

Towards Sustainable Livelihood of Tribal Farmers: Achievements under TSP by NIASM, Baramati



On-site Trainings



Field Demonstrations



Creation of Assets



Tapping Market Opportunities



ICAR-National Institute of Abiotic Stress Management
(Indian Council of Agricultural Research)
Malegaon, Baramati - 413 115, Pune



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Preface

Tribal, which constitute about 8.6 per cent of India's total population, are the oldest ethnic group in the country. They are socio-economically poor community, living under harsh and subsistence conditions of poverty and deprivation, even after 67 years of India's independence. The Government of India from time to time has made special affirmative policies, programmes and enacted laws towards promotion of socio-economic development among backward tribes across the country. Tribal Sub Plan (TSP) launched during Vth 5-year plan is one such endeavour in this direction for promoting developmental activities, protecting interest through legal and administrative support and ensuring accountability for non-disbursal of funds in tribal areas. Accordingly, ICAR-National Institute of Abiotic Stress Management (NIASM), Baramati started implementation of TSP activities in Navapur tehsil of Nandurbar district in Maharashtra state since 2011. The institute focused on implementation of four pronged strategy that involved human resources development, field demonstrations, creation of productive assets and marketing management for improving the livelihoods of rural tribal. Various exposure visits to showcase modern agricultural production technologies, farmers field schools, training and workshops, demonstration of advanced cultivation practices, etc. had significant effect on increased awareness among the tribal farmers about adoption of modern agriculture and thereby improved their standard of living. It had been a great learning experience not only for beneficiary tribal farmers but also for each and every official involved in the implementation process.

We express our deep sense of gratitude to all those individuals and institutions for extending their help and cooperation in implementing TSP programme successfully. Not only the scientists and experts of the ICAR and Non-ICAR institutions, assistance and cooperation extended by Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri; Bhabha Atomic Research Centre (BARC), Mumbai; Zonal Agriculture Research Station (ZARS), Igatpuri; Central Sugarcane Research Station (CSRS), Padegaon; KVK Nandurbar, KVK Baramati, KVK Narayangaon deserves special mention. We are highly obliged to Shri. Ravindra M. Patil, Subject Matter Specialist, KVK Nandurbar for all time cooperation for carrying out various activities. We are thankful to our dedicated team, who have worked tirelessly in the field. Shri. Chandu J. Gavit, Abhijeet M. Ugalmogale, Pravin M. Gavit and Anil M. Gavit were unobtrusively behind the conduct of various field demonstrations and

organization of various HRD programmes. Shri. Bapu B. Shinde and Shri. Madhukar N. Ghuge, progressive farmers immensely contributed to the success of this programme. We are thankful to Shri. Pravin H. More, Santosh M. Pawar, Sunil V. Potekar and Aniket T. More for providing timely technical support.

Last but not least, we express our sincere thanks and gratitude to all tribal farmers from Nandurbar district for their keen interest and voluntary participation in various activities without which it would have not been possible to implement the TSP successfully.

Authors

Foreword

Right from Himalayas in north to Kanyakumari in south, and deserts of Rajasthan in West to hilly and mountainous region of North-east, India enjoys a vast cultural diversity with many sub-religions, castes and tribes living peacefully in all the corners of the country. Among these, tribal are one of the oldest ethnic group living in the lap of nature. Tribal being geographically isolated community are still living under harsh and subsistence conditions of poverty and deprivation, despite considerable attention towards their development. The Tribal Sub Plan of Government of India held hopes for socio-economic development of tribal populations of the country. ICAR-National Institute of Abiotic Stress Management (NIASM), Baramati adopted Navapur tehsil in Nandurbar district of Maharashtra state for implementing this plan.

Considering the high levels of poverty, illiteracy and lack of awareness about advanced agricultural production technologies among the tribal farmers of Navapur tehsil, NIASM ventured with a focused and holistic approach for overall transformation of tribal, wherein grass root constraints were elicited by undertaking baseline surveys and group discussions. Keeping the resource base in mind, needs of the different category of farmers were ascertained. A concerted plan with four pronged strategy involving human resource development, field demonstrations, creations of productive assets and marketing management was enacted. The strategies envisaged by institute created significant impact on livelihood of poor tribal farmers by increasing income from agriculture. Dr. A. L. Kamble, the TSP programme leader of NIASM really deserves appreciation for his sincere efforts in overall planning, supervision and effective implementation of TSP.

The important activities implemented by NIASM in tribal villages of Navapur tehsil during last three years are being documented in this technical bulletin. Brief information on impact analysis of technological interventions on tribal farmers'livelihood is also provided. I am sure that this information will be a very useful practical guide to all those involved with implementations of various community development programmes, especially in tribal areas.

February, 2015



(P.S. Minhas)

Executive Summary

Tribals constituting about 8.6 per cent of the India's total population, are the oldest ethnic group for their distinct socio-cultural patterns. Though, they are culturally rich but due to geographical isolation and predominantly rural settings in the vicinity of forests and mountains are socio-economically poor. However, they are socially ignorant, economically weak, politically indifferent, behaviourally simple and highly trustworthy people. In spite of more than six decades of independence, tribals in India are still living under harsh and subsistence conditions of poverty and deprivation.

At the behest of Indian Council of Agricultural Research (ICAR), National Institute of Abiotic Stress Management (NIASM), Malegaon, Baramati implemented Tribal Sub Plan (TSP) in Nandurbar district of Maharashtra, where nearly 70 per cent of the population is of tribal category. Most of the farming activities in the area were highly subsistence type and a little surplus was either sold in local markets or exchanged for day-to-day's essential items. Just few farmers were growing the crops on commercial scale, but were finding it difficult to market their produce because of fragmented production units, market intelligence and poor market infrastructure. Looking into various dimensions of socio-cultural, physiographic, demographic, social fabric, etc., NIASM envisaged four pronged strategy for improving their livelihoods, namely, i) Human resource development (HRD), ii) Field demonstrations, iii) Creation of productive assets and iv) Marketing management.

With these interventions during the past 3 years, a perceptible improvement in the crop productivity has been observed. The maximum attained yields of sugarcane, paddy and groundnut before the intervention were 260, 15 and 7 q/acre respectively, has increased to 670, 33.5 and 23.5 q/acre realising nearby 2-4 fold jump in yields. Major change is also occurring in the cropping pattern with farmers now shifting to remunerative crops. With the focussed HRD programmes and introduction of new technologies, the way of farming is transforming from subsistence low-input low-output production system to commercialization. Farmers' groups were constituted who cultivated chilli and okra on 14.2 and 78.5 acres of land. Due to concerted efforts the farmers were able to produce okra worth Rs. 98.2 lakh with a net return of Rs. 1.05 lakh per acre. Hence, more and more interventions of vegetable are planned under TSP programme.

With reduced cost of production, the B:C ratio has improved substantially and has led to increased marketable surpluses, e.g. in case of paddy, the marketable surplus has risen from 15 to 56 per cent. The increased income realised by the farmers has also transformed the way of living and inducing a major social change. With enhanced awareness, they are voluntarily participating in various collective activities, e.g. the Bokalzar village won the second prize at state level of "Sant Gadge Baba Gram Swachhata Abhiyan" during 2012-13. Another village Gadad won the same award at tehsil level during 2013-14. In nut shell, the TSP interventions in Navapur tehsil of Nandurbar district has made a remarkable impact in agricultural production, thereby realising higher incomes translating into better lives of tribal people.

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1. Introduction

Tribal, constituting about 8.6 per cent of the India's total population (Census 2011), are the oldest ethnic group for their distinct socio-cultural patterns. Tribal are culturally rich but socio-economically poor community due to geographical isolation and predominantly rural living, mostly in forests and mountains. As such they are socially ignorant, economically weak, politically indifferent, behaviourally simple and highly trustworthy. Even after 67 years of independence, tribal are still living under harsh and subsistence conditions of poverty and deprivation.

To ensure balanced growth and economic development of all the communities across the country, the five year plans are strategically designed. Government has made special affirmative policies, programmes and enacted laws towards promotion of socio-economic development among backward tribes. However, the developmental programmes during different plan periods have not been successful in ameliorating the socio-economic situation of the tribals due to preponderance of illiteracy and ignorance, orthodox views, inadequacy of representation in government and non-government services, increased landlessness, rigid attitude to change their occupation, lack of risk taking capacity, etc. (Kaviraj and Lal, 2010).

Government of India launched the Tribal Sub Plan (TSP) during Vth 5-year plan with the objective of promoting developmental activities, protecting their interests through legal and administrative support and ensuring accountability for non-disbursal of funds in tribal areas. However, the mid-term appraisal of the TSP programmes revealed that several central ministries and departments have not

earmarked adequate funds towards TSP. Accordingly, all the central ministries and departments were instructed for earmarking sufficient funds and directing special activities towards overall socioeconomic development of scheduled tribes (STs) population (Planning Commission, GOI, D.O. No. N-11016/5 (1)/2006-PC, dated December 13, 2006). The following are broad objectives of the scheme at national level:

- To ensure that the share of resources spent for the benefit of the scheduled castes (SCs) and scheduled tribes (STs) is at least in proportion to their share in population of the country
- To reduce substantially the poverty and unemployment among the SCs and STs
- To create productive assets in favour of the SCs and STs
- To promote human resource development of the SCs and STs through specially providing adequate educational and health services
- To provide physical and financial security against all types of exploitation and oppression

Indian Council of Agricultural Research (ICAR), New Delhi under the Ministry of Agriculture, Government of India, vide letter F. No. 1-32/2011-IA.II, dated July 29, 2011 has instructed all of its constituent research institutions regarding allocation of 3.6 per cent of their annual total budget for implementation of TSP activities. Accordingly, ICAR-National Institute of Abiotic Stress Management (NIASM), Malegaon, Baramati started implementation of TSP in tribal areas of Navapur tehsil (District Nandurbar) of Maharashtra.

2. The Study Area

The Maharashtra state has the 2nd largest tribal population in the country (10.1 per cent), next only to Madhya Pradesh (14.7 per cent). Nandurbar and Gadchiroli are the two major tribal districts with 69.3 and 38.2 per cent tribal population out of districts' total population, respectively (Census, 2011). NIASM has adopted Nandurbar district as a study area for implementing its various activities under TSP.

2.1 Nandurbar district

Nandurbar district is a part of north Maharashtra situated between 73.31° and 74.32° E, and 21.03° and 22.00° N. The district occupies an area of 5034 km² which constitutes 1.6 per cent of the total geographical area of

Maharashtra state. The Nandurbar shares its border with Dhule district of Maharashtra at South, and with Gujarat and Madhya Pradesh states at North-west and North-east sides, respectively. The northern boundary of the district is defined by the great Narmada River. The district headquarter is located at Nandurbar city. The district is subdivided into six tehsils viz., Akkalkuwa, Shahada, Akrani (Dhadgaon), Nandurbar, Taloda and Navapur (Fig. 1). Physiographically, Nandurbar can be divided into two major areas: 'hilly terrain' of Satpuda ranges covering Akrani, Akkalkuwa and Taloda tehsils, and 'Tapi river basin', a fertile belt with good irrigation facilities, covered by Shahada, Nandurbar and Navapur tehsils (DES, 2012).

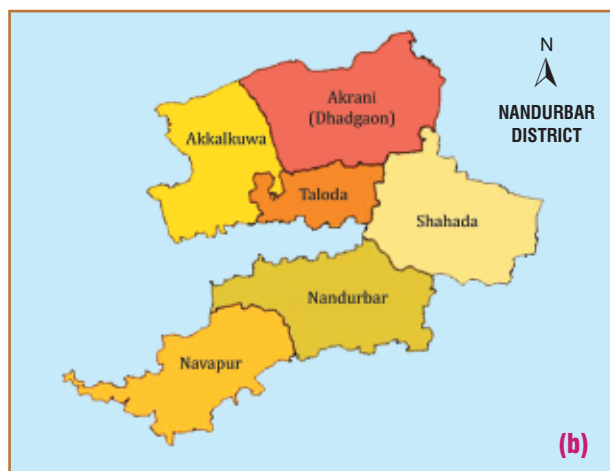
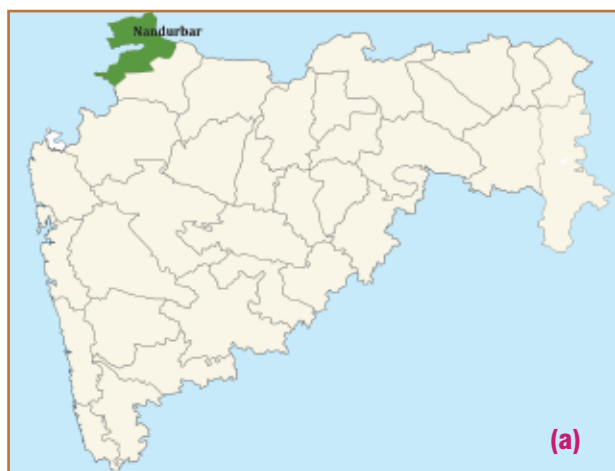


Fig.1. Map of Maharashtra state showing location of Nandurbar district (a) and different tehsils of Nandurbar district (b)

2.2 Navapur tehsil: the study area for TSP

Navapur is a municipal council and the tehsil headquarter. It is located at the border of Maharashtra state adjacent to the Gujarat state. The tribal is the major community which constituting 84.9 per cent of the total population of Navapur tehsil (DES, 2012). Bhili and

Konkani are the most spoken adivasi languages whereas Marathi is the official language. Besides, people can also speak Hindi and Gujarati languages, confluence of two different linguistic states viz., Gujarat and Madhya Pradesh. The place has good road and rail connectivity and is located along Surat - Bhusaval broad gauge railway line and Surat -

Nagpur national highway (NH-6). The nearest commercial airport is at Surat. The climate of Navapur tehsil is hot and dry. The maximum temperature reaches 47°C during summer. The average rainy days are 69, and annual rainfall is 1194.4 mm. Western part of Navapur block consists of light shallow and sandy soils while eastern part consists of medium quality soils. The black cotton soil is present in Rangavali river basin.

2.3 Cropping pattern in Navapur

The total geographical area of Navapur tehsil is 97,668 ha. The gross cropped area and net sown area are 59,395 and 56,229 ha, respectively (DES, 2012). The area under irrigation is 15.0 per cent. The forest area is 16.8 per cent. Agriculture is the main occupation in Navapur area. Rice, bajra, sorghum, wheat and maize constitute major cereals whereas pigeon pea, soybean, black gram, green gram and chick pea are the major pulse crops. The sugarcane, cotton, groundnut, banana and onion are the major commercial crops grown.

Baseline surveys were conducted during 2011-12 and the villages situated along Rangavali river basin were selected for implementing TSP. About 90 group discussions were held in 25 tribal villages. The major crops in Rangavali river basin are paddy, sugarcane and groundnut, which occupy 90-95 per cent of the gross cropped area. The productivity of these was substantially low. It ranged between 2.0-15.0, 50.0-260.0 and 2.0-7.0 q/acre in paddy, sugarcane and groundnut, respectively with an average of 7.2, 154.0 and 3.4 q/acre. Also the livestock rearing is not preferred in the area and the daily milk collection of villages is between 20.0-200.0 litres. The survey revealed that low agricultural productivity of the area is due to following factors:

- Use of poor quality seed
- Faulty land preparation practices
- Improper cultivation practices
- Indiscriminate and intensive fertilizer use
- Faulty irrigation management
- Lack of clean cultivation
- Incorrect weed, pest and disease management
- Conventional intercultural operations
- Poor harvest and post-harvest management
- Poor market intelligence
- Underdeveloped livestock sector

The agricultural economy in the region reflects a dismal performance predominantly due to poor technological uptake. The socioeconomic and demographic constraints in adoption of modern technologies include the following:

- Illiteracy, ignorance, unawareness and ethics
- Lack of knowledge about world outside
- Poor financial management
- Erroneous rumours, suspicion, rigidity and negative attitude
- Political interference
- Low satisfaction levels
- Lack of enthusiasm and motivation
- Hopelessness and aimlessness
- Non-agricultural environment
- Non-competitive environment
- Disguised unemployment

- Weak institutional development

However, the following strengths were identified, which can help in faster development of the area:

- Good road and rail connectivity and access of consumer markets
- Cheaper labour availability
- Relatively cooler climate, high rainfall and fertile soils

Looking into various dimensions of socio-

cultural, physiographic, demographic and social fabric, NIASM envisaged four pronged strategy under TSP for improving the livelihoods of tribal farmers. The strategies are:

1. Human resource development (HRD)
2. Field demonstrations
3. Creation of productive assets
4. Marketing management

The details of aforesaid strategies are included in the following sections.



3. Human Resource Development

The need for HRD was realised while conducting the baseline surveys. Therefore, various activities like organization of exposure visits, farmers’ meets, discussion fora, workshops, technology weeks, study tours, world women day, soil and water conservation programmes, on-farm training, field days, field visits, creating awareness through publication of agriculture literature, etc. were envisaged under TSP programme. The details of each of the activities undertaken are given below.

3.1 Exposure visits

As mentioned earlier, the tribal farmers due to illiteracy and ignorance are highly unaware of advanced agricultural production technologies. Hence, the exposure visits were planned as a starting activity under TSP with an objective of exposing the tribal farmers to the new and

improved practices of farming. This also gave them an opportunity to directly interact with progressive farming communities, research scientists and technology developers at various agricultural research institutes, universities, KVKs, Agro-industries, etc. thereby upgrading their knowledge on various aspects of agriculture. The details of places visited and technologies shown to the tribal farmers during exposure visits conducted during last three years are given in Table 1.

In the first year of TSP implementation (2011-12), an exposure visit was arranged during December 14-19, 2011. Forty five tribal farmers from different villages have participated in the exposure visit to various technological hubs like hi-tech horticultural nursery, micro-irrigation systems, etc. (Fig. 2).

Table 1. Places visited under exposure visits of tribal farmers

Place visited	Technologies seen / Knowledge gained
Jain Irrigation System, Jalgaon	<p><i>Cultivation methods:</i> High density planting in mango and guava with drip irrigation; onion cultivation on raised bed system; intercropping of onion and sweet orange; tissue culture for propagation of banana and pomegranate</p> <p><i>Micro-irrigation systems:</i> Inline / online drip, sprinkler</p> <p><i>Farm equipment / implements:</i> Onion seed planter</p> <p><i>Technical guidance:</i> Lecture on improved banana cultivation</p>
KVK, Babhaleshwar, Ahmednagar	<p>KVK farm, demonstration plots of vegetables, horticulture nursery, bio-fertilizer and bio-pesticides production unit, polyhouse, mobile SMS centre, radio centre, etc.</p>
MPKV, Rahuri, Ahmednagar	<p><i>Fruit orchards:</i> Sapota, mango, pomegranate, sweet orange, guava, ber, aonla, etc.</p> <p><i>Vegetables demonstration plots:</i> Brinjal, french bean, tomato, onion, etc.</p> <p><i>Dairy unit:</i> Triveni - a popular cross breed cattle developed by MPKV; cattle shade structures and animal husbandry practices; techniques of hygienic milk production</p> <p><i>Improved farm machinery developed by MPKV:</i> Tractor drawn cultivators, rotavators, ridger, planter, seeders, etc.</p> <p><i>Post-harvest technology laboratory:</i> Knowledge on preparing various products like aonla candy, aonla juice, jamun juice, mango juice, etc.</p> <p><i>Technical guidance:</i> ‘Seed and biofertilizers production technologies’ and ‘Improved agricultural technologies’</p>

Place visited	Technologies seen / Knowledge gained
Model Village, Hiware Bazar, Ahmednagar	Information on watershed development, sanitation, women welfare, population control, milk production, rainfed farming, etc. Inspirational lecture by Mr. Popatrao Pawar, a propounder of model village concept
Gunjalwadi, Pune	<i>Integrated farming systems:</i> Cultivation of sugarcane, maize, potato, cauliflower, brinjal and sapota by adopting improved techniques
Shiroli Khurd., Pune	Interactions with “Farmer Clubs” regarding benefits of group farming; visit to sugarcane plots by group farming; technical guidance by Mr. Subhash More, a progressive group farming member on different types of group basis activities to reduce cost of cultivation
DOGR, Rajgurunagar, Pune	<i>Improved onion and garlic production technologies:</i> Planting methods; storage structures for longer shelf life and improved storage quality; onion graders, etc.
NRCG, Pune	<i>Information on grape cultivation:</i> rootstocks, cultivars, planting and grafting, training and pruning, irrigation, fertigation, pest, diseases and post harvest management
Gayatri Farmers Club, Malegaon, Pune	Interaction with Mr. Sangram Taware on club formation - process, importance, supporting organizations and activities of farmers’ club; sericulture project of Mr. Sudhakar Taware and discussion on production to marketing process of sericulture
KVK, Baramati, Pune	Vegetable plots, horticulture nursery, bio-fertilizer and bio-pesticides production unit, polyhouse, mobile SMS center, radio center, etc.
Govindbag, Malegaon, Pune	Discussion with farm manager on various issues related to modern agriculture practices and organic farming
NIASM, Baramati, Pune	Information about the institute, its future plan of development and research activities; visit to laboratory and interaction with various scientists regarding management of abiotic stresses in crops
International Exhibition Centre, Moshi, Pune	<i>Improved farm machineries and implements:</i> Mahindra's - yuvraj 215 (15 hp engine) tractor; kubota agricultural machinery india's back hoe and front loader; sugarcane harvester; diesel engine based hand operated paddy cutter <i>Improved seeds and seedlings:</i> Brinjal, chilli, tomato, etc.; VNR hybrid grafts of Guava <i>Demonstrations:</i> Organic farming; compost preparation, application and importance



Fig. 2. Farmers visiting hi-tech horticultural nursery at KVK, Baramati (a) and micro-irrigation systems at Jain Irrigation Systems Pvt. Ltd., Jalgaon (b)

Subsequently, two more exposure visits were organised during 2012-13. In the first visit organised during December 11-15, 2012, the 100 tribal farmers including 39 tribal women participated while second was organised on March 5, 2013 that was solely for the farmers of Jamtalav village. The 110 farmers including 80 women visited model villages for soil and water conservation viz., Ralegan Siddhi and Hiware Bazar (District Ahmednagar). The participants had a chance to interact directly with Shri. Anna

Hazare, a renowned social activist and propounder of model village concept in Maharashtra, and Shri. Popatrao Pawar, a leader who brought overall development and transformation of Hiware Bazar as model village of social development (Fig. 3). The farmers realised the importance of soil and water conservation, micro watershed development with the community participation at village level and subsequent economic improvement.



(a)



(b)

Fig. 3. Visit to model villages adopting soil and water conservation for socio-economic development. Interacting with Shri. Anna Hazare, at village Ralegan Siddhi (a), and Shri. Popatrao Pawar at village Hiware Bazar (b)

In the 3rd year (2013-14), ninety two tribal farmers were taken to 'Kisan Mela' the India's largest agriculture exhibition held at Pune on December 14, 2013 where they had a chance to upgrade their knowledge on improved agricultural implements, tools, irrigation systems, seeds, pesticides, fertilizers, nutrients, etc. (Fig. 4).



Fig. 4. Visit to 'KISAN MELA' at Pune

3.2 Workshop

It was observed during baseline surveys that due to lack of knowledge, tribal farmers are practising indiscriminate and injudicious use of fertilizers in the crop production. Hence, a workshop was organised on “Soil testing and soil health management” on January 20, 2012 at KVK, Nandurbar wherein 110 farmers had participated in the workshop and benefited from the service and advisories. During workshop the farmers learnt about importance of soil and water testing in crop production, methods and process of soil and water sampling, drip irrigation and soil quality management, importance of organic matter in relation to soil health and nutritional quality of

food crops, importance of biofertilizers, biopesticides, organic manure, importance and functions of pH, CEC and minerals in soil and their effect on efficiency/uptake of major nutrients, importance of water management, etc. They were also briefed about right application of fertilizer, its quantity, timing, method and placement apply. They were also sensitized about correlation between fertilizer price rise and productivity enhancement during last 10 years. The discussion in workshop concluded with an action plan for conduct of soil and water testing programme at village level and adoption of laboratory results based nutrient management practices at individual levels in villages (Fig. 5).



Fig. 5. Interactions between the experts and the tribal farmers during workshop on ‘Soil testing and soil health management’

3.3 Farmers’ meets

Two farmers’ meets were organized with an aim of creating awareness, enhancing and upgrading knowledge level and motivating the tribal farmers to adopt new technologies of crop production. The detail is as under:

3.3.1 Vegetable growers’ meet

The study area is characterized by fertile soil, good water availability, relatively cooler

climate, surplus manpower and good road connectivity to commercial vegetable market of Surat (Gujarat). Though, all these characteristics make Navapur an ideal site for vegetable cultivation, but due to lack of awareness on vegetable farming and ample market avenues, farmers were deprived of this huge possible opportunity. Therefore, a meet was organised on February 15, 2012 at village Karanji Budruk for showcasing the advanced vegetable

cultivation technologies and exploring possibilities of increasing their income through such a venture. More than 2000 tribal farmers (50 per cent women) have participated from 30 nearby villages. Several seed companies, industries and local institutions were roped in for this meet. Among the technology exhibitors were the popular vegetable seed producing companies (Nirmal Seeds Pvt. Ltd., Nunhems Pvt. Ltd. and Syngenta Pvt. Ltd.), other agro-industries (Netafim Irrigation India Pvt. Ltd., Jain Irrigation Systems Ltd., Nagarjuna Fertilizers and Chemicals Pvt. Ltd.), KVK Nandurbar, etc. During the technical and interactive sessions, various experts provided details about technical know-how of vegetable farming such as selection of high yielding and consumer preferred varieties, integrated crop management with respect to water, nutrition, pests and diseases. The farmers were also made aware about the market intelligence in respect of arrival patterns and prevailing prices of various vegetables, so as to garner maximum returns from their produce (Fig. 6).

3.3.2 Farmers day

A 'Farmer Day' was organised at village Bokalzar of Navapur tehsil on April 18, 2013 which was attended by about 5000 tribal farmers from different villages of Nandurbar district. The exhibition-cum-demonstration involved various exhibits from companies producing seeds and other agro-inputs, KVK Nandurbar and women self-help groups. Dr. P.S. Minhas, Director, NIASM in his inaugural speech appreciated the enthusiasm shown by farmers which came in such a large numbers that was much beyond the expectations (Fig. 6). He stated that the programme holds great importance in terms of new agrarian challenges and technology dissemination to the tribal farming community. For further impetus on productivity enhancement and agricultural sustainability, he highlighted the need to create awareness among the farmers about the optimum use of inputs, judicious use of pesticides, organic products, etc. for long term sustainability.



(a)



(b)

Fig. 6. NIASM experts addressing the tribal farmers. Dr. A.L. Kamble addressing vegetable growers' meet (a), Dr. P.S. Minhas, Director giving his inaugural speech during farmers' day at village Bokalzar (b)

3.4 Trainings

3.4.1 Beekeeping enterprise

Keeping in view of the vast agro-biodiversity of flora of Nandurbar region that can sustain large number of bee colonies by providing nectar and pollen, a major food source for bees, the regions has been adapted by Maharashtra State Khadi and Village Industries Board for promotion of bee-keeping enterprise under the scheme 'Integrated bee-keeping, bee-breeding and

honey production'. To further promote the cause, training under TSP on bee-keeping enterprise was conducted on February 7, 2012 at Krishi Vigyan Kendra (KVK) Nandurbar. Fifteen tribal farmers from selected villages of Nandurbar district attended the training. Additional training was organised for 36 farmers at Directorate of Bee-keeping, Mahabaleshwar, Satara during February 25, 2012 - March 5, 2012 (Fig. 7).



Fig. 7. Tribal farmers at Directorate of Beekeeping, Mahabaleshwar, Satara (a), bee boxes with colonies of *Apis cerana indica* at the tribal farmers' fields (b)

Each trainee was provided with bee-keeping equipment and healthy bee colonies. However, the activity could not create meaningful impact on the tribal economy because of following reasons:

- Poor marketing of honey because of individual beekeepers
- Lack of persistent efforts by farmers since beekeeping is very laborious job
- Localised efforts and non-shifting of colonies to other areas for the nectar
- Adverse weather especially intense rains, hot and dry summers caused mortality in bees and thereby affecting the honey production

- Pests and predators like ant and hive beetles deteriorated the bee colonies
- Lack of networking for collective efforts for procuring and processing units for honey and wax, its marketing, etc.
- Theft of bee colonies before honey extractions

3.4.2 Mango production technology

The mango cultivation in Navapur tehsil is characterised by discrete planting of mango trees either in the farms or along the farm boundaries; however there are no organised commercial mango orchards. Keeping this in view, training was organized on mango production technology on October 1, 2012 at

KVK Nandurbar in which 46 tribal farmers from four villages participated. The talks covered the topics of economic importance of mango cultivation, agro-climatic requirements, improved varieties / hybrids, grafting methods, planting material, planting season, spacing, training of plants, nutrition, irrigation, intercultural operations, intercropping, regulation of bearing, regulation of fruit drop, plant protection measures, harvesting and yield, post-harvest management like grading, storage, packing, transportation, marketing, etc. (Fig. 8). Apart from that, they were also briefed about demand and supply patterns, export potential, etc. Besides, on-farm training on integrated nutrient management and demonstration on fertilizer application in mango was organized on July 7-8, 2013 at Bokalzar village. Total of 100 tribal farmers from 5 surrounding villages have participated. Demonstrations were conducted on method of application of organic and inorganic fertilizers to mango plants along with technique for removal of leaf webber (Fig. 8).

3.4.3 Urea briquettes to improve N-use efficiency

The Urea-DAP briquettes agro-technology is known to considerably improve fertilizer use efficiency. But due to non-availability of Urea-DAP briquettes in local markets, adoption of 'Charsutri' (four line) method of paddy cultivation in Navapur was hampering. Hence two days training was organized at Krishi Vigyan Kendra (KVK), Narayangaon, Pune during October 4-5, 2012 that was attended by 45 tribal women farmers.

3.4.4 Sugarcane production technology

Sugarcane occupies about one-tenth of the cropped area of Navapur tehsil with productivity of only about 15.4 ton/acre. The low productivity is mainly due to traditional methods of planting and management practices,

imbalanced use of fertilizers, inadequate farm mechanization, heavy infestations of weeds, insects and diseases, non-adaptation of area by sugar factories, etc. Therefore training on sugarcane production technology was organized during October 10-11, 2012 at Central Sugarcane Research Station (CSRS), Padegaon, Satara in which 59 tribal farmers participated. The farmers learnt about growing seasons, improved varieties, land preparation, planting material, planting time, selection of seed sets, set treatment, manuring and fertigation, weed management, intercropping, water management, earthing-up, detrashing, propping, removal of water shoots, harvesting management, yield, nutrient deficiency symptoms, pests and disease management, ratoon management, gap filling, etc. (Fig. 8). The training also included raising nursery using single budded chips, transplanting young seedlings, wide spacing cultivation, organic method of nutrient and plant protection measures, etc.

3.4.5 Paddy cultivation and post-harvest technology

The tribal farmers of Nandurbar district use to store non processed paddy produce and process it by traditional methods at household level whenever needed for household consumption. Most of rice processing methods are of the traditional huller type and are inefficient. The tribal farmers are adopting 'barter system' in rice marketing. Hence, the training programme on rice production and post-harvest technology for tribal farmers of Nandurbar district was organized during November 7-8, 2012 at Zonal Agriculture Research Station (ZARS), Igatpuri (MPKV, Rahuri). Thirty nine tribal farmers from Navapur tehsil had attended the training programme. The guidance involved soil health management, importance of green manuring

crops to improve soil fertility, seed production technology, plant protection, improved varieties, nutrient management, post-harvest technology and value addition in rice, mechanization of rice cultivation and scope of horticulture in rice growing area. At the end, a field visit of farmers was arranged to seed

production plots of ZARS (Fig. 8). The training on rice production and post-harvest technology helped to bridge the knowledge gap between commercial farming and present subsistence rice farming adopted by tribal farmers of Navapur tehsil.



(a)



(b)



(c)



(d)

Fig. 8. Tribal farmers' training on improved crop cultivation technologies. Demonstration of mango grafting (a), discussion forum on improved mango cultivation practices (b), earthing-up in sugarcane (c) and demonstration plot of paddy at Zonal Agriculture Research Station (MPKV), Igatpuri, Nasik (d)

3.4.6 Chilli production and its marketing

Despite favourable climate for chilli cultivation, it is not commercialized in Navapur tehsil due to lack of awareness on its recommended packages with respect to high yielding varieties, control of diseases and pests, marketing, etc. Hence, training was organized in Bokalzar

village on August 10, 2013. It was attended by 90 farmers from 10 villages. The topics covered were climate and soil requirements, varieties and hybrids, seedling raising, sowing time, land preparation, transplanting, spacing, manures and fertilizers, cultural practices, irrigation, weed control, insects and diseases, harvesting

and post-harvest operations, curing and storage, seed production, factors influencing prices, etc.

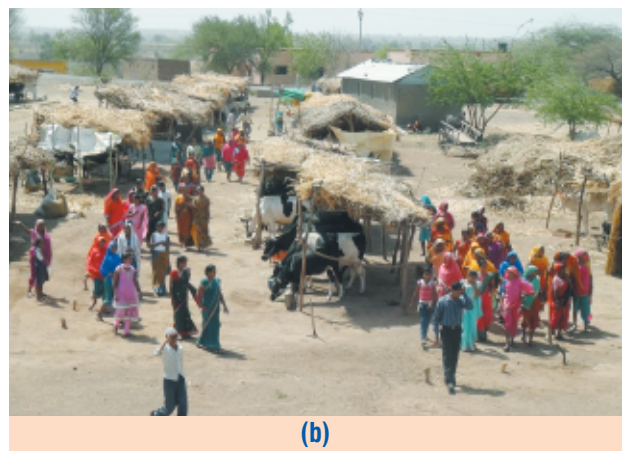
3.4.7 Livestock production and management

Non-descript and unproductive cattle breeds, improper livestock management practices, poor quality fodder, lack of nutrient management and balanced feeds, poor veterinary care, poor breeding facilities, lack of facilities for housing, lack of awareness about clean milk production, weak marketing linkages, etc. are the major constraints in livestock enterprise in Navapur tehsil. To overcome these constraints, a 3-day training was organised on 'Livestock production and management' during May 29 - 31, 2013 at KVK, Baramati. Sixty tribal women

farmers were given on-hand training on breeds of cattle, selection of good dairy animals, disease prevention measures in cattle and goats, artificial insemination technique in cattle and buffaloes, feeding practices for dairy cattle, buffaloes and goats. On next day, visit was organized to nearby small dairy units, loose housing system unit, biogas and cow dung slurry unit, silage unit, back yard poultry unit as well as soil testing laboratory, hydroponic unit, nursery, bio control lab and compost unit of KVK. On last day trainees visited to animal camp in drought affected area of Karjat tehsil of Ahmednagar district. In this visit they learn water and fodder management in dairy animals during severe drought conditions (Fig. 9).



(a)



(b)

Fig. 9. Visit of tribal women farmers to model dairy farm at KVK, Baramati (a) and animal camp at village Rashin, Tal. Karjat, Dist. Ahmednagar (b)

3.5 Discussion forum

The discussion forum on "Policy coherence for planning and execution of TSP programme during 2012-13" was organized on April 3, 2012 in village Bokalzar, tehsil Navapur. About 500 tribal farmers from five different tribal villages participated in the forum. The programme was chaired by Dr. P. S. Minhas, Director, NIASM. Other scientists/subject experts and administrative staff of NIASM were present

during the event. Shri. A. T. Kumbhar, the district collector of Nandurbar also attended the programme. Before starting discussions, the team of experts led by Director visited the various demonstration plots of brinjal, okra, sugarcane and apiary maintained under TSP. Initially the activities undertaken during 2011-12 were reviewed and action plan was made for 2012-13. The issue of substantially low productivity of all the agricultural crops was

discussed and a combination of four pronged strategies viz. human resource development, field demonstrations, productive assets creation and marketing management was decided. The session concluded with an emphasis on activities based upon the site specific needs of tribal farmers (Fig. 10).

3.6 Participation in agriculture technology week

During October 15-20, 2012, NIASM facilitated the participation of 423 tribal farmers in agriculture technology week (ATW) at KVK, Nandurbar. Similarly, in ATW during next year (September 30, 2013 - October 5, 2013) participation of 130 tribal farmers were facilitated (Fig. 10).

3.7 Observation of world women day

Rural women are key source of rural development, especially in tribal areas. They play a catalytic role towards achievement of transformational economic, environmental and social changes required for sustainable development. Empowering women is essential, not only for the well-being of individuals, families and rural communities, but also for overall economic productivity, given women's large presence in the agricultural workforce. Hence, the "World Women Day" was observed on March 8, 2013. The theme of the event was "Role of Women in Agriculture and Rural Development". The tribal women were proactive in making the event successful. More than 500 tribal women participated in a programme organized at Jamtalav village. The members of various women farmer groups explained the importance of group farming, activities undertaken by NIASM for women farmer development, role of tribal women in agriculture and rural development, etc. They also shared experiences during various

exposure visits and trainings organized by NIASM. During the next year, world women day was observed at Gadad village on March 8, 2014, the theme of which was "Role of Women in Dairy Sector Prosperity in India". More than 500 women farmers participated in women day. The participants were guided on success stories on dairy sector in India by experts from BAIF organization. The fodder crops like napier, marvel, lucerne, maize and sorghum grown by NIASM were exhibited in programme. Also the various vegetable crops like okra, chilli, cabbage, cauliflower, brinjal, etc. grown by farmers were demonstrated to the women farmers (Fig. 10).

3.8 Soil and water conservation programmes

Successful agriculture depends on soil fertility and quality irrigation water. The soil and water are vital but they are shrinking natural resources and hence needs to be conserved and used judiciously for long term use and sustainability. To create the awareness about importance of soil and water conservation among the tribal farmers, following programmes were organized.

3.8.1 Soil and water conservation week

The Jamtalav village of Navapur tehsil situated in the foothills of the mountains, is hard hit by the scarcity of water for agriculture and drinking during the period of January to June. In this regard, one day exposure visit of 110 tribal farmers of Jamtalav villagers was organized on March 5, 2013 to Ralegan Siddhi and Hiware Bazaar (model villages as an exemplar for soil and water conservation). During visit the tribal women and men interacted with social worker Shri. Anna Hazare and Shri. Popatrao Pawar on soil and water conservation issues, micro watershed



(a)



(b)



(c)

Fig. 10. Organisation of various events. Discussion forum (a), Agricultural Technology Week (b) and observation of World Women's Day (c)

development with the community participation at village level and subsequent economic improvement of village. Subsequently, soil and water conservation week was observed in Jamtalav village during May 7-13, 2013. The Jamtalav villagers voluntarily put "Shramadaan" for creation of soil and water conservation compositions in their village. The villagers created various structures like check dam, gully plugging, loose boulder and small earthen bunds across the slopes (Fig. 11).

3.8.2 Soil and water conservation month

The soil and water conservation month was observed during November 25, 2013 - December 25, 2013. The low-cost water conservation structures i.e. "Vanrai Bandhara" were constructed on village streams of Navapur tehsil. More than 1500 farmers participated voluntarily to construct 14 Vanrai Bandharas (Fig. 11). The Vanrai Bandharas are constructed across a stream or small river using gunny bags refilled with locally available soil or sand. These

bags are sealed properly and are arranged in the form of a wall barrier. This is a temporary structure built across water course to collect the water as well as to reduce the velocity of stream so that infiltration rate of water increases. It helps in replenishing the aquifer below the river

bed resulting in increase in ground water level in the surrounding area. Normally Vanrai Bandhara is constructed at the end of monsoon period and it lasts till the onset of the next monsoon, thereby making water availability during scarcity period.



Fig. 11. Implementation of soil and water conservation programmes through participation of tribal villagers. Construction of check dam (a) and construction of Vanrai Bandhara (b)

3.9 Field visits

The field visits of rice, sugarcane and okra farmers were organized to introduce the tribal crop growers to the new technologies and techniques so that they could see how these technologies or techniques could be practically used and applied to their own situations.

3.9.1 Rice field visit

Three days field visit of rice farmers was organized during October 7 - 9, 2013 at Gadad, Vijapur and Wadkalambi villages in which respectively 300, 700 and 1000 farmers were participated. Visits to demonstration plots followed by discussions on various package of practices in rice crop were arranged. The major objective of programme was to create awareness among tribal farmers through rice plots cultivated using improved technologies on their own land (Fig. 12).

3.9.2 Sugarcane field visit

The two days field visit of 300 sugarcane farmers was organized during October 15-16, 2013 at sugarcane demonstration plots of Gadad, Vijapur, Bokalzar and Wadkalambi villages. During visits the farmers saw the sugarcane plots grown by improved technologies (Fig. 12).

3.9.3 Okra field visit

The field visit of okra growers was organized on February 6, 2014 at Bhavare village. The successful cultivation of okra on a group basis was demonstrated to more than 1500 tribal farmers including women farmers of Navapur tehsil. The major objective of field visit was creation of awareness about okra group farming. The farmers from nearly 50 villages participated and learned from intervention/ demonstration plots of okra.



(a)



(b)

Fig. 12. Visits of tribal farmers to field crops raised under demonstrations; rice (a) and sugarcane (b)

3.10 Study tours

To educate tribal farmers on best agricultural practices that will help them increase yield, several study tours were organized.

3.10.1 Groundnut farmers

A study tour of 37 tribal farmers was organized on December 17, 2014 to Kehal village, Jintur tehsil, Parbhani district of Maharashtra. The groundnut demonstration plots of progressive groundnut growers were visited. During study tour farmers learned about soil selection, climatic requirement, crop rotation, land preparation, fertilizer application, seed selection

and treatment, plant spacing and seed rate, weed control, irrigation management, plant protection measures, harvesting, post-harvest handling, drying, etc. (Fig. 13).

3.10.2 Gadad villagers

A study tour of Gadad villagers was organized on February 1, 2014 to study the developmental activities of Mahida and Daab villages of Nandurbar district. It is noteworthy to mention here that these twin villages were awarded Sant Gadgebaba Gram Swachhata Abhiyan Award 2013-14 by Govt. of Maharashtra. A total of 100 villagers participated in this study tour.



(a)



(b)

Fig. 13. Various study tours of tribal farmers: groundnut field of progressive farmer at Parbhani (a) and capicum cultivation in shed net at Dahanu, Thane (b)

3.10.3 Chilli farmers

The climate of Navapur is conducive and favourable for chilli cultivation either in open or protected conditions. The tribal farmers of Navapur have started growing chilli on small scale area; however the chilli cultivation is not yet commercialized. Hence, study tour of tribal chilli farmers was organized on March 12, 2014 at Dahanu tehsil of Thane district in Maharashtra state. The 109 tribal farmers participated in this study tour. During study tour, farmers learned about various knowledge on protected cultivation like selection of site, various greenhouse structures, cultural and nursery practices, selection of cultivars, nursery raising, land preparation, fumigation, fertilizer application, mulching and spacing, transplanting, pruning, training, drip irrigation and fertigation, integrated pest and disease management, harvesting and yield, post-harvest management as well as received special tips from progressive farmers to achieve higher and quality yield (Fig. 13).



3.11 Meetings and group discussions

Face-to-face meetings are the most common ways for groups to make decisions, solve problems, educate people and plan programs and projects. Meetings can be productive to accomplish the goals efficiently. Under HRD activities of TSP, large number of meetings and group discussions were held on issues related to sensitization of tribal farmers on agricultural development (Fig. 14).

3.12 Gram swachhata abhiyan

In Navapur tehsil health issues are increasingly affecting household decision making, farm labor, and agricultural productivity. There is high correlation between health and labor efficiency and agricultural productivity. Therefore, the farmers group formed under TSP activities of NIASM undertook various rural development activities like gram swachhata abhiyan to make the villages clean and hygiene (Fig. 14).



Fig. 14. Various social developmental activities. Periodical group meetings of villagers (a) and village cleaning campaign (b)



4. Field Demonstrations

Field demonstrations are the effective means to facilitate dissemination and adaptation of farm innovations and other practical information among the farmers. These are based on the principle of “seeing in believing”. Thus the recommended packages of practices were demonstrated especially for high value field and horticultural crops and livestock rearing. Initially a soil health campaign was organised to assess the fertility status of soils of the area. The details of various interventions performed are described in this chapter.

4.1 Soil health campaign

Under this campaign, 100 soil samples from the fields of tribal farmers were tested at soil testing laboratory of KVK, Nandurbar. Of these, 27 samples were rated very low in organic carbon (< 2 g/kg), whereas remaining 73 having OC (2.1-4.0 g/kg) were rated as low. All were rated low (141-280 kg/ha) in available nitrogen while 32 samples had medium (15-21 kg/ha), 49 were medium high (22-28 kg/ha) and 19 were having high phosphorus content (29-35 kg/ha). The potassium content was very high (>300 kg/ha)

in all the soil samples. The pH and EC were normal and their calcite content was > 1.0 per cent. The 54 soil samples were rated low (<4.50 ppm) and 46 medium (4.50-10.00 ppm) in ferrous content. Similarly 62 were low in zinc (<0.60 ppm) whereas remaining 38 had medium zinc (0.61-1.00 ppm). Almost all the samples had high contents of manganese and copper.

4.2 Demonstrations on improved package of practices

Field demonstrations were conducted on cultivation of sugarcane, paddy and groundnut crops at tribal farmer’s fields wherein the farmers adopted complete package of recommended practices. Besides, seeds of improved varieties of wheat (NIAW-34 and Trimbak), soybean (JS-335) and pigeon pea (ICPL-87 and Vipula) were provided to tribal growers for cultivation in 208 acres. The cultivation of horticultural crops like chilli, okra and brinjal was initiated for the first time on a commercial scale. The details of area under crops and beneficiaries under each activity are given in Table 2.

Table 2. List of beneficiaries of crop demonstrations

Crops	2011-12		2012-13		2013-14	
	Area (acre)	Beneficiaries (No.)	Area (acre)	Beneficiaries (No.)	Area (acre)	Beneficiaries (No.)
Sugarcane	10	10	52	55	105	107
Paddy	-	-	100	109	379.5	416
Groundnut	-	-	71	71	11	22
Wheat	-	-	59	65	-	-
Soybean / pigeon pea	-	-	-	-	149	154
Mango	-	-	5	20	15	71
Brinjal	23	32	-	-	-	-
Chilli	-	-	-	-	14.2	56
Okra	50	79	-	-	78.5	106
Fruits / ornamentals	-	-	-	-	-	429

4.2.1 Field crops

The detailed crop wise interventions made are highlighted in the Table 3 and Fig. 15.

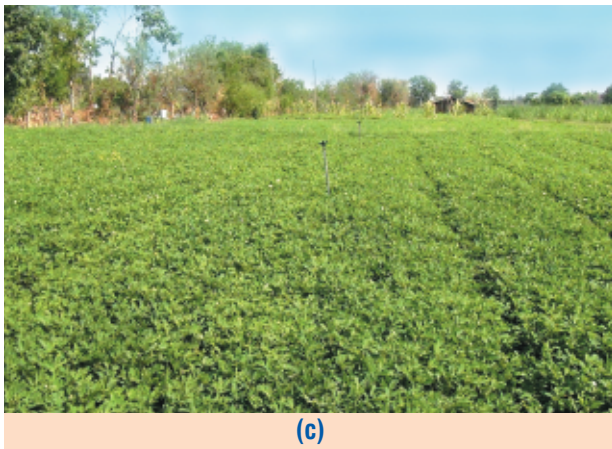


Fig. 15. Demonstrations on improved package of practices. Sugarcane cultivation by 5'x2' spacing with single bud method (a), Paddy cultivation by Charsutri method (b), Groundnut cultivation on raised bed with sprinkler system (c), Soybean (d), wheat (e) and Pigeon pea (f) cultivation by improved methods

Table 3. Crop wise interventions made and technical inputs provided to the tribal farmers

Activity	Farmers' practice	NIASM interventions		
		Sugarcane	Paddy	Groundnut
Field selection	<i>Sugarcane:</i> Water logged, ill drained, shallow soils and having trees <i>Paddy:</i> Fields with shade of trees <i>Groundnut:</i> Water logged, ill drained, deep soils and having trees	Well drained, medium to deep fertile soils without trees	Fields without shade of trees	Well drained, shallow to medium fertile soils without trees
Field preparation	Shallow ploughing with bullock drawn ploughs, no proper tillages, no FYM	Deep criss-cross ploughing, preferably using tractors followed by harrowing to create good tilth, use of FYM	Deep ploughing in summer preferably using tractors, use of FYM	Deep ploughing, preferably using tractors followed by harrowing to create good tilth, use of FYM
Variety	Local varieties	COM265 along with CO86032	HYV (Indrayani and Phule Samruddhi)	HYV (TAG-24, TG-37A, TG-51)
Seed / planting material	Impure, over matured, pest and disease infected	Superior quality, 10-11 month age, healthy planting material	Superior quality, healthy seed	Superior quality, healthy pods
Planting method	No definite geometry, narrow spacing, high plant population	Proper geometry with 1.5m row and 0.6m plant to plant spacing, optimal population with single budded seed sets	Introduction of four lined strategy (Charsutri) involving adoption of optimum plant spacing, use of Urea-DAP briquettes, application of paddy straw during puddling and incorporation of green manuring crops like gliricidia / dhaincha	Proper row to row (25 cm) and plant to plant (10 cm) spacing, dibbling method on raised bed and gap filling
Planting time	Delayed planting in sugarcane and early sowing in groundnut	Timely Suru planting (Dec. – Feb.)	June - July	Timely (late Jan. – early Feb.)
Seed / set treatment	No seed / set treatment	Set treatment with insecticides, fungicides, germination enhancers	Seed treatment with insecticides and fungicides	Seed treatment with germination enhancers and biopesticides
Nutrient management	Imbalanced and untimely use of NPK, no use of micronutrients, biofertilizers and organic manures	As recommended on soil test basis, micronutrients like Fe, Zn and Boron, biofertilizers like Acetobacter, Azotobacter, PSB and KMB	Use of Urea-DAP Briquettes, micronutrients like Fe, Zn and Boron, biofertilizers like Azotobacter, PSB and KMB	As recommended on soil test basis, micronutrients like Fe, Zn and Boron, Biofertilizers like Rhizobium
Weed / pest management	Poor weed / pest management, severe weed infestations fields, no herbicide use	Proper weed control using atrazine, 2-4-D, glyphosate and timely weeding	As per recommendations	Proper and timely weeding before peg formation
Irrigation management	Flood irrigation, excessive quantities, improper schedule	Drip irrigation, schedule of proper and timely irrigations	As per recommendations according to various stages	Sprinkler irrigation, proper and timely irrigations

Table 3. Contd.

Activity	Farmers' practice	NIASM interventions		
		Sugarcane	Paddy	Groundnut
Intercultural operations	<i>Sugarcane</i> : Untimely partial earthing-up and no full earthing-up <i>Paddy and groundnut</i> : No inter-cultural operations	Timely earthing-up, de-trashing, removal of main shoot	Timely uprooting of weed / off-type plants	Drenching with growth promoters, fungicides and insecticides
Harvesting	Harvesting before / after maturity	Harvesting at right maturity stage	Harvesting at right maturity stage	Pre-soaking irrigation followed by harvesting at right stage
Residue management	<i>Sugarcane</i> : Burning of trash after harvesting <i>Paddy and groundnut</i> : feeding of straw to animals	Chopping and surface retention of trash after harvesting	Incorporation in soil as well as feeding to animals	Feeding to animals after chopping

4.2.2 Horticulture crops

Mango: The interventions made included the integrated nutrient management (INM) as well as integrated pest management (IPM) (Fig. 16)



Fig. 16. Demonstrations on INM (a) and IPM (b) in mango

Vegetables: During 2011-12, group cultivation of vegetables like brinjal and okra was initiated and the area covered was 23 and 50 acres, respectively. This was the first attempt of vegetable cultivation on group basis, several constraints were faced in implementing the activity which included: lack of knowledge about field preparation for vegetables, imbalanced fertilizer use, inappropriate water management and inter-cultural operations, little know-how about pests and diseases, nutrient deficiency symptoms, appropriate time of harvesting, post-harvest management, market arrival and price

patterns of vegetables, etc. Moreover, there existed groupism and thus lack of co-ordination. As a follow-up, new farmer groups were constituted during 2013-14 for cultivation of okra and chilli (Fig. 17). The complete package of inputs and marketing were provided to the vegetable growers (Chilli-14.2 and Okra-78.5 acre) as given below:

- Provision of quality seedlings, fertilizers, pesticides and plastic crates

- Advisory services on field selection, variety, planting technique and proper period, seed treatment, nutrient, weed and irrigation management, harvesting and post-harvest management, etc.
- Market survey, observance of arrival and price pattern of markets as well as group procurement of inputs and group marketing of outputs



(a)



(b)

Fig. 17. Demonstrations on improved package of practices in chilli (a) and okra (b)

Plantation of fruit and ornamental trees:

The 2754 seedlings of fruit crops (mango, sapota and coconut) and ornamentals like ashoka,

bottle palm and almonds were distributed to 429 tribal farmers and 13 schools / village panchayats (Fig. 18).



(a)



(b)

Fig. 18. Plantation of fruit and ornamental trees. Almond (a) and Coconut (b)

4.2.3 Dairy development

The purpose of these activities was to boost the milk production to meet the day-to-days requirement of the tribals and also improve their livelihood with livestock rearing. The major interventions and implementation strategies thereof were as follows:

- Organization of exposure visits / trainings at advanced dairy units / farms
- Organization of on-farm trainings at innovator dairy farmers' houses
- Surveys for milk production and availability of marketable surplus
- Facilitation for nutritional, health, shelter, financial, marketing, insurance, record, management programs in existing animals
- Raising high yielding fodder crop on tribal farmers' fields
- Formation of milk producers' co-operative societies in tribal villages
- Facilitation for cattle breeding and animal health services
- Introduction of high yielding improved breeds of milch cattle and buffalos



- Formation of dairy farmers group

In conforming to the above strategy, NIASM undertook following activities for livestock promotion in tribal areas of Navapur. Entire strategies are yet to be rolled out.

Fodder demonstration plot: The demonstrations of various forages like napier grass, marvel grass, lucerne, maize and jowar were undertaken on one acre plot with a purpose to showcase the available options to feed dairy animals (Fig. 19). Besides, they were educated about the importance of green fodder as a source of roughages to meet the nutritional requirement of dairy cattle.

Establishment of dairy demonstration unit: The dairy demonstration unit with one Holstein Friesian Cow and one Murrah Buffalo was established at Bokalzar village (Fig. 19). This will help in providing vocational and skill oriented training programmes to dairy farmers to ensure their higher profitability from livestock rearing. The dairy husbandry has huge potential in the region and will provides ample opportunity for running a profitable business for tribal unemployed women and youth.



Fig. 19. Establishment of dairy unit. Improved fodder plot (a) and cattle farm (b)



5. Creation of Productive Assets

Asset is anything that is capable of being owned or controlled to produce value and that is held to have positive economic value. Assets are multi-dimensional, and thus have manifold benefits. In agriculture, the productive assets like land, livestock, farm house, farm implements and equipment, etc. enable farmers to create more stable and productive lives and contribute to sustainable poverty reduction. As tribal farmers are highly resource-poor and own very few assets, creating productive assets is one of the major mandates of TSP. NIASM helped in creating productive assets in tribal areas of Navapur in the form of farm implement,

machineries, micro irrigation systems and livestock. The details of activities under creation of productive assets are described in this chapter.

5.1 Implement bank

Mechanization of agriculture is imperative to improve productivity and to transform agriculture from subsistence farming to agri-business. Mechanization not only reduces the drudgery and cost of field operations, it also improves the quality of land preparation, planting, intercultural operations, harvesting and processing. These modern machineries

Table 4. Implements / equipment / machinery under implement bank

Farm implement/s provided	Purpose to provide implement
Land preparation	
MB plough	Deep ploughing and to remove the hard pans formed at shallow depth
Rotavator	Break the hard and compact clods and loosening of soil
Cultivator	Prepare fine seed bed
Offset disc harrow	Prepare seed bed
Ridger	Formation of ridges and furrows for crops like sugarcane, vegetables, etc.
Front end dozer	Levelling of the land for uniform irrigation and crop growth
Reverse forward blade	Levelling, filling, back filling and farmyard cleaning
Sowing / transplanting	
Seed drill	For uniform sowing depth, optimum seed rate
Post hole digger	To drill / dig holes of various sizes and depths in soil for planting of fruit crops
Intercultural operations	
Wheel hoes	To reduce the women drudgery and improve the weeding efficiency
Power tiller	Puddling, mixing the green manure and crop residues, seed bed preparations, etc.
Sugarcane multi-purpose implement	To effectively carry out all sugarcane intercultural operations
Knapsack sprayer	Spraying in vegetable plots to control pest, diseases and weeds
HTP power sprayer	To spray pesticides, apply plant growth regulators and foliar nutrients to trees
Crop residue management	
Sugarcane trash chopper	Chopping trash and its surface retention to minimise burning

Table 4. Contd.

Farm implement/s provided	Purpose to provide implement
Post-harvest management	
Paddy thresher	To improve threshing efficiency and reduce human drudgery
Mini rice mill	Reduce women drudgery due to traditional rice milling
Dal mill plant	To provide dal from pulses in villages itself
Groundnut decorticator	To mechanically shell the groundnut and separate husk and kernel
Farm machineries	
Tractor with dumping trailer	Mechanical operations like deep ploughing, cultivating and pulverizing, levelling, sugarcane trash cutting, etc.
Mini tractor with trailer	Perform intercultural operations, transport farm inputs and produce, spraying, etc.
Urea briquetting machine	Minimizing wastages and increasing N-use efficiency in paddy cultivation
Chaff cutter	Cutting straw or hay into tiny and smaller pieces to be fed to cattle

have higher capacity and better efficiency to achieve timelines of operations and reduction in

human drudgery. However, these implements are more expensive and costly to maintain by



Fig. 20. Demonstration of various farm implements used for preparatory tillage operations. Mouldboard plough (a), Rotavator (b), Cultivator (c) and Ridger (d)

poor tribal farmers. This problem could be overcome by forming small groups and communities of tribal farmers which can afford to maintain these costly equipment. Hence under 'Implement Bank', farm implements/

machinery was provided that cover entire range of the farm operations like land preparation, sowing, intercultural operations, harvest and post-harvest management and crop residue management (Table 4-5 and Fig. 20-22).

Table 5. List of implements under implement bank

Year	Implements / equipment / machinery
2011-12	Rotavator (2), Power tiller (1), Sugarcane trash chopper (1), MB plough (1), Spray pump (3), Ridger (3), Chaff cutter (3), Wheel hoes (25) and Seed drill (1)
2012-13	Tractor with dumping trailer (1), Front end dozer (1), Mini rice mill (1), Paddy thresher (1), Urea briquetting machines (2), Mini tractors with trailer (2), Mini MB ploughs (2), Mini cultivators (2), Mini rotavators (2) and Double MB plough (1)
2013-14	HTP sprayer (1), Mini dal mill with polishers (5), Power tillers (5), Post hole digger (1), Groundnut decorticator (1), Offset disc harrow (1), Sugarcane multi-operations implement (4), Reverse - forward blades (2) and Cultivator (1)

Note: Figures in brackets represent number of items



Fig. 21. Demonstration of various farm implements used for intercultural operations. Earthing-up in sugarcane (a), Post hole digger (b), Sugarcane trash chopper (c) and Power tiller (d)



Fig. 22. Demonstration of post-harvest equipment. Dal mill (a) and Groundnut decorticator (b)

5.2 Micro-irrigation system

The water use efficiency is very low under conventional flood method of irrigation due to substantial conveyance and distribution losses. Though the region gets about 1194 mm rain during monsoons, a major part is wasted as runoff and thus scarcity occurs during the dry season. Hence the drip and sprinkler irrigation systems are demonstrated to the tribal farmers (Fig. 23).

5.2.1 Installation of drip irrigation systems

The micro irrigation in general and drip irrigation in particular has received considerable attention from policy makers, researchers, economists, etc. for its perceived ability to enhance water use efficiency and thus

contribute to enhance agricultural productivity, economic growth and environmental sustainability. This method results in resources saving, reducing energy (electricity) requirement, weed problems, soil erosion, cost of cultivation, increased yield of crops and farm profitability. Hence, drip irrigation system was installed on 51.2 acres of land. A total of 49 tribal farmers were benefitted from this activity.

5.2.2 Introduction of sprinkler irrigation system

Sprinkler system, another method of micro irrigation was not being used in tribal areas of Navapur. Therefore the demonstration of overhead sprinkler with raised bed system in groundnut was conducted to promote the use of sprinkler irrigation system.

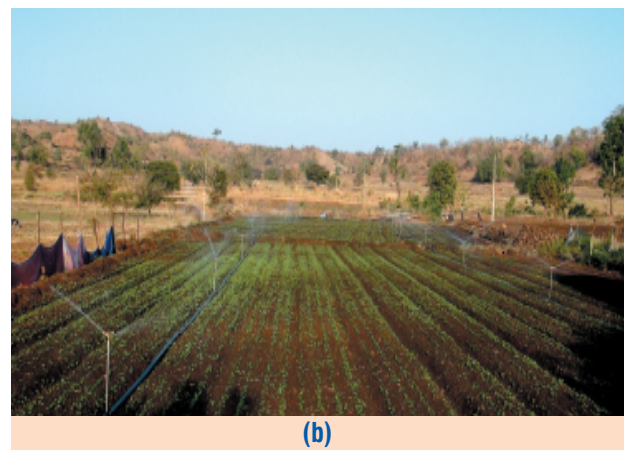
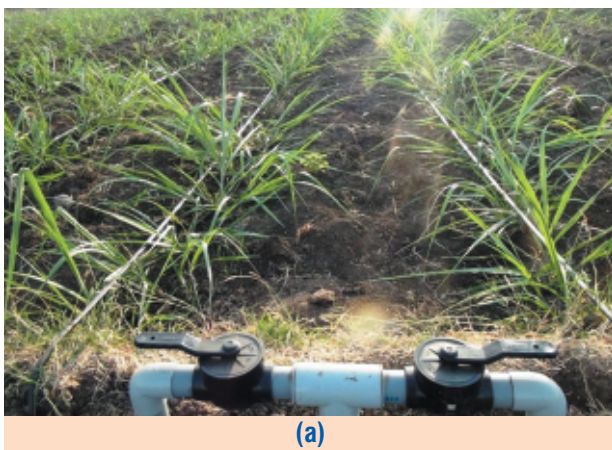


Fig. 23. Demonstrations of micro-irrigation systems. Drip (a) and Sprinkler (b)

6. Marketing Management

Most of the farming activities in the area are highly subsistent type, where the major proportion of the produce is used for home consumption. Only a tiny surplus is either sold in local markets or exchanged for day-to-day's essential items. Only a few farmers were growing the crops on commercial scale, but were finding it difficult to market their produce because of fragmented production units, market intelligence and poor market infrastructure. Operating through groups, farmers can reduce the cost of accessing inputs, production technologies, information and markets by sharing these costs amongst all members of the group. More specifically, farmers' group get benefitted by the following:

- Facilitate communication between extension workers and farmer
- Provide technical transfer and farmer training
- Facilitate credit provision and group guarantee

- Achieve economies of scale
- Aid quality control and assurance
- Improve bargaining power and upgrade processes
- Obtaining equipment and services on share basis

Considering these, NIASM initiated various activities like exposure visits, group meetings, trainings, marketing studies to educate tribal farmers to understand how markets work, how they can earn more money by collective action and how they can put these ideas into practice. The tribal farmers are motivated to form an association. The groups of farmers were created to encourage group based farming and marketing of agricultural produce. The institute developed information sharing and marketing model in a network mode is depicted in Fig. 24 and 25.

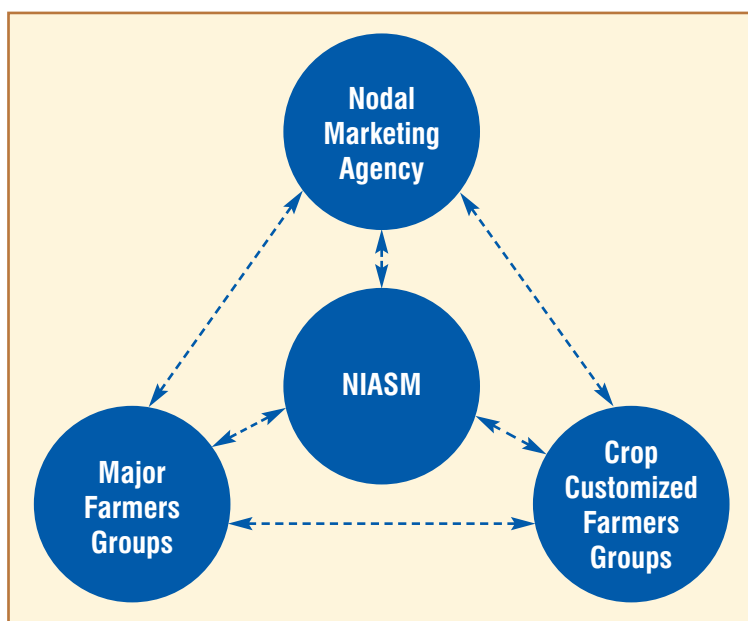


Fig. 24. Illustration of information sharing model

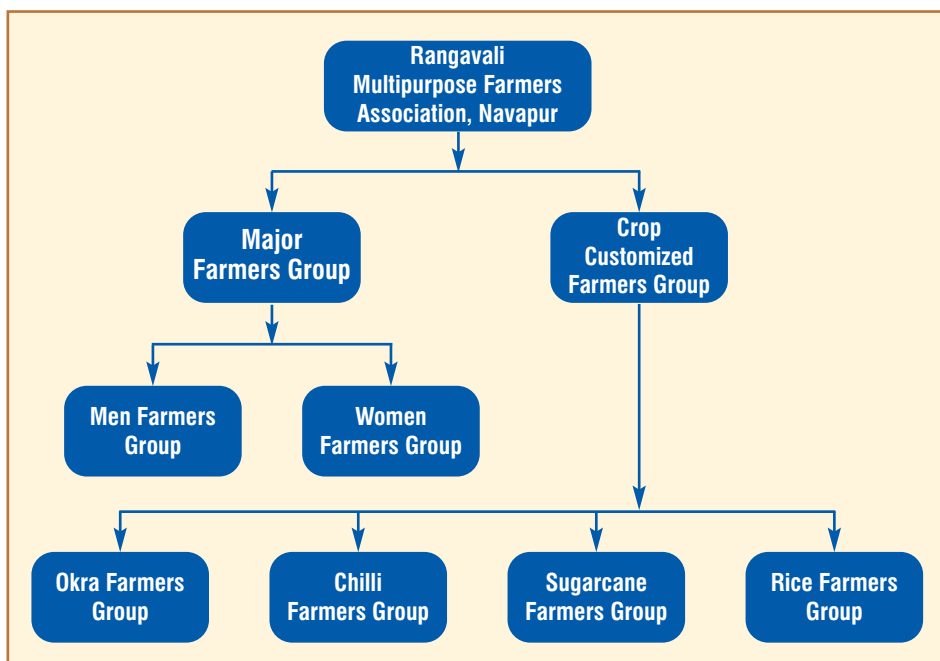


Fig. 25. Linkages among group of farmers

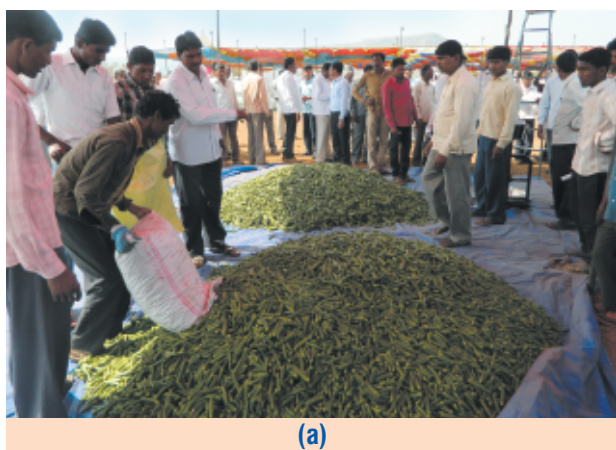
6.1 Major farmers' groups

The institute facilitated the formation of two major farmers' groups (one men and one women farmers group) in each selected villages of Navapur tehsil. The groups have no limitations for the number of members. The major functions of these groups are coordination and information flow between NIASM and crop customized farmers group. The biweekly meetings of these groups are

arranged regularly. The issues discussed in these biweekly meetings are crop planning, implementation and monitoring during crop seasons.

6.2 Crop customized farmers' groups

The purpose of forming customized farmers groups was to bring together farmers of one or more villages interested to grow a particular type of crop, e.g. the tribal farmers interested in



(a)



(b)

Fig. 26. Cooperative marketing of okra by farmers' group. Collection of harvested produce at hub (a) and group transportation to save transport cost (b)

growing okra were grouped under “Okra farmers’ group”, and so on for other crops like chilli, rice, sugarcane, groundnut, etc. (Fig. 26). Unlike major farmer groups, the members of these groups need not to be from same village but with same motive of growing a crop. These types of groups may be either temporary or limited to the one crop growing season or may be continued for the next growing season depending on the farmers’ will. These crop based farmers’ groups perform the following activities collectively:

- The group procurement of inputs
- Collective land preparation, fertilizer application, water management and intercultural operations
- Collective identifications of pest, disease and nutrient deficiency problems
- Collective cleaning, curing, handling, storage, packaging, transport, etc.

- Marketing management through study of market arrival and price patterns

6.3 Nodal marketing agency

The institute facilitated formation of ‘Rangavali Multipurpose Farmers Association’ to coordinate and facilitate the permanent groups and temporary crop customized farmers’ groups of Navapur tehsil. The membership of association is open to all the farmers of Navapur tehsil.

6.4 The institute: NIASM

Above all, the institute is performing the functions likes facilitation and coordination among major groups, crop customized groups and nodal marketing agency. Also the TSP team of institute is constantly monitoring and supervising various activities through visits, timely technical advice, etc.



7. Impact Assessment of TSP Interventions

Impact assessment of TSP interventions was carried out to evaluate change in agricultural production, productivity and profitability as well as knowledge of tribal farmers, i.e. both on quantitative and qualitative attributes which is discussed below:

7.1 Change in knowledge about package of practices of crops

In agriculture human resource development is an important factor in capacity building and improving the overall efficiency of functionaries involved in farming system. In order to achieve this, several HRD interventions were made by

NIASM and their impacts in terms of changes in knowledge and attitude of tribal farmers was assessed. The 50 farmers who attended various HRD programmes were selected randomly and divided into five groups containing 10 farmers each. The five groups represented five major crops, viz. sugarcane, rice, groundnut, vegetables and mango. The tribal farmers were interviewed before and after implementation of various activities under TSP and the change in knowledge level with regard to advanced crop production technologies were adjudged (Table 6).

Table 6. The explanatory variables for package of practices

Package of practices	Abbreviation	Explanations (Dummy variable for knowledge on)
Soil requirement	SR	Soil type, depth, pH, etc., requirement of crops: 1 for knowledge existing, otherwise 0
Climate requirement	CR	Temperature, humidity, rainfall, etc., requirement of crops: 1 for knowledge existing, otherwise 0
Land preparation	LP	Ploughing, harrowing and FYM application: 1 for knowledge existing, otherwise 0
Seed selection	SS	Different varieties and hybrids; quality seed, seed rate and seed treatment: 1 for knowledge existing, otherwise 0
Planting geometry	PG	Time, spacing and depth of planting / transplanting: 1 for knowledge existing, otherwise 0
Nutrient management	NM	Type, quantity, method and time of fertilizer applications: 1 for knowledge existing, otherwise 0
Intercultural operations	IO	Weeding, earthing-up and drenching: 1 for knowledge existing, otherwise 0
Irrigation management	IM	Quantity, time and quality of irrigation: 1 for knowledge existing, otherwise 0
Plant protection	PP	Methods, time, quantity and quality of plant protection: 1 for knowledge existing, otherwise 0
Post harvest management	PH	Drying, threshing, grading and storage: 1 for knowledge existing, otherwise 0
Role of institutions	RI	Research, extension and education institutions in agriculture: 1 for knowledge existing, otherwise 0

It was observed that before attending the HRD programmes, the overall knowledge of tribal farmers about package of practices was 22 per cent, but it has increased to almost three times to 74 per cent after attending TSP programmes. Earlier 38 per cent farmers were having knowledge on soil requirement of particular crop, which has increased to 96 per

cent farmers. Likewise, knowledge gain about various farming attributes like climate, land preparation, seed selection, planting geometry, nutrient management, intercultural operations, irrigation management, plant protection, post harvest management and role of institutions is shown in Fig. 27.

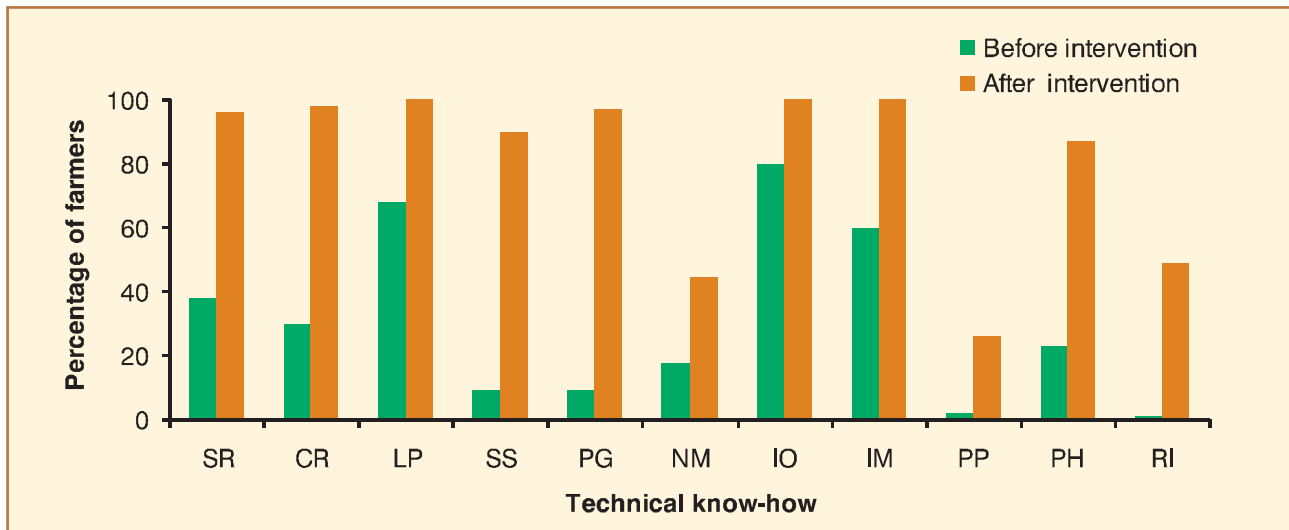


Fig. 27. Level of knowledge and awareness of various farming attributes (Table 6 for abbreviations)

7.2 Changes in crop productivity

Due to TSP interventions, a marked improvement in the productivity of crops was observed (Fig. 28 and 29). The maximum yield of sugarcane, paddy and groundnut before the intervention was 260, 15 and 7 q/acre respectively, which was increased to 670, 33.5

and 23.5 q/acre over a period of 3-years of TSP interventions. Similarly, on an average the farmers were getting 154, 7.2 and 3.4 q/acres of sugarcane, paddy and groundnut yields before various interventions under TSP which was increased to 429, 20.9, 12.2 q/acre in three years, indicating around 2-4 fold increase in yields.

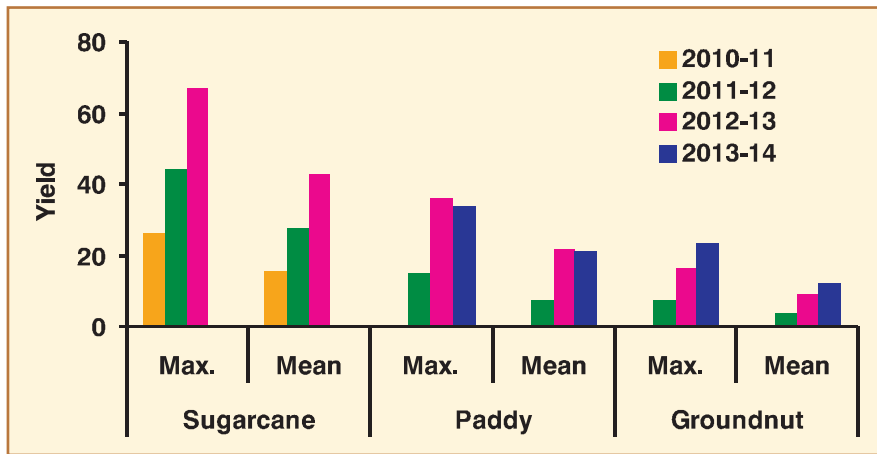


Fig. 28. Changes in crop productivity with TSP interventions (Sugarcane - ton/acre, paddy and groundnut - q/acre)

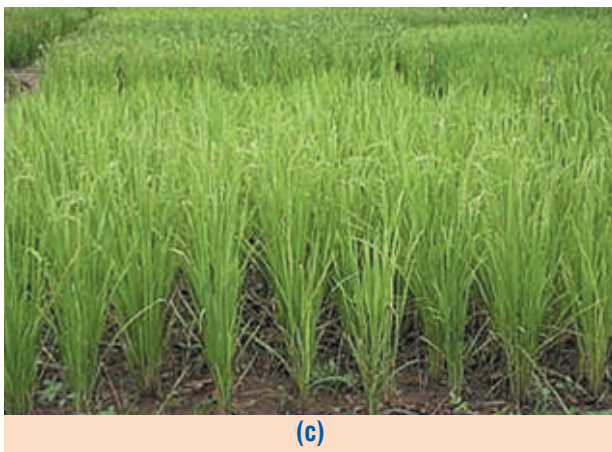
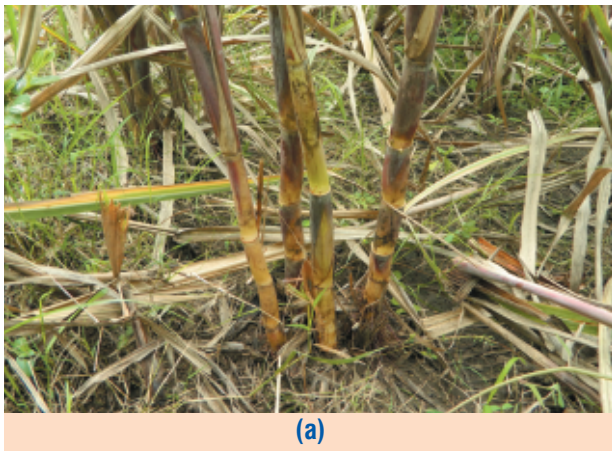


Fig. 29. Improvement in crop growth and performance with TSP interventions. Sugarcane: before (a) and after (b) interventions; Paddy: before (c) and after (d) interventions

7.3 Change in area under improved cultivation

In addition to productivity, the cropping activity increased markedly as reflected by increased acreage under sugarcane and paddy (Fig. 30) in the following years of intervention.

The area under improved sugarcane cultivation was nil before TSP interventions, which increased to 105 acres in 3rd year. Similarly, improved cultivation of paddy was also not adopted earlier but following the demonstrations, its area increased to 431 acres.

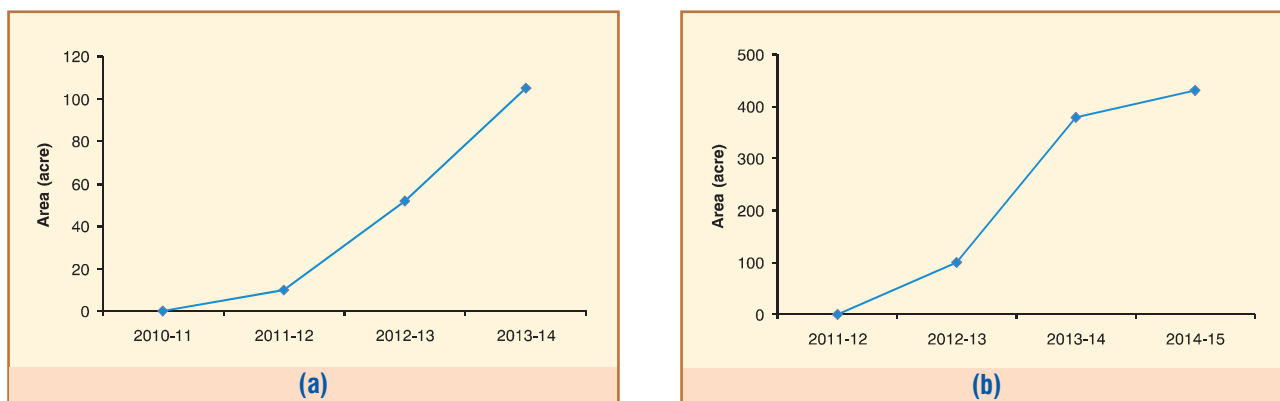


Fig. 30. Area under improved cultivations of sugarcane (a) and paddy (b) during TSP intervention phase

7.4 Commercialization of vegetable cultivation

Earlier, majority of vegetable production in Navapur tehsil was based on traditional subsistence agriculture in a low-input low-output production system. The introduction of new available technologies and HRD programmes transformed farming towards

commercialization with cultivation of vegetable crops. Farmers groups were constituted for cultivating chilli and okra on 14.2 and 78.5 acres of land on commercial lines with improved package and practices. It is noteworthy to mention here that farmers were able to produce okra worth Rs. 98.2 lakh with a net gain of Rs. 1.05 lakh per acre (Table 7).

Table 7. Economics of okra farmer group

Particular	Quantity
Total farmers (No.)	106
Total acres (No.)	78.5
Total villages (No.)	6
Total production (ton)	365.6
Average price (Rs./kg)	26.9
Minimum – Maximum price (Rs./kg)	15-55
Gross income of group of farmers (Lakh rupees)	98.2
Average per acre income (Lakh rupees)	1.25
Expenditure (tillage, seed, pesticides, etc.) (Rs./acre)	19,850
Net profit to farmers (Rs./acre)	1,05,235

7.5 Cost-benefit analysis of traditional vs. improved methods

The comparison of cost of cultivation and returns from sugarcane and paddy as cultivated by following traditional and modern methods are given in Table 8.

Sugarcane: Improved cultivation of sugarcane production involves the use of less seeds, less labor, less water and optimum utilization of fertilizers and land to achieve more yields compared to conventional seed, labor, water and space intensive cultivations. The per ton cost of sugarcane production is Rs.2889/- in traditional method whereas it is only Rs.1236/- in modern method. Compared to traditional method, the gross income (Rs.33880/- per acre) is almost 178.6 per cent

higher in modern method (Rs.94380/- per acre). The B:C ratio in traditional method is 0.76 where as it is 1.78 in modern methods. It indicates that modern method is economically efficient method compared to traditional method.

Paddy: The cost of production works out to be Rs.17540/- per ton in traditional method whereas it is Rs.9590/- per ton in modern method. This shows that per unit cost of production is 82.9 per cent less in modern method compared with traditional methods. Compared to traditional method (Rs.12306/- per acre) the gross income is 253.6 per cent higher in modern method (Rs.43510/- per acre). The B:C ratio in traditional method is 0.97 where as it is 2.17 in improved methods.

Table 8. Cost of cultivation (Rs/acre) for sugarcane and paddy

Particulars	Sugarcane		Paddy	
	Traditional	Improved	Traditional	Improved
Operational cost (I)	35053	32726	9552	11093
Human labor	11392	7848	5148	6667
Animal labor	1600	Nil	800	1000
Machine labor	2600	8600	Nil	1000
Seed	9600	2900	1450	530
Fertilizer and manure	7127	9725	1871	1400
Chemicals	Nil	1081	Nil	176
Irrigation	750	720	50	50
Interest on working capital	1984	1852	233	271
Fixed cost (II)	5397	15480	1926	7127
Sub-total (I+II)	40450	48206	11478	18220
Managerial cost @ 10%	4045	4821	1148	1822
Total cost	44496	53027	12626	20042
Yield (ton)	15.4	42.9	0.72	2.09
Gross income	33880	94380	12306	43510
Cost of production (Rs./ton)	2889	1236	17540	9590
B:C ratio	0.76	1.78	0.97	2.17

7.6 Marketable surplus

The improvements in crop yields led to an increase in marketable surpluses, e.g. it was only about 14.8 per cent of paddy production which increased to 56.4 per cent. This indicates that the tribal farmers are shifting from subsistence to commercial farming thereby leading to an increased area under commercial paddy cultivation.

7.7 Growth of agriculture input values

The overall economic growth of farmers is leading to improvements in their purchasing power and this in turn is leading to an increase in market value of goods and services as detailed below.

Irrigated land: In Navapur, value of irrigated agriculture land has increased from about Rs. 1.19 lakh during 2010-11 to Rs. 3.00 lakh per acre in 2013-14.

Labor: The male labour wages (hiring costs) have improved considerably. This was Rs. 45.9/- per day during 2010-11 and has increased to Rs. 99.6/- during 2013-14. Also the female labor wages have increased from Rs. 33.2/- during 2010-11 to Rs. 69.2/- during 2013-14.

Farmyard manure: Earlier, farmers were

not aware about the importance of FYM in agriculture and were selling the same to non-tribal progressive farmers of other areas at very cheaper rates. With interventions under TSP about importance of FYM, they are increasingly using FYM at their farms. This has led to almost four-fold increase in prices of FYM, i.e. from Rs. 190.2/- in 2010-11 to Rs. 1002.4/- per ton in 2013-14.

Ploughing and harrowing: The market rates of getting field operations done have also increased substantially, e.g. the rate for ploughing and harrowing operations which were Rs. 379.3/- and 351.2/- per hour in 2010-11 have increased to Rs. 562.2/- and 530.5/- in 2013-14.

7.8 Social change

A major social change that occurred in rural community is that now they are shifting towards progressive way of living. With overall improvement in awareness, they are voluntarily participating in various collective activities, e.g. the Bokalzar village won the second prize at state level of "Sant Gadge Baba Gram Swachhata Abhiyan" during 2012-13 (Fig. 31). Another village Gadad won the same award at tehsil level during 2013-14.



Fig. 31. "Sant Gadge Baba Gram Swachhata Abhiyan" award. Second prize at state level for Bokalzar village (a) and third prize at District level for Gadad village (b)

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9. NIASM in News

The local media took no time in disseminating the success stories and soon entire district was abuzz with the interventions created by NIASM in Navapur tehsil, hitherto ignored by any agency in this remote, poor and tribal

dominated district of Maharashtra. The news about success of TSP programme in Navapur tehsils is published by 39 times in local newspaper during three years. The few of them are given below.



Source: Daily Lokmat, Nandurbar, September 4, 2012.



Source: Daily Sakal, Pune, November 22, 2014



Source: Daily Lokmat, Pune, October 15, 2012



Source: Daily Agronow, October 16, 2012



Source: Daily Sakal, Pune, October 31, 2012



Source: Daily Sakal, Jalgaon, November 24, 2014



Abbreviations

ATW	: Agriculture Technology Week	IPM	: Integrated Pest Management
BAIF	: BAIF Development Research Foundation	KMB	: Potash Mobilizing Bacteria
CEC	: Cation Exchange Capacity	KVK	: Krishi Vigyan Kendra
CSRS	: Central Sugarcane Research Station, Padegaon	MB Plough	: Mould Board Plough
DAP	: Di-ammonium Phosphate	MPKV	: Mahatma Phule Krishi Vidyapeeth, Rahuri
DES	: Directorate of Economics and Statistics	NH	: National Highway
DOGR	: Directorate of Onion and Garlic Research, Rajgurunagar	NIASM	: National Institute of Abiotic Stress Management, Baramati
EC	: Electrical Conductivity	NRCG	: National Research Centre for Grapes, Pune
FYM	: Farm Yard Manure	OC	: Organic Carbon
GOI	: Government of India	PPM	: Parts Per Million
HP	: Horsepower	PSB	: Phosphate Solubilizing Bacteria
HRD	: Human Resource Development	SC	: Scheduled Caste
HTP	: Horizontal Triplex Power	SMS	: Short Message Services
HYV	: High Yielding Varieties	ST	: Scheduled Tribes
ICAR	: Indian Council of Agricultural Research	TSP	: Tribal Sub Plan
INM	: Integrated Nutrient Management	ZARS	: Zonal Agriculture Research Station, Igatpuri





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