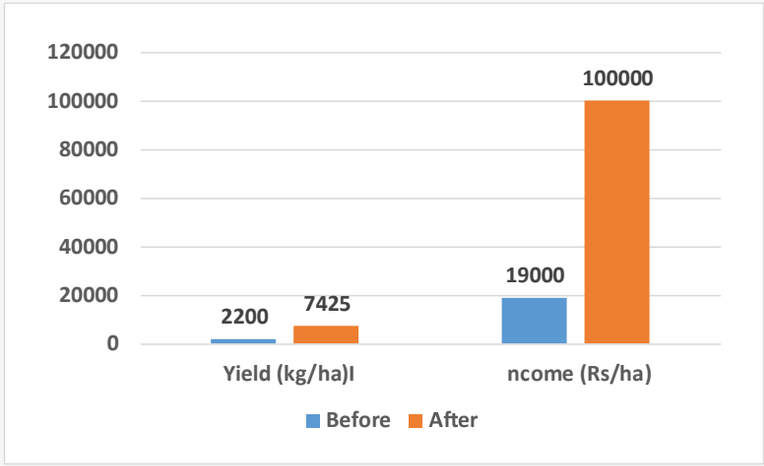
Cultivation of Elephant Foot Yam in Birbhum district of West Bengal was a common practice during the 80's when State Development Departments initiated it as cash crop mainly among small and marginal farmers. But the farmers stopped its cultivation after 2-3 years as they failed to get remunerative price . Since then the farmers were looking for such a crop which could fetch them substantial amount of money to uplift their socio-economic condition.

Technology, Implementation and Support

KVK Birbhum in a bid to transfer some of the technologies in agriculture and allied sector approached a cluster of four villages namely Kankutia, Kastikdanga, Senkapur and Deuli under Bolpur-Sriniketan block of the district. Detailed discussion with farmers revealed the history of foot yam cultivation in the villages and reasons for rejecting this crop by the farmers as the introduced variety was of local selection, low yielding, more raphide content, long duration, less market demand and detrimental to soil health.

Survey conducted by the KVK revealed plenty of opportunity in terms of congenial climate, availability of fallow and backyard land where elephant foot yam could be reintroduced. The KVK in consultation with farmers decided to conduct on station trial of ***Kavoor variety of foot yam*** to create a favorable attitude of the farmers towards its adoption. The farmers were frequently invited to observe the performance of the variety during crop growth. This self-observation method motivated the farmers of these villages to cultivate Kavoor variety in their land. Once they were convinced, the KVK organized training programme on ***package of practices for foot yam*** both in KVK campus and villages. The KVK also arranged quality seed from State Research Farm and Bidhan Chandra Krishi Viswavidyalaya to the farmers.

Fifteen farmers from four villages cultivated elephant foot yam in their fallow lands and backyards during Kharif 2002 after making proper pits, maintaining recommended spacing, application of organic and inorganic manures and other practices. The KVK supervised each and every operation to infuse confidence among them. Finally the farmers could harvest yield of 74250 kg/ha against 2200 kg/ha from the local variety. Moreover, the farmers themselves shared the responsibility of aggregating the total production by forming groups and taken the produce to the market located 10 Km away for remunerative market price.



Uptake, Spread and Benefits

Elephant foot yam as a cash crop became quite popular within a span of five years with the involvement of small and marginal farmers of the region covering about 20 villages and 200 farmers. The area under elephant foot yam increased from a meager 3.75 ha to approximately 55 ha during the five years time.

The successful cultivation led to the group approach in the cultivation of elephant foot yam. The farmers group sold the produce and profit was divided among the farmers as per area of cultivation owned by individual farmer. A certain quantity of seed was stored for further multiplication by the farmers. As per the economics worked out by them they could earn a net profit of nearly one lakh rupees from one hectare of land following all the recommended practices. This success not only influenced the neighboring farmers, the farmers of adjacent districts like Burdwan and Bankura took interest to learn the cultivation practices from this KVK. Farmer to farmer extension of this cultivation practice played major role in reviving elephant foot yam cultivation in the entire region. A total of 200 farmers across 20 villages were benefitted with net returns of ₹ 55 lakh.

Dryland Mango ensures Income in Drought-Prone Areas

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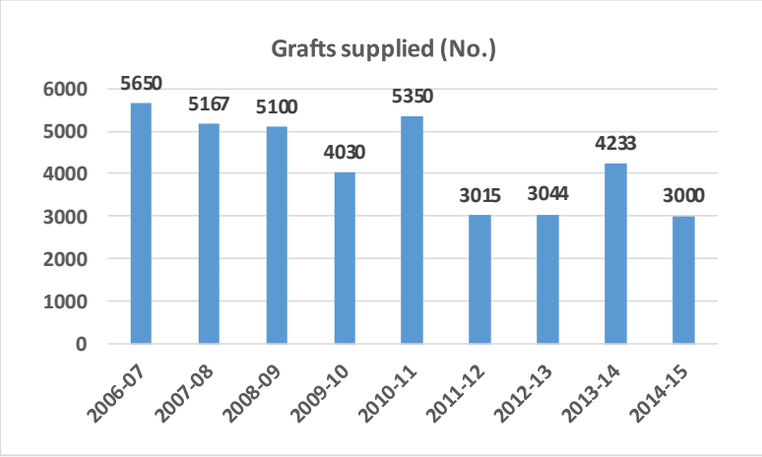
Situation Analysis

Nearly 30 per cent of soil type in Gadag district is red sandy loam. Farmers mainly cultivate spreading groundnut to the extent of 30000-35000 ha in red soil during Kharif season. The average productivity of groundnut is 6-7 q/ha. The reasons for low productivity are moisture stress, high cost of production, high incidence of pest and diseases and non-availability of labours. Thus, spreading groundnut cultivation in red soil area has become non-remunerative Unlike in the case of black soils where farmers take two crops a year, red soils not even produce one good crop if rainfall is inadequate.

Technology, Implementation and Support

In the backdrop of constraints faced by the farmers in red soil based cropping system, KVK developed strategies and interventions to promote ***mango based farming system in rainfed red soils*** with a long term objective to bring income security to the farmers. An integrated training module was developed by KVK that included soil and water conservation, rainwater harvesting through digging of trenches,

orchard layout, pit digging and filling, selection and planting of grafts, staking, management of pest and diseases, and intercropping systems in mango orchard. During the 10 year period from 2006-07 to 2015-16, KVK organised 98 training courses on dry land horticulture for 2733 farmers. Exposure visits were organised to successful rainfed mango orchards established by few farmers under the technical guidance of KVK. From 2010-11 onwards, production and supply of quality mango grafts was one of the important interventions of KVK. During the period from 2006-07 to 2015-16, KVK supplied nearly 40000 grafts of Alphonso variety of mango to over 400 farmers. Apart from this, KVK facilitated many farmers to get mango grafts from Regional Fruit Research Station, Vengurla of Konkan Krishi Vidya Peeth, Maharashtra State. Further, various farm advisory services *viz.,* orchard layout, planting technique, rain water harvesting and conservation, plant protection were provided by KVK to the farmers from time to time.



Strategy followed by KVK for up scaling mango based farming system in drought prone area of Gadag district is summarized below:

- Mango Growers Association consisting of 143 farmers was formed in Gadag block under the guidance of KVK during 2014-15.
- KVK facilitated direct marketing of fruits from producers to consumers from 2014 onwards
- Month long Mango Mela was organised by KVK and brought mango growers close to consumers.
- Effective convergence of KVK with State Horticulture and Watershed Departments, National Horticulture Mission and Mahatma Gandhi National Rural Employment Guarantee Programme (MGNREGP) for promotion of mango based farming system
- Establishment of linkages by KVK with Non-Government organisations viz., Reliance Foundation and Desphande Foundation for providing technical support and farm advisories.

Uptake, spread and benefits

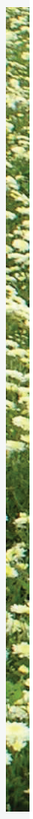
KVK's efforts during the period from 2007-08 to 2016-17 paved way for spread of mango area to 112 villages of Gadag district in an area of 1734 ha belonging to 404 farmers. When this data is compared with bench mark data of the year 2006-07, there has been 172 % increase in area over a decade.

Spread of area under mango during 2007-10 to 2016-17

Taluk	Farmers (No.)	Villages (No.)	Area (ha)
Gadag	205	17	1225
Ron	82	26	117
Shirahatti	54	34	165
Mundaragi	32	25	194
Naragund	31	10	33
Total	404	112	1734
There has been significant change in the income of farmers owing to adoption of rainfed mango cultivation. This is evident from the income realised by the farmers from mango cultivation. Mango growers are also aware of production of quality fruits and profitability from direct marketing. Mango Growers Association is in the process of developing a mechanism for export of mango fruits for realising higher profitability. In the years to come, mango growers would be contributing much to the district economy. Projections based on current trends reveal that the mango income from 2016-17 to 2020-21 would be ₹ 77.50 crore in Gadag district.			

The results of KVK interventions further indicate the following:

- Mango is a very good alternative in red soils and gives returns even during drought years.
- Farmers obtained an average net income of ₹ 80000/ha on own cultivation and marketing and ₹ 38000/ha on leased out orchard as against ₹ 21000/ha from spreading groundnut under rainfed situation.
- Out of 1734 hectares of area expansion during the year 2007-08 to 2016-17, 586 ha of mango orchards belonging to 218 farmers are in the age group of 5-9 years of mango orchards and data were collected from these farmers for the year 2015-16.
- Data revealed that the 218 farmers have earned net income of ₹ 181.41 lakh from 586 ha of mango orchard.
- With the KVK intervention, a large number of mango growers stopped using chemical fertilizers and pesticides in their orchards thereby increasing area under organic cultivation of mango.
- Apart from this, growers are not using carbide for ripening process instead they are using locally available grass for ripening of mango fruits. This has significantly improved the quality of mango fruits and attracted the attention of consumers as well as traders.



Improved Floriculture Practices Usher Prosperity to Farmers

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Situation Analysis

Floriculture has emerged as a prominent and an attractive sector of agriculture in villages Asrawad and Mirjapur in Indore district of Madhya Pradesh. About 90 % of the farmers are having less than 5 acre of land. Many of the farmers opted to improve their cropping pattern for better livelihood status through commercial floriculture but due to lack of knowledge and expertise, production and profitability is very less through flower crops like marigold, gladiolus and chrysanthemum.

Technology, Implementation and Support

To improve the area, production, productivity and quality of flowers, KVK Indore demonstrated ***nutrient management, integrated pest management and disease management in chrysanthemum, seed production techniques in gladiolus, nutrient management and hybrid cultivation in marigold.*** The KVK disseminated the technology in convergence with Dept. of Horticulture, Indore, which provided planting material and subsidy on inputs. KVK conducted survey, diagnostic field visits, interaction with farmers; and arranged quality planting material, conducted OFT followed by FLD on chrysanthemum and marigold

on Integrated Nnutrient Management and Integrated Pest Management during the year 2010 -11, 2011 -12, 2012-13 and 2013-14. Regular field visits, farmers training and field days were also conducted.

Technologies promoted by the KVK

Parameters	Crops		
	Chrysanthemum (nutrient, pest and disease management)	Gladiolus (seed production)	Marigold (hybrid cultivation with nutrient management)
Cost of technology (₹ /ha)	26550	225000	10150
Operational cost (₹ /ha)	2250	75000	1000
Expected production increase	18.57 %	10-12 %	15-18 %
Cost reduction possibilities (%)	15 %	8-10 %	15 %

Results obtained due to KVK interventions

Yield	106.33 q/ha (Chrysanthemum)
B:C Ratio	1:4.85
Saving of inputs	25 % fertilizer, 32 % of Pesticides
Quality improvement in produce	Size and shining of flower increased
Employment generation	2 female household members employed for plucking, grading etc.
No. of beneficiary covered	26
Extent of problem addressed (%)	Blight (90 %) Borer &Sucking pest (85%) Plant mortality (20 %)

Uptake, Spread and Benefits

- With diversification of cropping system, production and profitability significantly enhanced. Diversification to chrysanthemum helped farmers to get additional average net income by ₹ 88725/ ha in comparison to traditional crop i.e. soybean – wheat. Average productivity of Chrysanthemum has been increased from 70 q/ha to 83q/ha with additional average income approximately ₹ 50000/ ha.
- Average net income from marigold was ₹ 95000/ha with comparison to soybean (₹ 28000/ha).
- Quality planting material (bulb) production of gladiolus has been carried out in villages Asrawad & Mirjapur. Average 350000 bulbs produced and benefited to additional 33 farmers of the district.
- Similarly production and productivity of marigold and gladiolus increased by 18-19%.
- Area of flower crops chrysanthemum, marigold and gladiolus has increased from 24 ha to 31 ha (72 to 124 farmers), 80 ha to 102 ha (240 to 306 farmers) and 6 ha to 9 ha (24 to 54 farmers) respectively during 2010 to 2012.
- Use of biofertilizers and micronutrient in chrysanthemum were adopted by the farmers since 2012 of villages Asrawad (13 farmers), Mirjapur(17 farmers) and Ralamandal (12 farmers)
- Gladiolus farmers were able to produce quality bulb (seed) in village Asrawad & Mirjapur. Around 350000 bulbs of gladiolus worth of ₹ 700000 were produced by farmers. Similarly quality planting material (suckers) of chrysanthemum were produced by the farmers of village Asrawad & Mirjapur for their own use and supplied to 30 other farmers, vz worth Rs 60000.

Protected Cultivation: A Success in Sirmour

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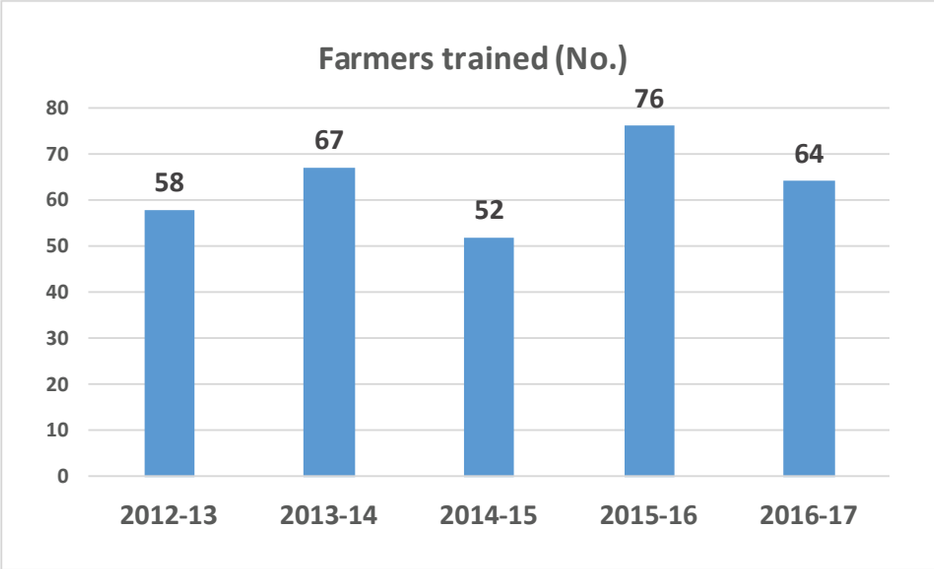
Situation Analysis

Biotic and abiotic stresses are the main factors responsible for low yield and poor quality of vegetables under open field cultivations. Protected cultivation could be a boon to marginal and small farmers from their small land holdings to produce high quality vegetables throughout the year. The main advantage of protected cultivation is that it ensures high productivity and provides self-employment avenues to the youth and the rural population. It also aims to create a supply of fresh vegetables to big markets during high-price period.

Technology, Implementation and Support

KVK Sirmour of Himachal Pradesh conducted On Farm Trials (OFTs) on capsicum and tomato for assessment and validation of technologies under protected cultivation. KVK further upscaled the protected faming among the farmers through multifarious activities such frontline demonstrations (FLDs), method demonstrations, capacity building of farmers, extension personnel, diagnostic visits, extension literature, mobile advisory SMS service on protected cultivation, exclusive programme on radio & TV, marketing intelligence, adoption of polyhouses by the KVK, etc. Departments of Agriculture & Horticulture as well as the KVK Sirmour worked together for its success.



Uptake, Spread and Benefits

Based on the on-farm trials conducted by KVK, Sirmour, the proven technology for coloured capsicum and tomato cultivation under protected cultivation was provided to the extension functionaries of the State Department of Agriculture and Horticulture as well as polyhouse growers through trainings, method demonstrations and literature support. The diagnostic visits by KVK scientists helped farmers to overcome biotic and abiotic problems.

Surveys were conducted during the year 2015- 16 in different polyhouses in the district and observations were recorded on the performance of different cultivars grown by the farmers. On an average 53 q of coloured capsicum and tomato can be harvested from a polyhouse unit of 500 m^2 with net returns of ₹ 174000 and ₹ 55000, respectively, per unit.

KVK Sirmour conduced market study on arrival pattern and prices of tomato and capsicum in markets of Sirmour and Solan district of Himachal Pradesh. On the basis of ***price trend analysis,*** KVK Sirmour is motivating the farmers to grow tomato and capsicum in polyhouses so that the produce can be harvested and marketed during July to January months ***for getting the premium price*** in the market.

A total 511 polyhouses have been constructed covering an area of 17.36 ha in the district. This achievement can be attributed to the efforts of agriculture and horticulture departments in infrastructure development along with sound technological backstopping by the KVK to the extension personnel as well as polyhouse farmers. Agriculture department is promoting off-season vegetable cultivation while Horticulture Department is encouraging the farmers to opt for floriculture.

The economic impact of vegetable cultivation under protected cultivation was studied from a random sample of 25 polyhouse farmers in Sirmour district. Economic analysis revealed that the average income earned by the vegetable grower was ₹ 1.25 lakh from 500 m^2 which is equivalent to ₹ 24 lakh/ha. KVK Sirmour has also educated farmers regarding marketing strategies to be adopted for their produce. As there is a good demand for vegetables in the nearby big city markets, the produce from the district goes to Chandigarh, Dehradun and Delhi through direct marketing links between the commission agents and the farmers in these markets. A few vegetable grower entrepreneurs are retailing their produce in the local markets (Paonta Sahib and Nahan). Some polyhouse farmers are also selling their vegetables to the local regulated markets and retailers in the district.

Economic Empowerment of Tribal through Disease Free Vegetable Nursery Raising

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Situation Analysis

Lahaul & Spiti is a tribal district and characterised as High Hills Temperate Dry Zone of Himachal Pradesh. Among the off-season temperate vegetables cauliflower, cabbage and exotic vegetables like lettuce, red cabbage, chinese cabbage, broccoli etc. are being grown by the farmers as they get high rates in the market. Raising of early and healthy vegetable plant nursery in the Lahaul valley was a challenge to the farmers as the fields remain snow covered up to the end of April or even first fortnight of May. The farmers of the valley procure vegetable nursery from Kullu district after the opening of Rohtang pass to save time and grow early off-season vegetables to fetch premium price in the distant markets. Often, long distance transportation and transplanting shock resulted in huge economic loss to farmers. This practice of procuring the vegetable nursery from intensive vegetable growing areas of Kullu district also introduced the inoculum of some soil borne diseases like bacterial blight in the virgin soils of Lahaul valley.

Technology, Implement and Support

The KVK Lahaul & Spiti started producing nursery at its farm under protected and open conditions

since 2010. Due to heavy snowfall during winter season in the district, a ***modified design of polyhouse with wire gauge at roof under the sheet*** was standardized with the help of Department of Agricultural Engineering, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur. The ***technique of small poly tunnels*** was also introduced and demonstrated in selected farmers' fields. The KVK conducted 33 training programmes benefiting 747 farmers along with demonstrations on raising of healthy vegetable nursery for commercial vegetable crops grown in the valley. The nursery raised at KVK farm provided technical knowhow through trainings and hands-on practice to the farmers.

Uptake, Spread and Benefits

Five farmers have established vegetable nursery units as an enterprise and marketed vegetable nursery to the vegetable growers of the valley whereas 35 farmers who are producing it for their own use as well as for commercial purpose. Net returns being earned by the commercial units ranged from ₹ 1 lakh to 2.45 lakh per unit per annum.

Forty units of nurseries established in the valley have adopted the technique for raising early and healthy vegetable nursery and are able to meet about 60-70 per cent demand of nursery of different vegetable crops of the valley. Rest 30-40 per cent requirement is met by the farmers themselves through small scale nurseries for personal use. The crop failures due to transplanting shock have been minimised.

Due to availability of healthy vegetable nursery at door steps of the farmers in the district, the total area under cole crops like cauliflower, cabbage etc. has increase from mere 72 ha in 2011-12 to 650 ha in 2015-16, which includes introduction of some new exotic vegetables like red cabbage, lettuce, broccoli, etc.

Diversification to Off-Season Vegetable Production Supports Livelihood

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Situation Analysis

Kullu district of Himachal Pradesh is endowed with comparative advantage for growing various off-season vegetables, which can be an attractive proposition to engage more and more rural youth to adopt agriculture as a vocation (means of self employment). Off-season vegetables is the suitable and remunerative alternative in the event of shifting of apple cultivation to higher altitudes due to raising winter temperature.

Technology, Implementation and Support

During early nineties, awareness campaigns were initiated by KVK, Kullu to popularize the off-season vegetable cultivation with the formation of 20 Kisan clubs. Simultaneously, about 100 rural youth were trained at KVK, Kullu in collaboration with the Department of Agriculture for meeting the input requirements of off-season vegetables. KVK established a ***knowledge hub on off-season vegetable*** cultivation. State Government Departments for Agriculture, Horticulture, Animal husbandry, Mid-

Himalayan Watershed Project (Forest), Great Himalayan National Park, District Youth Services and Sports, SHGs, NGOs, etc. are seeking KVK's expertise for the diversification through off-season vegetable production. On farm testing and frontline demonstrations on various aspects of off-season vegetable cultivation were conducted involving 1430 farmers. The knowledge hub of KVK, Kullu conducted various extension activities in the district for promotion of off-season vegetable cultivation.

Activities carried out by KVK Kullu during 2012-2016

Programme/activities	Activities (No.)	Beneficiaries (No.)
Off campus training programmes	20	435
On campus training programmes	16	486
Vocational trainings on healthy nursery raising	15	351
Hands- on- practice trainings on exotic vegetables	3	95
Trainings on water management	2	75
Farmers - Scientists interaction programmes	15	375
Farm School programmes	18	450
Joint visits to the farmers fields with Extension Personnel	22	345
Exposure visit to technological parks	3	350
Organization of Exhibitions and Kisan melas	10	>25,000

Uptake, spread and benefits

KVK has assessed various technologies on off-season vegetable cultivation and also prepared technology modules based on recommendation domains for different agro-ecological situations in the district. Literature pertaining to these technologies was developed and distributed to the farmers and extension officers. Kullu Krishi Patrika, a quarterly magazine of the Krishi Vigyan Kendra, played a significant role in dissemination of aforesaid technologies. For the quality production of vegetables, availability of healthy nursery is kingpin. Therefore, KVK promoted large number of the farmers as entrepreneurs for nursery raising. Regular services are also provided to the farmers to solve their day to day problems and to monitor the progress and obtain feedback. Now, regular text messages (SMSs) are also being sent to nearly 45,600 farmers of the district for timely information and alerts. Due to KVK interventions, the adoption rate of various vegetable cultivation technologies was in the range of 65-85 per cent.

As a result of KVK efforts, there was considerable increase in area under vegetables in the district. The total area under off-season vegetables in the district has increased from 301 ha in 1995-96 to 6046 ha in 2015-16. The productivity (average) of the vegetables as a whole has also increased to 186 q/ha in 2015-16. Various vegetable cultivation technologies demonstrated by KVK Kullu have also been spread to the adjoining district Mandi. Response from a random sample of 200 farmers in the district revealed that the adoption rate of various vegetable cultivation technologies varied from 65-85 per cent. Demand for fresh vegetables in big city markets encouraged farmers to send their vegetable produce directly to Azadpur market or other parts of the country through the wholesale traders. Adoption of vegetable cultivation resulted in net annual income of the farmers in the range Rs.1.50 to 2.00 lakh from one acre of land and subsequently their standard of living has improved.

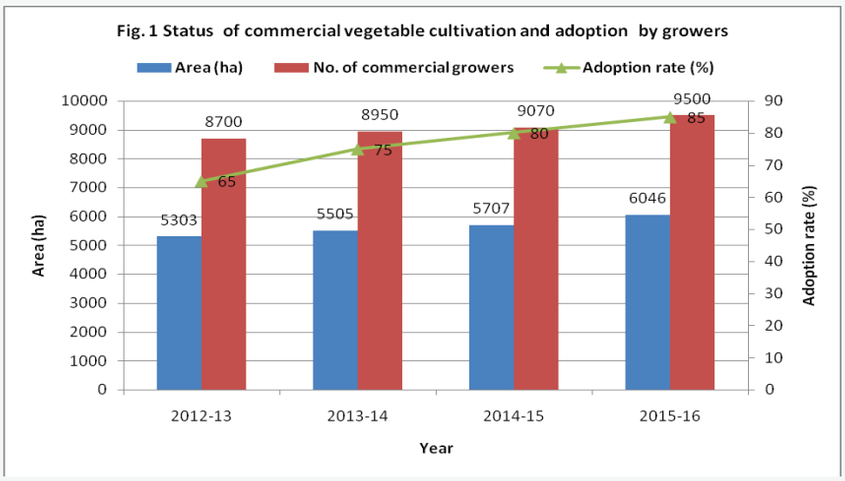
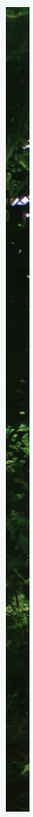


Fig. 1 Status of commercial vegetable cultivation and adoption by growers
Area (ha)
No. of commercial growers
Adoption rate (%)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Area (ha)
90
80
70
60
50
40
30
20
10
0
Adoption rate (%)
5303
8700
65
5505
8950
75
5707
9070
80
6046
9500
85
2012-13
2013-14
2014-15
2015-16
Year



Multi-tier Vegetable Cropping –Technology for Efficient Resource Utilization and Profitability

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Situation Analysis

Cultivation of vegetables was a common practice of the farmers of Nipaniya, a predominant agricultural village of Godda district of Jharkhand. But, it was confined to rainy season only as water scarcity was a major problem in the village. Sandy soil, light reddish in colour, undulated topography followed by deficient macro and micro nutrients were the characteristic features of the village. Run off loss due to heavy downpour during rainy season and erosion of soil particles due to high wind velocity during summer were the regular feature. Water table being too deep, irrigation facility could not be provided. Vegetables like sponge gourd, ridge gourd, bottle gourd and bitter gourd were mainly cultivated by the farmers' alongwith elephant foot yam as sole crop. But the profitability, particularly of elephant foot yam was very low as the local variety had high calcium oxalate content that led to less market demand.

Technology, Implementation and Support

KVK Godda while implementing National Agricultural Innovation Project of ICAR)came in touch with the village Nipaniya in the early 2009. Baseline survey conducted by the Project Implementation

Agency and problems prioritized subsequently revealed that low agricultural productivity, particularly of vegetable crops was the most important problem perceived by the villagers. To have an effective agricultural development plan, the staff of KVK discussed in detail with the villagers and concluded that the ***local varieties of vegetables and elephant foot yam need replacement with improved ones followed by cultivation of vegetables and elephant foot yam together in the same field***. The idea of multi-tier cropping system was implemented in the summer of 2009 in the village with marked difference in the yield of both crops. A bamboo and thread-based structure (Machan) was prepared when the vines of cucurbits became longer for easy climbing and spreading of cucurbit vines. The success of the idea prompted the KVK to implement multi-tier cropping system through 52 farmers of SHG formed during next year. The seeds of cucurbits and elephant foot yam were provided by the KVK to the farmers and the layout was prepared under the guidance of KVK experts. Elephant foot yam was planted at 75 x 75 cm spacing and when the plants attained height of 10 cm, ridges were prepared. On the prepared ridge, cucurbits like ridge gourd, bitter gourd and bottle gourd were sown at 1x1 meter spacing.

Uptake, Spread and Benefits

Cultivation of elephant foot yam with ridge gourd, bitter gourd and bottle gourd proved effective both in terms of enhanced productivity as well as benefit accrued to the farmers. The comparative performance d indicated that, bitter gourd and elephant foot yam was the most suitable combination. It was observed that furrow in between ridges served as drainage channel to drain out excess water, helped in better germination, reducing seedling mortality and maintaining optimum plant population. Moreover, less compactness of soil on the ridges encouraged extensive root development, well aeration and reduction in disease infestation ultimately increased yield of both the companion crops. In addition, different root systems (cucurbits being deep rooted and elephant foot yam shallow rooted) of the combination of crops helped in utilizing the soil nutrients to a great extent. The crop combinations did not produce any adverse physiological activity as well as antagonistic effect on its yield.

Yield and economics of vegetable cultivation under multi-tier cropping system

Crop	Yield of EFY (q/ha)	Yield of companion crop (q/ha)	Cost of cultivation (₹)	Gross return (₹)	Net return (₹)	BC ratio
EFY+ Ridgegourd	368.0	152	169300	580180	410880	1:3.4
EFY+ Bittergourd	373.6	148	166400	682320	515920	1:4.1
EFY+ Bottlegourd	327.4	248	173400	662716	489216	1:3.8

The multi-tier pattern provided a sort of crop insurance to the farmers. Advantages found out in this technique motivated many farmers of Nipaniya and adjoining villages to adopt this technique in their field. The performance of this technology impressed the District Collector of Godda district so much that he sanctioned 200 wells for irrigation and drinking purpose. The KVK has been assigned the task of replicating the technology in the entire district and with the spontaneous support of the farmers from various corners of the district, the KVK is striving hard to accomplish its task within short span of time.

Enhanced Livelihood Security Through Improved Jasmine Production and Collective Marketing

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Situation Analysis

Jawhar, Vikramgad, Dahanu, and Talasari talukas of Thane district of Maharashtra are dominated by tribal communities like Warli, Kokna, Malhar Koli and Katkari. These tribal families are predominantly dependent on agriculture. Low productivity of land and lack of awareness regarding modern farming practices and paucity of money for investment are the main reasons for low productivity of crops in these areas. Rabi cultivation is practically non-existent due to non-availability of irrigation facilities. Floriculture has emerged as an alternative source of livelihood for small and marginal farmers in this area over the years. The income from floriculture was very low due to fragmented landholdings and poor management practices.

Technology, Implementation and Support

The KVK, Palghar adopted Ganje Dhekale village in Palghar tehsil and demonstrated the improved jasmine cultivation model which included ***fertilizer management*** (60 : 120 : 120 g of NPK / plant during June-July & Jan.-Feb.), ***spraying of water soluble fertilizer*** (19:19:19) 4 times per year @ 0.5 % (August, September, March & April) and ***low cost drip irrigation system*** in place of flood irrigation. The

floriculture model gained quick acceptance by the tribal farmers because of low resource requirement, ease of management and good access to markets. The model includes cultivation of 200 jasmine plants on 500 sq. m (0.05 ha) of land, with an investment of Rs. 3,000. The KVK facilitated the formation of a collective called Eklavya Pushpa Utpadak Sangh in village, Ganje Dhekale. As many as 1904 tribal farmers of the village growing jasmine came together as members of the society. The produce is collected at one point in the village and transported to a wholesale dealer in Mumbai. The income so derived is distributed among members based on their contribution to the consignment.

Uptake, Spread and Benefits

The yield of jasmine went up by 34 % due to improved nutrition management and drip irrigation. A net income of ₹ 27000 was realized from 0.05 ha area (500 m^2) in this method. Collective marketing of the flowers fetched ₹ 55000-60000 annually to each member of Eklavya Pushpa Utpadak Sangh.

Influence of demonstrations on income of farmers

Interventions	Gross income (₹ /500 m^2)	Net income (₹ /500 m^2)	B:C ratio
Farmers Practice	38400	11200	1.41
Demonstration on Nutrient Management and Drip Irrigation	61680	31580	2.04

The collective marketing ensured continuity of access to markets and higher remuneration to the produce. Inputs for cultivation are also purchased collectively and distributed to the members of the society. The enhanced income levels of tribal farmers in the village got translated into higher education, improved health enhancement of civic amenities and living standards. This successful intervention spread to the entire Palghar district over years and tribal farmers are encouraged to take up floriculture as a stable livelihood option.

About 1904 farmers are now involved in floriculture as an income-generation activity in Thane district. Over the years, the farmers have collectively earned more than ₹ 2 crore from selling jasmine. Not only has this money helped improve the quality of life, education and health of the farmers but also helped them build their asset base by constructing homes and wells, buying vehicles and other agricultural implements to aid floriculture. Working in groups has improved the social interactions among farmers by developing their communication skills and also helped in developing leadership skills at the community level. Exposure to the markets in Mumbai has boosted confidence of the members who are now venturing into flower crops such as marigold, champaka, gaillardia, rose and tuberose. The formation of common interest groups and their federation at the taluka level has effectively democratized the process and brought in total transparency

Rain Water Harvesting and Micro Irrigation System Improves Livelihoods

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Situation Analysis

Kutch is the second largest district in India after Ladakh. It covers about one fourth part of the Gujarat state. Major portion of this district has arid and semiarid climate. Summer is too hot and winter is dry and cold. Monsoon is very short and irregular. Average annual rainfall in the district is only 360 mm with 13 average rainy days. Drought is very common phenomenon of the district. Salinity is the foremost problem both in soil and water. Only 12 % of total cultivated area has irrigation facilities. Cotton, castor, sesamum, groundnut, sorghum, and pearl millet are the major seasonal crops and datepalm, sapota and mango are the major horticultural crops. Major source of irrigation is bore well. The ground water is reducing day by day due to heavy withdrawal of water. Salinity in ground water is increasing rapidly due to sea water ingression. Looking to the situation, KrishiVigyan Kendra, Mundra –Kutch decided to develop and popularize rain water harvesting structure for judicious use of irrigation water. The source of irrigation water in Bhalot village is open wells. About five years ago, there were about 150 open wells in the village to serve as source of irrigation. Due to poor rainfall and lack of rainwater harvesting the water in the wells bacame very scarce. Besides, the available water could not be used judiciously due to non-adoption

of water saving methods of irrigation such as drip systems. Hence, unavailability and inefficient use of irrigation water was the main cause for the limited crop area under irrigation.

Technology, Implementation and Support

In 2011, KrishiVigyan Kendra, Mundra-Kutch started working in this village. During the PRA survey, the KVK diagnosed the situation and decided to implement rainwater harvesting interventions in the village. Small check-dams on different water streams, farm bunding, well recharging, deepening of old ponds, etc were implemented in convergence with NGOs, and District Watershed Development Unit (DWDU).

- Two small ***check dams*** were built by the KVK besides 15 smaller check dams with the support of other agencies.
- Five ***wells*** were ***recharged,*** ten old check dams were ***de-silted,*** repaired in participatory mode.
- Three ponds were desilted and water storage capacity was increased.

The KVK engaged in generation of awareness among farmers regarding efficient and proper use of water by use of drip irrigation system. Farmers were promoted and linked with subsidy of Gujarat state Government. As a result, 85 farmers adopted drip irrigation in 105 ha area.

Uptake, Spread and Benefits

As a result of KVK impetus to rainwater harvesting and judicious use of water, farmers started to dug new wells for irrigation with provision for rainwater harvesting. Presently, more than 250 open wells are fully functional and are serving farmers with irrigation to various crops. Water level in open wells has risen substantially due to rainwater conservation during good monsoon.

In spite of enough water in open wells, farmers were able to irrigate only one season crop, due to inefficient use of water. KVK has developed a model regarding efficient and proper use of water by use of drip irrigation system. The KVK provided little financial support to the farmers under NICRA project to install drip irrigation system. As a result of these activities irrigation area has increased in the village. Nearly 90 farmers have adopted drip irrigation in 105 ha area. Farmers are now able to grow more than one crop with same amount of water. Average increase in cotton yield in the village due to drip irrigation is 26%. Area covered under irrigation has doubled in the past 5 years. The following are the overall benefits of the rainwater harvesting technology adoption.

- Almost 42 open wells were added within last two years.
- Ground water level has been raised by 3 to 6 meter.
- Water in 5 open wells overflows during monsoon.
- Farmers were earlier giving only two to three irrigations to crops during kharif season. Majority of farmers in the village have switched over to drip irrigation system.
- Earlier, pre monsoon sowing of Bt. cotton was not possible because of less quantity of water in open well. But during 2014-15, 65 farmers could grow Bt. cotton in 80 ha area before monsoon.
- Total 148 ha area under irrigation is increased due to different rain water harvesting work and efficient use of irrigation water. Area under castor (62 ha) and Bt. cotton (81 ha) increased after adoption of drip irrigation.

- Total rainfall during 2014-15 was very less (375 mm). It was 145 mm less as compared to average annual rainfall of last decade of the district. Irrigation water in open well was very less. Inspite of this, farmers successfully grew Bt. cotton in 42 ha area, castor in 23 ha area and vegetable in 6 ha area. Those farmers who have no drip system could not successfully produce castor crop, 14 farmers could grow fodder crop even in Summer 2015. Three farmers have grown pomegranate under drip irrigation. Earlier, there was not a single farmer who adopted fruit crop plantation.

- Additional 247 ha area (from 355 ha to 602 ha) was brought under irrigation, mainly due to rain water harvesting work. Value of crop produced from additional 247 ha is about ₹ 148 lakh in the village which increased due to Rain Water Harvesting Work. Additional 1550 q cotton & castor yield, worth ₹ 62 lakh obtained due to expanded area under irrigation.

- Bt. Cotton yield was increased by 25% in last 2 years due to drip irrigation. From 80 ha area of Bt. Cotton under drip irrigation during 2014-15, additional 480 q cotton worth ₹ 19.2 lakh realized. Cotton yield increased by 5900 kg /ha under drip as compared to without drip system resulting in ₹ 22000 additional income per ha.

- Thus, annual income of the village farmers has been increased by ₹ 81.20 lakh from only cotton & castor crop due to drip irrigation. Cost of labour reduced by 50% leading to saving of ₹ 4500 per ha. Thus, total economic gain per ha was ₹ 26500.

- The success and impact of rainwater harvesting combined with micro irrigation system in the village has motivated the farmers of surrounding villages Lifra, Bagada, Waghura, Fachariya to adopt drip irrigation in over 300 ha area.

Land Shaping/Ail Cultivation for Enhanced Profitability and Nutritional Security

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Situation Analysis

Ail is the land embankment, which is made to demarcate a given land. This demarcation is made to identify the land with individual ownership. Traditionally, the width and height of this *Ail* remain upto 40 cm and 30 cm respectively. In Sundarbans, it is usually noticed that the depth of water on the low land become 2½ ft. to 3 ft. during rainy season. Only long duration traditional paddy is grown in the low land situation keeping the *Ail* barren. During rainy season, no vegetable crops cultivation is possible in this land and as the optimum moisture condition of the soil comes in too late, it is also not possible to grow any vegetable crop during winter season. Besides, source of sweet water for irrigation is minimum to irrigate the winter vegetables. Under this situation, *Ail* can be put into productive use through cultivation of vegetable crops.

Technology, Implementation and Support

KVK conceptualized and modified the width and height of this *Ails* upto that level where vegetables can be grown both in rainy and winter seasons. To overcome the inundation problem during rainy season, the height of the *Ail* was raised upto 1 meter, keeping the low land paddy field aside. The width of the top of the *Ail*

is made 90 cm where base remains 150 cm. The transverse section of this modified land embankment would be like a trapezium, which is required for strengthening the structure.

To make a raised land embankment along the circumference of 1 ha (10,000 sq. meter) land, having 400 running meter *Ail*, it requires 480 cubic meter soil. This volume of soil is collected by making a trench all along the *Ail* or by digging a small sized pond of about 24 meter length, 10 meter width and 2 meter depth within the paddy field itself. The trench so developed is utilized for harvesting of rain water for life saving irrigation of the vegetable crops grown on the Ail during winter season. The pond excavated within the paddy field for construction of *Ail* can also be used for pisci culture. As paddy-cum- fish culture is a popular practice here, the fish takes shelter in that pond when the water of the paddy field becomes insufficient or dry up. During rainy season, as the height of the *Ail* is more than that of the existing field, there is no chance of damaging the vegetable crops on *Ail* by submersion. In this way, the *Ail* can be developed in any land irrespective of its size and high value vegetables can be grown throughout the year. Once a raised *Ail* is developed, it lasts for about 8-10 years without incurring additional expenditure to a great extent and only periodical repairing of the structure is required as and when necessary.

Cultivation on the land embankment *(Ail)* starts from the month of June each year just before the onset of monsoon. During rainy season, crops like okra, bitter gourd etc. and during winter season tomato, french bean etc. are cultivated on the land embankment. The land preparation starts from the second week to last week of May. After digging the soil with spade, well decomposed manure mainly FYM is applied into the soil. Weeding, if needed, is done before the preparation of the soil. Then two rows of pits are made along the length of the *Ail.* The rows are made 60 cm apart from each other and the pit to pit distance varies according to the crop to be grown. Normally, 15 cm space is left on the both outer sides of the rows. The soil of each pit is mixed with *Trichoderma viridi* or *T.harzianum* and *Pseudomonas fluorescens* @10 g each per 1 kg organic manure.

Neem cake @ 25 g per pit is used along with the organic manure. Then the water soaked seeds or germinated seeds are sown in the pit @ 2 to 3 seeds/pit depending upon the crop varieties. After sowing, the pits are covered with straw or other biomass to keep the underneath soil cool and moist. Generally, in the rainy season, no irrigation is required for crop growth, development and production. Little life-saving irrigation, in the event of long rainless period is given in the initial phases of crop stand. During winter season, bucket or can irrigation is provided using the rain water so harvested in the trench aside the *Ail.* Even, non saline pond water from the pond so excavated within the paddy field is also taken using mud pitcher or metallic bucket to irrigate the crop particularly in the critical stages of crop growth. The trellis are required to provide support to the crops like french bean and bitter gourd and these vertical trellis are made upto the height of 150 cm to 200 cm. Two rows of vertical trellis along the crop rows are installed. To strengthen the structure, bamboo is used as vertical pole and G.I. wire are tied with the poles at two to three parallel horizontal levels. Jute string is also used for providing the support to the plant to climb upwards.

Training programs, demonstrations and field days were organized for the farmers so that the technology is being adopted as conceptualized and other farmers are also motivated on seeing the performance of the technology.

Uptake, Spread and Benefits

The technology of *Ail* and Aerial cultivation was first conceptualized by KVK in the year 1997-98 after the innovation of land shaping technology in the year 1981-82. The on-station trial on *Ail* and Aerial cultivation was set up in the KVK Instructional Farm and observing its remarkable additional income generating potential, these technologies were demonstrated in two villages under Jaynagar-II block in the year 2000-01. Within a span of 5-years, most of the farmers of South 24-Parganas district realized the benefit of this technology and adopted it on their own, knowing the technicalities from the KVK and even from the KVK adopted Farm Science Clubs. In the first year of adoption (2001-02), the total length of *Ail* under vegetable cultivation was around 5 km which presently extrapolated to most of the blocks of South 24 Parganas district having a length of more than 500 km. Seeing the rapid change of economy, *Ail* and Aerial cultivation technologies have not only spread in South 24-Parganas district but also it spread to the neighboring district like North 24-Parganas having more or less same type of agro-ecological condition. The State Agriculture Department has included this technology as a component of Natural Resource Management of NWDPRA (National Watershed Development Programme for Rainfed Area) programme implemented in these districts, which further giving boost to the technology adoption.

The *Ail* and Aerial cultivation technologies developed by KVK, South 24-Parganas have created an immense impact for augmenting the vegetable production throughout the year particularly in the lean period. This sustainable technology has not only increased the productivity of vegetables but also improved the standard of living of small and marginal farmers by increasing their income per unit area. A very rapid horizontal percolation of this technology has been observed as compared to other contemporary technology in South 24-Parganas district as well as neighboring districts.

It has been observed that from one hectare of land, at least 400 meter long *Ail* is obtained having the width of 90 cm at the top. The main field is engaged with paddy during rainy season and the *Ail* land is utilized for cultivation of vegetables which fetches good market price and hence augmenting the economic status of a small fragmented holding viz. i) mega-economics of the monsoon paddy which is less remunerative and often threatened by the natural calamity and ii) micro economics from the *Ail* which many times become more viable than mega economy. In the traditional system, 120 m^2 of land is utilized for construction of *Ail* whereas in the modified system of *Ail* cultivation, additional 280 m^2 of land is utilized on the main field.

Success Story on Cultivation of Oyster Mushroom

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Situation Analysis

West Khasi Hills is endowed with rich heritage of natural resources and wide range of climatic conditions. Farmers take up different allied activities apart from farming for boosting their family income. Mushrooms play an important role in the rural livelihood as different species of wild mushrooms are available in deep jungles of West Khasi Hills. Farm women collect seasonal mushrooms grown wild in the jungle during lean period for family nutrition and income. The availability of these wild mushrooms is limited only for few months in a year. Further, with recent incidents of wild mushroom poisoning in different parts of Meghalaya, collection and consumption of wild grown mushroom is at stake for farming community. Climatic conditions of West Khasi Hills is found suitable for growing oyster mushroom as it requires a temperature of 25^0C -28^0C for the growth and fruiting. Oyster mushroom can be grown throughout the year but the best season is April to November in West Khasi Hills. Though fruiting is achieved during winter and rainy days, quality and production is little less as compared to summer season. Deficient in diffused sunlight may be one of the many factors for less production during rainy days and winter season.

Technology, Implementation and Support

In order to promote the cultivable species of mushroom which is safe and rich in nutrition, Krishi

Vigyan Kendra, West Khasi Hills has identified oyster mushroom cultivation as a thrust area. Oyster mushroom cultivation was first introduced in Tengri village, West Khasi Hills, Meghalaya by KVK West Khasi Hills during 2013-14. Awareness programme was conducted on the importance and nutritional benefits of mushrooms. Laitreilang Self Help Group (SHG), consisting 12 women members, actively participated in the programmes conducted by KVK. On farm testing was conducted in the village to test the suitability of the technology of growing oyster mushroom in Tengri village. Frontline demonstrations were conducted in the village which ***included selection of healthy paddy straw, procurement of healthy spawn, cultivation technology of oyster mushroom, pest and disease management.*** Need based trainings were conducted on after-care management, pest and disease management. Among all the participants Smt. Billinda Syiemlieh, a progressive farmer from Tengri village adopted the technology and started cultivation immediately. Mushroom spawns were regularly supplied by KVK West Khasi Hills from Division of Plant Pathology, ICAR for NEH Region, Umiam.

Uptake, Spread and Benefits

Smt. Billinda Syiemlieh started mushroom cultivation with 50 mushroom beds which yielded 90 kg of fresh mushrooms in 45 days. The effort gave a gross return of ₹ 13500 and net return of ₹ 4100. From second year onwards, she expanded her cultivation area by building two more low cost cropping houses. Availability of mushroom spawn was the major constraint in mushroom production at farmer's field.

KVK West Khasi Hills taught her low cost spawn multiplication technique. Low cost materials were provided to her in one corner of her house. Basic materials required for low cost multiplication *viz.* inoculation chamber made of plywood, candles, inoculating needles and thermocol box for incubation were provided. The multiplication unit was kept in aseptic conditions with time to time cleaning with ethanol. Mother spawn of oyster mushroom was procured from Division of Plant Pathology, ICAR, Umiam for multiplication. She started spawn production in her own multiplication unit. She could produce 270 packets of good commercial spawn, which was supplied to 10 new small-scale mushroom growers, through which she could earn an additional income of ₹ 13500.

Diversifying successfully from mushroom production, Smt. Billinda Syiemlieh became a role model for other farmers. Many farmers got exposure to her experiences as well as participating in trainings and programmes conducted by KVK. Now the technology has spread to eight villages namely- Nongshillong, Sohphriah, Mawlangkhar, Pyndengumiong, Diengsiang, Mawkyrwat, Mawphanniew and Nongstoin in the district covering 30 numbers of mushroom growers in the district. On an average 180 to 200 kgs of fresh mushrooms are being produced in one cycle consisting of 40-50 days of cropping period from 80-100 mushroom beds. Net return of ₹ 4500 to 5000 is being profited by the mushroom growers depending on the number of spawn quality and number of mushroom beds.

Farmers expressed about the good returns from mushroom especially during lean farming season. Farm women admitted their productive utilization of leisure time which otherwise they spend by chitchatting with other folks in the evening. They also quoted that by working just two hours in the evening for two three days, they can harvest 8 to 10 times up to 180 to 200 kg of fresh mushrooms in a period of 45 to 50 days. The present market price of oyster mushroom is ₹ 150 to 200/kg depending on the quality of

fresh mushroom. They expressed their happiness and gratitude to KVK West Khasi Hills for introducing the technology in the District which has given them extra income. Farmers have realized that it is more convenient and remunerative to grow at home throughout the year rather than collecting wild seasonal mushroom from the jungle. Quality spawn, good weather conditions, aseptic cropping room and after care are the various criteria for boosting up mushroom production.

Cost of production of oyster mushroom and return from one unit

Cost of production for 100 beds	Mushroom production	Gross return ₹	Net return ₹	B:C ratio
14945	243 kgs	35100	20155	2.3

Production and Up-scaling of Fodder Promotes Entrepreneurship

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Situation Analysis

The main economy of Ramanagara district is agriculture which depends upon rainfall. It is categorized under Zone-5 of Agro-climatic zones of Karnataka. The temperature prevailing is 14^{O}C (min) to 40^{O}C (max). The district receives annual rainfall of 854 mm. The district is spread over an area of 3.56 lakh ha with 2.60 lakh households. The district has a gross cropped area of 169722 ha (47.69% of total geographical area) out of which net sown area is 164955 ha. The district has gross irrigated area of 36172 ha (26.08 per cent of total cropped area). The total number of agriculture farm families in the district is 271448 among which small and marginal farm families constitute 250649 (92.34%). Apart from agriculture, the allied activities are dairy, sheep and goat rearing. Sericulture is most enterprising activity carried by most of the farmers in the district. The total population of livestock in the Ramanagara district is 695178 which include cattle, buffalo, sheep and goat. Most of the livestock farmers meet their green fodder requirements through fodder maize or local napier grass grown in small area apart from cereal based straw. During the year 2016-17 the availability of green fodder was only 10864 t that would not suffice the requirement of huge livestock population in the district. The main fodder crops grown in the district are annual fodder maize and Bangalore hybrid Napier grass (BN-21). Fodder maize being single cut yields 90 t/ha/year and requires land preparation and sowing every time that incurs high cost of cultivation. Low yielding, less palatable and non-availability of the green fodder throughout the

year is a common scenario in the district leading to fodder scarcity. Existence of congenial climatic conditions for livestock farming and scope for enhancing the productivity of fodder crops is a boon for the farmers of the district.

Technology, Implementation and Support

Krishi Vigyan Kendra, Ramanagara implemented various extension programs to increase the availability of planting materials and green fodder throughout the year apart from providing technical back stopping to increase fodder production in the district. Since inception many extension activities on promotion of fodder crops were carried out. The demonstration in farmer's field was strengthened by conducting following various capacity building programs and other educational activities.

Uptake, Spread and Benefits

Apart from numerous extension activities, on farm trials and demonstrations conducted during 2013-16 indicated that DHN-6 variety was most acceptable by the farmers for its luxurious growth, high palatability, availability of green fodder throughout the year and its good effect on health of milch animals. To meet the demand of fodder cuttings and to curtail the transportation charges, six farmers in the district were identified and participatory seed production was taken up. These farmers sell the fodder cuttings @ ₹ 1/ per stem cutting to the needy farmers. Similarly the other farmers who have resorted to fodder seed production were of the opinion that venturing into the activity has helped them to earn an additional income which has its own economic benefits. The preference of fodder specially DHN-6 for its flourishing green colour coupled with abundant foliage, easy to harvest as it is non pubescence, highly palatable and most preferred by the cattle, high yield (220 tons/ha /year) made the farmers happy about its performance. Apart from its high yielding and other quality parameters, DHN-6 fodder has ample quantity of proteins, fats, carbohydrates and minerals. High moisture content in green fodder makes digestion easy. The extension activities of KVK resulted in covering an increase in the area by 31 ha and an average increase in milk yield of 0.25 to 0.5 lt/day.

Production and impact on up-scaling of fodder crops

Particulars	Numbers
Farmers trained	1344
Farmers participated in field days	186
Slips produced (KVK + Farmers) (No.)	425000
Slips outsourced to other district (No.)	35000
Farmers to whom slips were sold (No.)	1820
Exposure visits conducted (No.)	6
Area covered in dist (ha)	32
Average increase in milk yield / day (lt)	0.25-0.50
Total Income generated by farmer (₹ /year)	30000
Total Income generated at KVK	425000

Implementation of various extension activities by Krishi Vigyan Kendra supported well in the dissemination of skill and knowledge of new fodder variety DHN-6. Results indicated that DHN-6 variety was most acceptable by the farmers for its quality and quantity parameters. The efforts of KVK in conducting on-farm testing, frontline demonstrations and several educational activities paved way for technology up-scaling. However, from the perspective point and for further up-scaling of the technology, there is a need for educative efforts from milk union and line departments in sensitizing the milk producers and ensuring the availability of improved fodder varieties.

Silage Makes Dairy Farming Sustainable

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Situation Analysis

Village Nirmal Pimpri in Ahmednagar district of Maharashtra is largely supported by rainfed agriculture (90 per cent area). Dairy is the only source of sustainable income for livelihood security of the villagers, as the rainfall in recent years has been more erratic. There are 1177 farm families in the village and cattle population is 2500 (95% cross-bred cows). Farmers are unable to cultivate annual or perennial fodder crops due to water scarcity. Seasonal fodder crops such as sorghum and maize are grown with limited water because of availability of green fodder for a limited period of the year (up to December). As a result, farmers were forced to purchase green fodder like lucerne, maize from neighboring villages at higher cost leading to higher cost of milk production. Those farmers who were unable to afford purchase of fodder from elsewhere fed only dry fodder (crop residue) to their dairy animals which affected milk production.

Technology, Implementation and Support

To supplement the feed and fodder availability during lean seasons, the practice of silage was introduced by KVK in Nirmal Pimpri during the year 2012-13 through well designed training programs. Initially pit method of silage was demonstrated to 10 famers, but due to difficulties like

higher cost of digging the pit, chances of fungal infection due to rainwater and other sources, the KVK introduced polythene silage bag for the first time in the village. Thirty bags of silage were prepared covering 19 farmers. This silage was used during summer when green fodder was not available. To promote adoption of technology, KVK organized exposure visits, group meeting, field days and made available the polythene silage bags at KVK Farmers Service Centre. The KVK supplied 2500 silage bags to more than 800 farmers including those from neighboring villages.

Uptake, Spread and Benefits

The practice of feeding silage improved the animal health, increased the milk production and reduced the cost of fodder. These positive gains encouraged farmers to adopt silage as evident by the fact that during 2014-15, 189 farmers of village Nirmal Pimpri started silage making. Out of them, 182 farmers filled 323 silage bags and prepared 194 t silage. Four farmers adopted pit method and prepared 37 t silage while three farmers used tower method and prepared 30 t silage. Altogether, 431.6 t silage met the fodder requirement of 267 animals for 3 months (scarcity period) and saved ₹ 1.73 lakh on green fodder.

Economics of silage compared to purchased green fodder

	Milk production (Litre/animal/day)		Fat %		Price (₹ / litre)	
	Silage	**Normal**	**Silage**	**Normal**	**Silage**	**Normal**
2012-13	11.86	11.60	3.72	3.50	23.90	23.20
2013-14	11.75	11.40	3.79	3.57	24.10	23.40
2014-15	14.67	13.96	3.78	3.55	22.60	21.80

Three farmers also took up silage as an enterprise. They prepare silage in bags and sell @ ₹ 5 /kg to the farmers. More than 1000 bags were sold during last year. State Animal Husbandry Department and ATMA also promoted this technology and extended subsidy for preparation of silage. Co-operative and private dairy of the districts also promoted the silage by providing silage bags at subsidized rates.

Empowering Women in Dairy Enterprise Through Self Help Group

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Situation Analysis

Jaipur District in Rajasthan has a total population of 38,87,900. Women constitute 43.9% of agricultural labourers. Though agriculture is main occupation for majority of the people in the district, because of rainfed farming and limited irrigation facilities, agriculture alone could not meet their requirements, which forced them to go in for a subsidiary occupation like milk production. With milk chilling and storage facility available all over the district, dairy is proving as a profitable enterprise in Jaipur, Rajasthan.

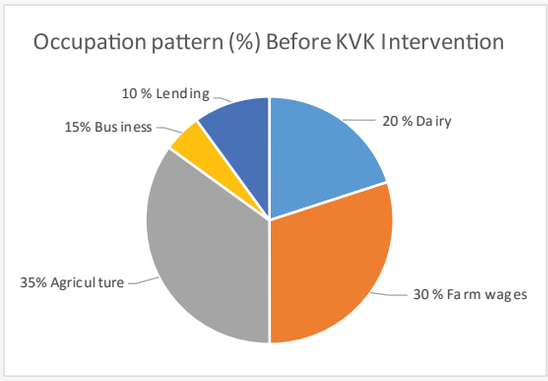
Technology, Implementation and Support

Initially two mandals i.e. Sandersar & Ginoi were identified for the implementation of scientific dairy farming. Total number of villages covered in these two mandals were 120. In these villages, group discussions were held to acquaint the livestock farmers with the details of the plan of programme implementation. The survey carried out in the villages indicated dairy to be a profitable enterprise and it was felt that group activities and income generating activities like dairying be highly useful and viable propositions. Established linkage with private dairies, established Milk Collection Center, formed SHGs,

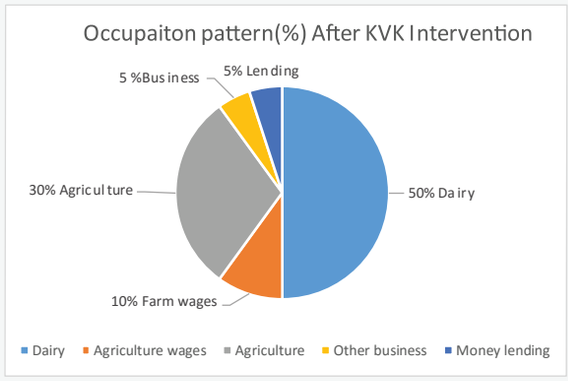
imparted training on management techniques for handling of cross bred animals and motivated for dairy enterprise. KVK trained women in preparing feed concentrate at home using locally available ingredients like wheat bran, oilseed cakes etc. in proper proportion depending on the requirement of animals. Every year KVK, with support of the other organization, arranged vaccination camps where diagnosis of repeat breeding cases and treatment of various ailments were taken up.

Uptake, Spread and Benefits

Before intervention of the dairy programmes, women were spending 30% of their time as agriculture labour. After the implementation of the programme, 50% of their time was devoted to dairying. The income raised through dairy was higher as compared to agriculture based activities. The details of income & expenditure are shown in figures below :-



BEFORE



AFTER

Before the implementation of the dairy programmes, the annual income of the partner women was low (about ₹ 12000). Consequently, utilization of the amount towards different activities like food, social functions, clothing, health and education was also low (10-15%). However, after the implementation of the project the annual income level has increased (₹ 14,000 – 15,000). Hence, utilization of money towards different activities like food, health, education, creation of asset, saving etc. also improved considerably (15-25%).

Before the intervention of the dairy activity, the partner women utilized most of the money for the agriculture and household activities. After the intervention of the programme merely 35% of the money spent was on dairy activities, 35% on agriculture activities, 10% for labour activities and remaining for household activities .

The economic empowerment of rural women through dairy sector based on group approach has been emphaisised with concerted efforts of KVK Jaipur-I and active involvement of farm women. The major impact of these activities is increased milk yield (1.15 liter/animal/day) with the help of azolla (2.0 kg/day) and chelated mineral mixture (60 gm/day) given to the animals. They got additional 200 litres milk in 300 milking days per animal. In this way, increased their income by ₹ 6000/lactation/animal and changed their social and economic conditions.

Rural Entrepreneurs Benefit from Scientific Pig Farming

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Situation Analysis

Kodagu is a mountainous district, with an altitude of 1525 M above MSL and an average annual rainfall of 2800 mm. It consists of three taluks with an area of 4100 sq. kms and a population of 5.56 lakhs. The agriculture scenario of the district consists of coffee based cropping system. viz. coffee + black pepper + cardamom and paddy. Among the animal husbandry enterprises, piggery is the main activity practiced in the districtdue to local consumer preference.Piggery farming scenario in Kodagu district was dominated by local breeds of pigs which are slow in growth with low feed conversion ratio. The maintenance of piggery unit is highly skilled and labour intensive enterprise. Only farmers with good entrepreneurial skills could succeed in this enterprise. Average adult body weight of these local pigs is around 50-60 kgs. The main problems faced by the farmers in pig farming were poor body growth, low litter size, early piglet mortality and death due to unscientific castration of male piglets.

Technology, Implementation and Support:

KVK, Gonikoppal, Kodaguconducted a number of field surveys, group discussions to identify the technological gaps and accordingly KVK planned various activities from 2005-06. KVK established Duroc

and Yorkshire piggery demonstration farms. The KVK planned and conducted various interventions like vocational training programmes, method demonstrations, field days and FFS programmes on scientific pig farming. On farm testing, frontline demonstration and Farmers Field School (FFS) were conducted on ***Duroc and Yorkshire breeds and their management practices.*** Duroc breed was found to be more preferred by the farmers as there was good market and demand for its meat. This is because the Duroc meat is lean with low body fat content, tender and also its dark brown body colour is most preferred by the people.

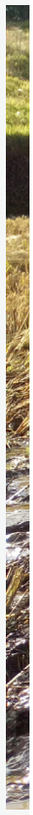
Duroc and Yorkshire male piglets were produced and supplied to 718 farmers, some as pure farms and some for the upgradation of the local pigs. Exotic pig breed farms with Duroc and Yorkshire pigs were also supported in the selected farmer's units to meet the demand of quality piglets production and distributing them among the farmers of the district. Piglets produced are now being sold to the neighbouring farmers, members of Self Help Groups and also to the farmers from neighbouring districts.

Uptake, Spread and Benefits

Management practices introduced by the KVK resulted in reducing the incidences of early piglet mortality and foot rot problems. All the 718 farmers are utilising the advisory services from both KVK and state animal husbandry department on animal health management. Farmers have adopted the correct way of waste food feeding (hotel, hostel, vegetables, chicken stall waste etc) to the pigs after boiling by adding lime and salt to check any toxicity on animals. Approximately about 5-8 kg of waste and 0.5 kg of balanced piggery feed are fed to the pigs for their optimum growth. Farmers could save on the feed cost and were able to get more profit compared to other livestock enterprises. The Duroc piglets produced were sold among the farmers @ Rs. 3000-4000 per piglet of 2-3 month old.

Some of the farmers were able to construct good piggery sheds with concrete floor, roof with tiles leading to hygienic practices and regular care of the animals which is the key success in maintaining the good health of the herd. The shed washes were collected in nearby pits and allowed to decompose for a year, later pumped as organic manure to coffee and paddy production. The piggery enterprise has changed socio-economic status of many piggery farmers in ten years. Better economic status made them to provide better education to their children.

The KVK is utilizing the vast practical experience of the successful farmers and farm women during the farmers training, seminars and melas for the benefit of farming community in the district and neighbouring districts. Mrs.Suchitra Surendra of Kannangala village, Virajpet Taluk and Mrs.Jyothi Ganesh, AthurHarangi Village, Somwarpet Taluk, have become role models for aspiring farmwomen entrepreneurs in the district. Mrs.Suchitra Surendra, Kannangala village got 'Best Woman Piggery Entrepreneur' from the University of Agricultural Sciences (UAS), Bengaluru.



Success story on Rice-Fish Culture

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Situation Analysis

West Khasi Hills district lies in the central part of the state of Meghalaya. The climate of the district is mildly tropical in the northern and southern foothills, while in the central upland zone, the climate is temperate and places at medium altitude in the northern, western and southern parts of the district, experience sub-tropical climate. The district is influenced by the South-West monsoon and the average rainfall ranges from 1200 mm to 3000 mm per annum. Rice is one of the major crops and staple food which is grown in a wide range of climatic conditions. In recent years, many farmers showed keen interest in fish culture and hence, construction of ponds came up in many feasible areas. There are also farmers who convert their productive paddy fields into fish ponds. But, there is no improvement in terms of productivity and profitability due to poor management, lack of technical knowhow and inadequate fish feed management. Scientific integration of fish and rice has the potential to help poor small farmers by reducing input cost and better utilization of natural resources.

Technology, Implementation and Support

To encourage the small farmers to go for integration of fish in paddy fields, frontline demonstration (FLD) on integrated rice-fish farming was conducted by the KVK at Mawthungkper near Nonglwai

village. Smt. Sketina Kharbani, a progressive farmer from the district modified the field by digging canals/ trenches of 0.5 - 0.6 m deep and 1 m wide connecting (intersect) to the small central sump in the middle of the field. Elevated dykes installed with protected inlet and outlet and fencing with netting material was also done at the lower part of the field to prevent fish from escaping during heavy rains. After two weeks of transplantation of local rice variety (balwai), fingerlings of common carp (main species), silver carp, gonius, etc are stocked @ 6000/ha. Minimal feed was given with rice bran and mustard oil cake in the ratio of 1:1. Liming and manuring was also done regularly.

Uptake, Spread and Benefits

Before intervention, the yield of paddy was about 15 q/ha but after intervention, the yield of paddy enhanced to 20 q/ha and what is more interesting, she also got fish from the same plot. The yield of fish from the paddy field was 500 kg/ha. According to her, this technology is very simple and low cost with high economic return. The increase in rice production is also a result of stocking fish (common carp as the main species) as a component of integrated pest management. As most of the farmers are small holders, this kind of technology helps the farmers to effectively manage and utilize the land.

Plant protection measures using the traditional methods were labour intensive and increased the cost of production. Integration of fish in the same paddy field avoided the use of tobacco as organic pesticides and pine as repellent for insects. The cost of cultivation was reduced by ₹ 2400 – ₹ 3000 per 1000 m^2. Based on the result of field trial conducted at different villages, economics of this system for 1 ha of paddy field having different form and size of trenches (Average: 0.5 m deep and 1 m wide) with common carp as the main species gave a net profit of ₹ 70315.

Economics of rice-fish culture

Crops	Area	Production	Gross expenditure (₹)	Gross income (₹)	Net income (₹)	B:C ratio
Fish	1 ha	500 kg	74685	145000	70315	1.9
Paddy		20 q				

Rice-fish culture is gaining acceptance in many villages because of the simplicity of the technology and improved production. But there are also difficulties because many paddy fields are not feasible for fish integration due to the hilly terrain that restricts the size of the field. Following the success at Mawthungkper village, this technology has spread to Sohparu, Diengsyiang, Mawkynbat, Mawlangkhar, Lawrapha, Nongkasen, Mawlangren villages in which 15 farmers from these villages are practicing the technology in their paddy fields. There are also other farmers from different villages that are eager to adopt the technology and seek technical guidance from the KVK.

Apart from the demonstrations that are implemented by the KVK, the office of the Deputy Commissioner, West Khasi Hills is in its initial stage of implementing the technology of rice-fish culture on a large scale through the Block Development Officer of Nongstoin, Mawshynrut, Mawthadraishan and Mairang covering most of the villages of West Khasi Hills. KVK, West Khasi Hills is providing the technical assistance.

Drudgery Reduction Tools Improved Health of Women Farm Labourers

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Situation Analysis

Cotton and vegetable picking/plucking is a tedious job with considerable drudgery exclusively handled by women laborers. Fatehabad of Haryana is a predominantly cotton growing district. Women in the region face severe health hazards due to cotton and vegetable picking. Okra picking led to problems of hand injury, cuts and blisters, wounds and skin allergies. In cotton plucking, women faced problems of pain in shoulder and hands and experience a lot of fatigue. Drudgery reducing technology for specific operations for the farm women engaged in cotton and vegetable picking/plucking was a felt need of the region. Protective gloves protect the worker from dust, chemical sprays etc. Body part discomfort analysis in agricultural operations by farm women, indicated that maximum discomfort score was found in right palm followed by lower back (3.44) and neck (3.42). Minimum discomfort was found in left elbow (1.14) and right elbow (1.58). It is concluded from the results that in vegetable picking, farm women face very severe to moderate discomfort in some of the body parts like right palm, left palm, neck and right shoulder. To minimize body discomfort, there is a need to provide them ergonomic intervention in the form of protective gloves, picking bag and capron while picking vegetables.

Technology, Implement and Support

Recommended and specifically designed protective garments developed by CCS HAU, Hisar were demonstrated by KVK Fatehabad in different villages in the region. The pick bag is used for picking and collecting cotton as well as vegetables. It is made of cotton cloth and designed as per the anthropometric measurements of women. Shaped pockets are provided in the front and below the waist line, which makes it user friendly. Cushioned belts avoid strain on shoulder, hand and neck. It thus reduces the drudgery while picking the vegetables and cotton. ***Cotton bag, protective gloves, bhindi picking bag, capron were the protective tools*** promoted by the KVK through various activities listed below.

Activities carried out by KVK, Fatehabad regarding drudgery reduction of women during 2012-2016

Programme/activities	Number	Beneficiaries
Field Days	04	400
Labour day celebration	04	380
Frontline demonstration	100	2000
Organization of Exhibitions and Kisan melas	2	800
Farmers scientists- Interaction programmes	4	80
Vocational trainings on garment construction	20	600

Uptake, Spread and Benefits

Very few farm women experienced strain on shoulder using improved bags (6.25 % as against 90 % in conventional bags), pain in hand (only 15.0 %) and back (only 15.0 %). None of the respondents reported pain in neck and wrist. Harvesting efficiency increased as 97.5 per cent of the respondents took less than an hour for a single loading in improved bags whereas, only 12.5 % could do that in conventional bags. Capacity of cotton picking has gone up to 72 kg/person/day with the use of developed cotton picking bag, as compared to 50kg/person/day with the conventional bag. Moreover, every individual's earning per day have increased by 44 per cent due to the intervention. With the conventional method more than 75 per cent of the respondents have experienced injuries, blisters etc.; even less than seven per cent using protective gloves have acknowledged occurrence of any such incidence. Moreover, none had faced any kind of cuts or wound using protective gloves. Further, the capacity of okra picking has gone up to 50kg/person/day with the protective gloves, as compared to 35kg/person/day with the conventional method. Moreover, every individual's earning per day increased by 42.5 per cent due to the intervention. The overall adoption feasibility index of 89% for the drudgery reduction technologies shows a very high acceptability of the technology among farm women. The farmers involved in vegetable cultivation as well as cotton picking have positive attitude towards the improved technology. They have realised that the technology has improved their efficiency and economic returns. This has resulted in increased adoption of the protective tools.

Nutritional Garden Saves Money for Schools

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Situation Analysis

To fulfill the nutrient requirement of farm families KVK scientists designed ideal nutritional (kitchen) garden which included vegetables and fruits like banana, papaya and drumstick etc to fulfill the daily requirement of family. Kitchen garden is an ancient method but not a commercial method. On an average 300 sqm space is sufficient for kitchen garden to meet out the daily vegetable requirement of 5 to 6 members family.

Technology, Implementation and Support

KVK scientists designed ideal nutritional garden and it was first tested at KVK farm then trainings, field day and demonstrations were organized at KVK farm for farmers, extension workers and hostel warden and principal of schools. The technology encompassing cropping pattern ***seeds of improved varieties, nursery raising, planting methods, vermicomposting, drip irrigation,*** was replicated in 15 farmers fields who were interested to established nutritional garden. The District Collector appreciated this work and provided funds @ ₹ 10000 per nutritional garden to KVK for further replication. The 40

Ashram schools of Antagarh block were selected for replication, with an objective to make available fresh vegetables to students in mid day meal and dinner (in Ashram schools). KVK scientists provided technical knowledge and quality seeds and time to time advise on plant protection aspects. The warden of Ashram school started growing of vegetables and fruits in the backyard of Ashram. They were also maintaining daily record of production.

Uptake, Spread and Benefits

Established nutritional garden in 40 schools of Antagarh block, in some of the nutritional gardens, drip system was introduced. For control of insect pests, mechanical and organic control measures were demonstrated and trained the hostel warden and students. Besides seasonal vegetables, perennial vegetables like jackfruit, drum steak, and fruits including papaya, banana and guava were also planted which provided regular fruits and vegetables to the students.

Establishment of kitchen garden in schools of Antagarh block led to saving an amount of ₹ 12000 per school in six months. The nutritional requirements of school children was fulfilled round the year with seasonal vegetables and fruits from nutritional (kitchen) garden.

On an average, each school harvested bottle gourd (170 kg), pumpkin (143 kg), cowpea (36 kg), brinjal (93 kg), okra (33 kg), bittergourd (38 kg), tomato (62 kg), cluster beans (9 kg), lablab (22 kg), and leafy vegetables (28 kg) in six months.

Empowering Women Through Small Scale Entrepreneurship

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Situation Analysis

Kangra district of Himachal Pradesh lies in the lap of north-western Himalayas and endowed with great variation in agro-climatic conditions. Due to lack of job opportunities on farms during the lean period, the women devote their time in preparing traditional local products from farm produce viz. pickles, nuggets (barian), vermicelli (sevian), seera , cheese etc. for their own families. But most of these women enterprises usually survive for a year or two as the products prepared have limited self life and lacked in market competitiveness. Lack of scientific preservation techniques and limited awareness about the financial facility and inadequate knowledge of various government/non-government schemes promoting the entrepreneurship were the major hurdles.

Technology, Implementation and Support

Lakshmi Self Help Group in village Shahpur, Kangra was formed by the department of agriculture, which consisted of 20 women members. In the year 2013 , KVK Kangra encouraged the group to undertake the small scale processing activity. KVK organized eight vocational training programmes and 11 method

demonstrations to build capacity of the members in preparation of various products. Guidance, follow up and advisory services were also provided to women on time. Literature comprising leaflets and informative cards (10) and booklets (2) on value added products published by the KVK were provided to the members as reference material. The group started preparing various products like ***nuggets, seera, vermicelli, dried mango powder, triphala powder, dalia and pickles.*** The group acquired the equipment consisting of large grinding machines for preparing products of nuggets and vermicelli on large scale. Procured the required raw material during surplus at cheaper rates, preserved and used them on demand basis. Products prepared by the group were displayed and sold in kisan melas, exhibitions, kisan goshthis etc and these activities gave them an opportunity to introduce their products in the market and obtain the consumer feedback. The group members developed techniques to diversify their products by blending papaya pulp or spinach powder in the black gram or lentil for preparing nuggets which make this product nutritionally rich by supplementing vitamins and minerals. About 20 kg of spinach blended nuggets and 10 kg papaya blended nuggets were sold and these nuggets received a good response from the customers.

Uptake, Spread and Benefits

The groups started from a small venture of production of 50 kg each has grown to the scale of 2-3 q of nuggets, 3-4 q seera, and 1 q each of vermicelli and pickles. Adoption of scientific preservation and value addition improved the quality, packaging and shelf life of the products.

Success achieved by the self help group of 20 women members has influenced about 80 groups (partially or fully) with these activities. Nearly 200 women from villages Darang, Pahara, Amtrar, Dhungiari, Chowki khalet, Paragpur, Kohala, Dadh etc of Kangra district have been motivated to form the self help groups for processing activities.

The SHG and its products have earned a good name in the area and people prefer to buy their products. Local buyers directly come to their homes to purchase the products. Marketing was started from their own village which has now been extended to local fairs, festivals, exhibitions and markets. The technical and market support provided by the KVK to this group have led to selling of these agri- based value added products in district and state festivals like Kullu Dusshera, Minzar mela of Chamba, Shivratri mela of Mandi and Holi mela in Palampur, HP. The group has achieved a great success by participating in international festivals like Kullu Dusshera for ten days where lot of foreign visitors visit their stalls and buy their home made products.

Small-scale processing activity has created round the year on-farm employment among the farm women. A remarkable improvement in the self-confidence of group members was observed in terms of the ability to express their feelings and conduct dealings with the bank freely without hesitation. Talking about the success story, the Group Leader, Mrs. Suman Lata said, "This venture not only supplemented income but also brought out the hidden talent and leadership qualities among the members".

Lac Cultivation Improves Tribal Livelihoods

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Situation Analysis

Forest occupies about 67% of the total geographical area of Dantewada district. Lac is a resinous secretion from a small insect (*Lacifer lacca*) called as lac insect, that inhabits on Ber (*Ziziphus marutiana*), Palas (*Butea monosperma*) and Kusum (*Schleichera oleosa*). Availability of natural Lac host plants and favourable climate conditions in the district is the main reason for lac farming. Lac cultivation is an important secondary sources of income for the villagers. Small and marginal farmers having poor socio-economic conditions constitute bulk of the population.

Technology, Implementation and Support

Having seen a potential to provide additional employment and income for the tribal people, KVK Dantewada promoted lac production technologies by organizing week-long training programmes exclusively for the tribal people. The short-term objective was to provide additional source of income to the tribal villagers. It was also planned to develop some of them as master trainers so that they further help other people in their vicinity. They were imparted training on management of brood lac. The project sponsored by the Dantewada district administration was implemented by KVK Dantewada so that people can adopt scientific cultivation of lac.

Uptake, Spread and Benefits

In this scheme 24 villages were selected for lac cultivation and 100 kusum trees were selected for the inoculation of brood lac in 10 villages. The brood lac obtained from these 100 trees was used for the inoculation of 24 villages in the district.

The 240 farmers in these selected villages had 959 kusum lac plants. They earned an amount of ₹ 789646 from a unit of 40 kusum lac trees. The per plant profit was ₹ 19741. Therefore, each farmer was earning approximately ₹ 6504 per month.

Lac cultivation is environment friendly, generate employment for all sections of the society, empowers women, and has a lot of export potential which improves the socio-economic condition of the tribal farmers. The kusum plants can be grown even on marginally degraded lands during adverse climatic conditions particularly in drought situation, acting as insurance crop for the tribal.

Promotion of scientific lac cultivation has directly uplifted the socio-economic conditions of the tribal farmers with assured ecological approach. Adoption of lac cultivation helps in soil erosion management. The women participate in marketing activities too which empowered them to have active participation in decision making in household affairs being bread earner for the family. One hectare of kusumi lac cultivation on ber generates 620 man days of employment in a year.

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