Doubling of Farmers' Income by 2022

More Production

Less Cost of Production

Remunerative Price

ORGANISATION & PLANNING

SOIL MANAGEMENT & FERTILITY

CROP HEALTH & PROTECTION

ENERGY EFFICIENCY

LIVESTOCK

WATER MANAGEMENT

VALUE ADDITION

भाकृअनुप

ICAR

भाकृअनुप–राष्ट्रीय अजैविक स्ट्रैस प्रबंधन संस्थान

ICAR-National Institute of Abiotic Stress Management

(समतुल्य विश्वविद्यालय / Deemed to be University)

मालेगाव (खु), बारामती – ४१३ ११५, पुणे

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Preface

Agriculture provides employment to more than 50% of the population but its contribution to national GDP is about 14 %. Despite self-sufficiency in food production and state of art agricultural technologies, it is unfortunate that the farmers income has not been given due attention and consequently there is an increase in agrarian distress. Taking into consideration the concerns of farmer, Honourable Prime Minister of India called for necessary action to double the income of farmers by March, 2022, when the country completes 75 years of independence. The need for doubling the farmers income was elaborated and possible strategies emphasised by Dr Ramesh Chand, Member of NITI Aayog in the Directors conference organised by ICAR on 14th and 15th February, 2017. As a follow-up, Indian Council of Agricultural Research (ICAR) constituted the State Coordination Committee (SCC) involving Vice Chancellors, Directors of ICAR institutes and the Key officials from Department of Agriculture of the respective state. National Institute of Abiotic Stress Management (NIASM), one of the key institutes of ICAR in Maharashtra was assigned the duty of convening the meeting and submitting the strategy document to accomplish the task under the Chairmanship of Hon'ble Vice Chancellor of MPKV, Rahuri. The committee had a detailed discussion involving different stakeholders in the state in two separate meetings on the issues related to doubling the farmers income. In addition a series of online discussion was held. Opinion of all the members, scientists from SAUs, NGOs and farmers representatives were collected. This document brings together the opinions and suggestions emerged from the meeting and discussions to achieve the task of doubling the farmers income. The key documents on doubling the farmers income published by NITI Aayog, NAIP and the valuable suggestions by Dr. Swaminathan presented to Honourable Prime Minister were considered to structure this strategy document.

We sincerely thank Dr. T. Mohapatra, Secretary, DARE and DG, ICAR for guidance provided for this strategy document. Our gratitude to Shri. Kesarkar, Hon'ble, Minister of State for Home (Rural), Finance & Planning, Government of Maharashtra for making it convenient to attend the meeting and share his views. We acknowledge the support and guidance extended by Vice Chancellors and Director of Research for providing the valuable information for this document. Our sincere gratitude are due to Shri. Sachindra Pratap Singh for the encouragement and support extended to us in preparing this strategy document. We thank to University staff at Agricultural College, Pune and Dr. S.D. Sawant, Director of NRC Grapes for extending the conference facilities for the meetings. We are extremely thankful to Directors of ICAR-NBSSLUP, Nagpur: ICAR-ClCR, Nagpur: ICAR-CCRI, Nagpur: ICAR-NRC Pomegranate, Solapur: ICAR-DOGR, Pune, We also thank Agriculture Commissioner, Maharashtra State and key authorities in the department of agricultural of the state. Our thanks are due to all our colleagues who assisted in convening the meetings. We also appreciate the assistance extended by Dr. Jagadish Rane, Principal Scientist and Member Secretary, PME, NIASM in compiling this document. Technical assistance by Mr. Madhukar Gubbala.

Dr. Narendra Pratap Singh
(Director, ICAR-NIASM)
Convener

Dr. K.P. Vishwanatha
(Vice Chancellor, MPKV)
Chairman

State Level Coordination Committee of Maharashtra

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1 Introduction

Remarkable progress in food production from different sectors including crop cultivation, horticulture, livestock, fisheries and other allied sectors is highly evident in the recent years. In addition to technologies, the farmers role in this achievement is highly significant. However, except few many farmers in the country are poor though they are the key persons associated with food security of more than a billion people in the country. Realizing this ground truth and necessity for sincere initiatives, the Hon'ble Prime Minister while addressing a farmers rally in Bareilly, Uttar Pradesh, on 28th February, 2016 shared his vision on doubling the farmers income by the time the nation celebrates her 75 years of independence in the year 2022, He subsequently reiterated this by shaping his vision around the following frame work:

- Special focus on irrigation with sufficient budget, with the aim of "Per Drop More Crop".
- Provision of quality seeds and nutrients based on soil health of each field.
- Large investments in Warehousing and Cold Chains to prevent post-harvest crop losses
- Promotion of value addition through food processing.
- Creation of a National Farm Market, removing distortion and e-platform across 585 Stations
- Introduction of a New Crop Insurance Scheme to mitigate risks at affordable cost.
- Promotion of ancillary activities like poultry, beekeeping and fisheries.

The Finance Minister reading out his budget speech for the year 2016-17 stressed the need to think beyond food security and give back to our farmers a sense of income security. Elaborating further, he said that the Government will reorient its interventions in the farm and non-farm sectors to double the income of the farmers by the year 2022.

1.1 Initiatives by ICAR

In pursuance of the policy initiative taken by the Government of India towards doubling the farmers income by March 2022, a presentation was made by Prof. (Dr.) Ramesh Chand, Member NITI Aayog on 24th Feb 2017 during the Annual Conference of the Vice Chancellors of the Agricultural Universities and the Directors of ICAR Institutes. As this is a very challenging task, it would involve coordinated effort from all the concerned departments and agencies with a mission-mode approach. Towards this objective, State-wise Coordination Committees (SCCs) for doubling farmers incomes have been constituted at the level of ICAR with the Vice Chancellor of one of the Agricultural Universities in the state as the Chairman and one of the Directors of ICAR Institute/ATARI as the convener of the committee. All the other Vice Chancellors and the ICAR Directors, Director ATARI of the concerned region, one nominee of DAC & FW, DAHDF, Ministry of Food Processing Industries and Ministry of Water Resources as well as the senior representatives of the concerned State Departments as the members of the committee. Senior representatives from CGIAR system and commodity boards and the farmers organizations have also been co-opted as additional members in some of the committees as per requirement (Annexure I). The committees have been assigned the task of developing the comprehensive strategy documents on doubling farmers income by 2022 for their respective states including existing productivity and income levels of the farmers in the respective states, interventions to double the income of farmers/ agricultural labourers by the year 2022, recommendations on the implementation of the action plan, its monitoring and midcourse corrections. The SCCs have been requested to focus on the strategies and technologies suitable for the particular Agro ecological regions of their respective states and maintain constant liaison with the various stakeholders and the implementing agencies in the state and central level and include proven technologies and success stories preferably in Farming Systems Mode in these documents giving end to end solution for their adoption. The presentation made by Dr. M. S. Swaminathan

before the Hon'ble Prime Minister on the subject, NITI Aayog Documents, DAC & FW Documents, Policy Papers developed by ICAR-NIAP and other relevant documents was also shared with the SCCs to develop the state specific proposals accordingly.

1.2 State Level Coordination Committee

With reference to councils office order vide F.No.5-4/2017-Cdn (Tech) Dated: March 6, 2017. The Secretary (DARE) & DG, ICAR is pleased to constitute a State-wise Coordination Committees for doubling Farmers income by March, 2022 as mentioned Table 1.2. National Institute of Abiotic Stress Management (NIASM), one of the key institutes of ICAR in Maharashtra was assigned the duty of convening the meeting and submitting the strategy document to accomplish the task under the Chairmanship of Hon'ble Vice Chancellor of MPKV, Rahuri. Consequently, the first meeting was organized on April 3, 2017 inviting all the members of the SCC, Maharashtra at Agricultural College Pune. This was followed by another meeting on April 27, 2017 to include the views of prominent persons and progressive farmers in Maharashtra agriculture.

Table 1.1 : State Level Coordination Committee, for doubling farmers incomer in Maharashtra :

Designation	Role
Vice Chancellor, MPKV, Rahuri, Ahmednagar-413 722, Maharashtra	Chairman
Director, Natl. Institute of Abiotic Stress Mgmt., Baramati-413 115, Pune, Maharashtra	Convener
Vice Chancellor, VNMKV, Parbhani-431 402	Member
Vice Chancellor, Dr. PDKV, Akola - 444 104, Maharashtra	Member
Vice Chancellor, MAFSU, Nagpur-440 001, Maharashtra	Member
Vice Chancellor, Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri-415 712, Maharashtra	Member
Director, Central Institute of Cotton Research, Nagpur-440 010, Maharashtra	Convener
Director, Central Institute on Fisheries Education, Andheri (West) Mumbai-400061, Maharashtra	Member
Director, Central Citrus Research Institute, Nagpur-440010, Maharashtra	Member
Director, NRC Grapes, Pune-412 307, Maharashtra	Member
Director, NRC Pomegranate, Solapur-413 255, Maharashtra	Member
Director, Directorate of Onion and Garlic Research , Rajgurunagar, Pune-410 505, Maharashtra	Member
Director, Directorate of Floricultural Research, Pune-411 105,Maharashtra	Member
Director, National Bureau of Soil Survey and Land Use Planning, Nagpur-440 033, Maharashtra	Member
Director, Central Institute of Research on Cotton Technology, Mumbai-400019, Maharashtra	Member
Director, ATARI, Zone VIII, Pune	Member
Director Agriculture, State of Maharashtra	Member
Director Animal Husbandry, State of Maharashtra	Member
Director Horticulture, State of Maharashtra	Member
Director, Fisheries, Govt. of Maharashtra	Member
Nominee of Secretary DAC & FW	Member
Nominee of Secretary, DAHDF	Member
Nominee of Secretary, Ministry of Food Processing industries	Member

1.3 Meeting/consultation details

The first meeting of SLCC was organized on April 3, 2017 inviting all the members of the SCC, Maharashtra at Agricultural College Pune. This was followed by another meeting on April 27, 2017 to include the views of prominent persons and progressive farmers in Maharashtra agriculture.

It was observed that National Agricultural Research System (NARS) and other stakeholders are responsible for enhancing the income of farmers and there is need of concerted effort to evolve action plan, phase by phase with target of 5 years. It was opined that each institute is achieving the goals, however, there are some gaps which all should admit and address them to improve economic conditions of farmers who contributes to the nation significantly. Based on the discussion and suggestion provided by all the participants and the state level coordination committee the strategy document has been prepared with general information, constraints in accomplishing the task and options and opportunities and recommendations. Attempts have been made to highlight technology interventions along with examples for doubling the income of the farmers, policy interventions that need to be taken in this regard, strategies for the postharvest management and value addition, development of the value chain along with the market linkages and all the other aspects and alternate strategies along with combination of the enterprises. It was also suggested that the document also includes strategies for increasing the off-farm income and employment opportunities.

1.4 An overview of need for enhancing the income

Enhancing the income of the farmers in Maharashtra is highly essential as about 49.3% of farm households are earning income below the poverty line. The situation sounds critical from the data that on an average about 57% of the household had outstanding farm loan and average of outstanding loan /ha land was about Rs 35, 111 as reported in 2015. The crop cultivation is becoming increasingly unviable as the proportions of small and marginal holdings are rapidly increasing. Almost 49% of the farmers in Maharashtra own less than 1 ha. Land (Table 1.1).In contrast proportion of farmers having more than 5 ha is only about 26%.

Table 1.2 : Size of holdings in Maharashtra (2010-2011 Census)

Holding Size (ha.)	No. of Operational Holdings('000)	% to total	Area of operational Holdings ('000 ha.)	Percentage to total
Marginal (Up to 1.0)	6,709	49.0	3,186	16.1
Small (1.0-2.0)	4,049	29.6	5,734	28.9
Semi-medium (2.0-5.0)	2,158	15.8	5,761	29.0
Medium (5.0-10.0)	710	5.2	3,989	20.1
Large (10.0 and above)	73	0.4	1,171	5.9
Total	**13,699**	**100.0**	**19,842**	**100.0**

Source : http://planningcommission.nic.in/plans/stateplan/Presentations13_14/ maharashtra2013_14.pdf

Analysis of data from the year 1993 to 2015 clearly reveals that there has been gradual increase in the farmers income in Maharashtra over the base year 1993 (Fig). During the 23 years, farmers income in Maharashtra has increased by 391 per cent in the year 2015 over the base year 1993 while the highest farm income (Rs 110449) was recorded in the year 2013, and it was 443 per cent more than the base year. This clearly indicates that there is need to focus on avenues for enhancing the farmers income and that the various options are needed to achieve the target of doubling the farmers income by 2022.

Further it is also evident from analysis that there is wide variation in the cost benefit ratio of different field and horticultural crops. Figure reveals that the cotton, onion, sugarcane and many of the horticultural crops are having B: C ratio more than one while all the foodgrain, pulses and oilseeds crops are having B:C ratio less than one. It hints at the need for special focus on technological options for enhancing the productivity of food grains, reduction in cost of cultivation and measures for ensuring reasonable prices for these commodities.

Growth rate of farm income in Maharashtra, per cent per year Compound growth rate

The compound growth rate of Maharashtra's farm income was estimated by using semi log trend equation.

$$Y = ab^t$$

Compound growth rate (%) = (antilog b – 1) x 100

The compound growth rate of Maharashtra's farm income was estimated for the period 1993-94 to 2015-16. The analysis indicates that the farmers income increased at the rate of 7.20 per cent per annum. The farmers income in Maharashtra has to be enhanced to Rs 2,00,000 by 2022 instead of Rs 1,00,033 as on 2014-15. This implies need for nearly 20% increase per year till 2022.

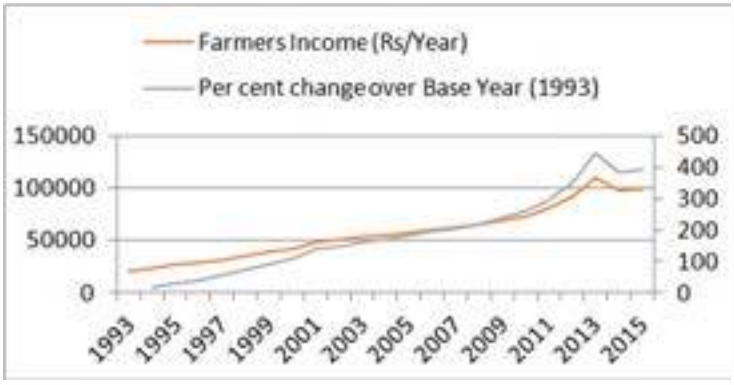

Figure 1.1 : Maharashtra state Average income of Agricultural Households at current price ( )

Note : With the available income figures for the year 2015 (DFI Committee) Farmers income is deflated with the Consumer Price Index for Maharashtra to get the farmers income from the year 1993 to 2014.

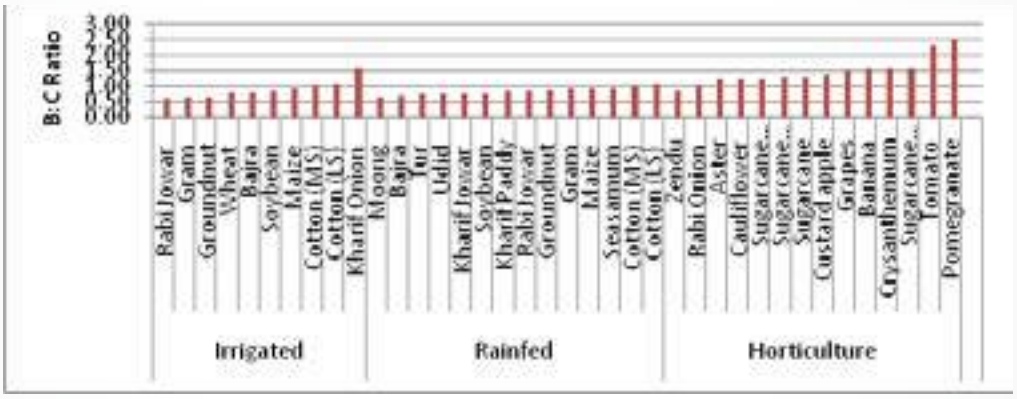

Figure 1.2 : B:C ratio for different crops in Maharashtra

Analysis of cost and benefit ratio further reveals that farmers are not getting any benefit from kharif crop with or without irrigation. However, the onion was an exception though its market price fluctuates significantly (Table 1.2). Further, rabi crops such as wheat, rabi jowar and gram were also not profitable. Further, sugarcane generated more income as indicated by the B: C ratio. Similar trend was observed for horticultural crops like onion, tomato, pomegranate and grapes. For pomegranate the benefit earned was twice the cost of cultivation (Table 1.3). This indicates that the scope for doubling farmers income by shifting to the high value crop in Maharashtra particularly in water scarcity zones. Cotton farmers get the remuneration from their crop equivalent to the cost of cultivation apparently without any profit. None of the major pulse and oilseed crops has been found to be profitable. This clearly emphasis urgent need for concerted efforts to increase the income of farmers of Maharashtra.

Table 1 3. : **Per ha value of output of field crops in Maharashtra for the year 2013-14**

Sr. No	Crops	Main yield (q/ ha)	Cost and Value of Product (Rs '000)						B:C Ratio
			Cost 'C'/ha	Rate/ qtl	Main	By produce	Gross	Cost/ qtl	
1	Kh. Jowar (U)	20.99	47.76	1.02	21.35	15.03	36.38	1.56	0.76
2	Bajra (U)	15.94	42.34	1.42	22.56	7.09	29.65	2.21	0.7
3	Bajra (I)	24.11	54.78	1.49	35.86	8.49	44.35	1.92	0.81
4	Groundnut (U)	12.11	55.91	3.82	46.23	2.26	48.49	4.43	0.87
5	Groundnut (I)	12.85	76.48	3.66	46.97	1.78	48.75	5.81	0.64
6	Cotton (LS) (U)	16.98	76.07	4.78	81.24	0.51	81.75	4.45	1.07
7	Cotton (LS) (I)	22.08	99.29	4.80	105.89	0.57	106.46	4.47	1.07
8	Cotton (MS) (I)	18.76	93.03	5.08	95.31	0.55	95.85	4.93	1.03
9	Cotton (MS) (U)	13.68	69.40	5.01	68.60	0.42	69.02	5.04	0.99
10	Maize (I)	49.27	64.52	1.03	50.61	8.79	59.40	1.13	0.92
11	Maize (U)	43.1	61.25	1.01	43.39	13.86	57.25	1.10	0.93
12	Moong (U)	5.07	39.05	4.92	24.95	0.71	25.65	7.56	0.66
13	Seasamum (U)	7.5	30.55	3.80	28.50	0.17	28.67	4.05	0.94
14	Soybean (I)	16.99	56.89	2.70	45.87	1.03	46.90	3.29	0.82
15	Soybean (U)	11.91	49.45	3.11	37.02	0.67	37.69	4.10	0.76
16	Kharif Paddy(U)	42.7	97.43	1.67	71.20	8.36	79.55	2.09	0.82
17	Tur (U)	6.78	44.04	4.70	31.86	1.11	32.97	6.33	0.75
18	Udid (U)	6.62	35.57	3.95	26.18	0.46	26.64	5.30	0.75
19	Kharif Onion (I)	105.65	129.83	1.90	200.76	0.00	200.76	1.23	1.55
20	Rabi Jowar (I)	12.97	65.99	1.93	25.08	13.48	38.56	4.05	0.58
21	Rabi Jowar (U)	8.37	31.12	1.85	15.48	10.31	25.79	2.49	0.83
22	Wheat (I)	24.29	67.08	2.16	52.51	0.48	52.99	2.74	0.79
23	Gram (I)	11.82	55.54	2.91	34.41	0.24	34.64	4.68	0.62
24	Gram (U)	9.7	30.45	2.82	27.35	0.93	28.28	3.04	0.93
25	Sugarcane (Ratoon)	925.49	129.89	0.21	194.35	12.50	206.86	0.13	1.59
26	Sugarcane (Pre-sea)	1227.53	212.14	0.21	257.78	18.35	276.13	0.16	1.3
27	Sugarcane (Adsali)	1375.46	245.30	0.21	288.85	20.92	309.77	0.16	1.26
28	Sugarcane (Suru)	1039.85	189.64	0.21	218.37	13.99	232.36	0.17	1.23

Table 1.4 : **Per ha value of output of major crops /groups in Maharashtra for the year 2013-14**

Sr. No	Crops	Main yield (q/ha)	Cost and Value of Product (Rs '000)					B:C Ratio
			Cost 'C'/ha	Rate/qtl	Main	Gross	Cost/qtl	
1	Kh. Onion (I)	105.65	129.83	1.90	200.76	200.76	1.23	1.55
2	Rabi Onion (I)	203.50	149.89	0.74	151.45	151.45	0.74	1.01
3	Pomegranate	86.23	280.89	8.13	701.15	701.15	3.26	2.5

Sr. No	Crops	Main yield (q/ha)	Cost and Value of Product (Rs '000)					B:C Ratio
			Cost 'C'/ha	Rate/qtl	Main	Gross	Cost/qtl	
4	Grapes	296.23	556.79	2.79	826.13	826.13	1.88	1.48
5	Banana	588.49	347.07	0.93	547.65	547.65	0.59	1.58
6	Custard apple	59.71	91.53	2.14	127.84	127.84	1.53	1.4
7	Tomato	90.00	95.51	2.45	220.50	220.50	1.06	2.31
8	Cauliflower	37.83	35.66	1.14	43.02	43.02	0.94	1.21
9	Zendu	56.67	224.63	3.40	192.95	192.95	3.96	0.86
10	Aster	34.68	119.23	4.14	143.68	143.68	3.44	1.21
11	Crysanthemum	57.92	186.74	5.09	294.99	294.99	3.22	1.58

Source : State cost of cultivation scheme, Dept.of Agricultural Economics, MPKV Rahuri.

From Table 3, it is evident that the worker productivity for the primary sector was Rs 63343 per worker while the productivity of the Non –farm worker was Rs 1, 49,384 per worker. This clearly indicates that the farmers in Maharashtra be encouraged for non -farm activities to increase the productivity of the workers and increase the income of the workers and farmers.

Table 1.5 : Worker productivity in farm and non -farm sectors in rural areas during 2011-12

Sector	Net Domestic Product		Workforce based on usual status		Worker productivity (Rs/Worker)
	Rs. Crore	Share (%) in total	Million	Share (%) in total	
Farm (Primary Sector)	143282	34.10	22.62	54.94	63343
Non-Farm (Secondary)	276958	65.90	18.54	45.03	149384
Total	420240			41.17	

Source : Economic survey of Maharashtra 2012-13

As per the advance estimates of real (at constant 2011-12 prices) Gross State Domestic Product (GSDP) for 2016-17, the State economy is expected to grow by 9.4 per cent over the previous year. The 'Agriculture & Allied Activities sector is expected to grow by 12.5 per cent while, 'Industry' and 'Service' sectors are expected to grow at 6.7 per cent and 10.8 per cent respectively over the previous year. As per advance estimates real GSDP for 2016-17 is expected to be 18,15,498 crore. The Indian economy is expected to grow by 7.1 per cent during 2016-17. However, it is necessary to boost the agricultural growth to double the income of the farmers.

1.5 Broad objectives

1. To review the income status of farmers at the state level
2. To review the gaps in productivity and remuneration that contributes to farmers income
3. To document scope, opportunities and action plan for doubling the farmers income with focus on
   a. Technologies for increasing the productivity of crops/commodities
   b. Technologies for reducing the cost of production
   c. Options for facilitating better market price for the commodities

1.6. Main documents referred

Reference and Resources

- Maharashtra State Horticulture and Medicinal Plant Board
- ICAR – National Institute of Agricultural Economics and Policy Research
- NITI Aayog document
- Economic Survey of Maharashtra 2016-17, Directorate of Economics and Statistics, Planning Department, Government of Maharashtra, Mumbai.
- Approach Paper on Strategies for Doubling Farmers Income by 2022 by ICAR.
- Agroclimatic Atlas of Maharashtra.

WEBSITES REFERRED FOR BASE LINE DATA

- http://planningcommission.nic.in
- https://mahades.maharashtra.gov.in
- http://www.internationalseminar.org
- http://www.indiagri.in
- http://suvarnakonkan.in
- http://mahaagri.gov.in
- https://ahd.maharashtra.gov.in/pdf/Statistical_Booklet_2015-16.pdf
- http://aps.dac.gov.in
- http://maharain.gov.in/
- https://mahades.maharashtra.gov.in
- http://mahaagri.gov.in/cropwatch
- http://mahaagri.gov.in
- http://agricoop.nic.in
- http://agricoop.nic.in/statistics/horticulture
- http://sericulturecouncil.com/maharashtra
- https://ahd.maharashtra.gov.in/
- http://www.fisheries.maharashtra.gov.in
- http://www.icar.org.in/
- https://kvk.icar.gov.in
- http://www.crida.in/

INFORMATION RECEIVED FROM THE INSTITUTES

- Agricultural Technology Application Research Institute
- Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
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- Central Institute for Cotton Research, Nagpur
- Central Institute of Fisheries Education, Mumbai
- Central Institute for Research on Cotton Technology

- Directorate of Floricultural Research
- Directorate of Onion and Garlic Research
- Maharashtra Animal & Fishery Sciences University
- National Research Centre For Grapes
- National Research Centre on Pomegranate

2 State Profile

Maharashtra occupies the western & central part of the country and has a long coastline stretching nearly 720 km along the Arabian Sea. The Sahyadri mountain ranges provide a natural backbone to the State on the west, while the Satpuda hills along the north and Bhamragad-Chiroli- Gaikhuri ranges on the east serve as its natural borders. The State is surrounded by Gujarat to the north west, Madhya Pradesh to the north, Chhattisgarh to the east, Telangana to the south east, Karnataka to the south and Goa to the south west.

Maharashtra is the second largest state in India in terms of population and has geographical area about 3.08 lakh sq. km. As per Population Census-2011, the population of the State is 11.24 crore which is 9.3 per cent of the total population of India and is highly urbanised with 45.2 per cent people residing in urban areas. Agriculture is major occupation of the people in Maharashtra. Both food and cash crops are grown in the State.

The state lies between 15.45 to 22.0 North latitude (degrees) and 72.45 to 80.45 East altitude. There are four major areas i.e.. Western Maharashtra, Vidarbha, Marathwada and Konkan. There is great deal of variation in rainfall in the state and agriculture is mainly rain fed. The state has an average rainfall about 100 cm. The Western Ghats, Konkan, Thane, Ratnagiri, receive 300cm rainfall, areas like Nasik, Pune, Ahmednagar, Beed, Nanded and Osmanabad get 75 to 100 cm rainfall while Amaravati, Yavatmal, Buldhana, Akola, receives about 75 cm rainfall. Only about 16.8 per cent of cultivable land being irrigated as compared to the national average of 33 per cent. Maharashtra's Agro-climatic condition favours promotion of less water intensive crops like horticultural crops.

Figure 2.1 : State Profile of Maharashtra

2.1. Profile of Maharashtra in comparison to the Nation

Maharashtra is spread over 9.4% of the geographical area of the nation and hosts about 9.3% of the population of the country. About 7.4 % of the rural population and 13.5% of the urban population of the country reside in Maharashtra. Literacy rate in the state is 82.3 which is slightly more than the national average.

Table2.1 : Status of population

Item	Unit	Maharashtra	India	Comparison with India (Percentage)
1 Population				
1.1 Total Population	**In'000**	**1,12,374**	**12,10,855**	**9.3**
(a) Male		**58,243**	**6,23,,270**	**9.3**
(b) Female		**54,243**	**5,87,587**	**9.2**
1.2 (a) Rural Population	**In'000**	**61,556**	**8,33,749**	**7.4**

Item	Unit	Maharashtra	India	Comparison with India (Percentage)
(b) Proportion of rural population to total population	Percent	54.8	68.9	
1.3(a) Urban Population	In'000	50,818	3,77,106	13.5
(b) Proportion of rural population to total population	Percent	45.2	31.1	
1.4 Sex Ratio	Females per thousand males	929	943	
1.5 Decadal growth rate of population (2001-2011)	Percent	16	17.7	
1.6 Literacy rate	Percent	82	73	
1.7 Population of scheduled castes and scheduled tribes	In'000	23,786	3,05,924	7.8
1.8 Total workers		49,428	4,81,889	10.3
1.9 Geographical area	Lakh sq. km.	3.08	32.9	9.4

Source : census 2011

Net area sown to various crops in the state is about 12.3% while gross area sown accounts for 11.3% as compared to the corresponding figures at the national level. The state contributes 55.4, 34.6, 21.9 and 10% of the area sown to sorghum, cotton, sugarcane, and the bajra respectively. However, contributes only 6.2% to the national livestock population. About 9.3% of the national electricity is produced by the state but consumption is about 13.9% indicating that the state faces electricity problems.

Diversity of agriculture in Maharashtra is largely influenced by rainfall ranging from 500 to 6000 mm rain and diverse types of soil with varying level of water holding capacity. Since more than 12 ICAR institutes and 5 SAUs are in action and hence there is scope to address the issues relevant to doubling the farmers income in concerted manner. In addition to crops, livestock can play a significant role in enhancing the farmers income if the marketing channel is streamlined. The area sown to different fruits, vegetable and flower crops are present in Table 2.3. While substantial areas are covered by fruits and vegetables, a small proportion of cultivated land is devoted for floriculture.

Table 2.2 : Status of agriculture in Maharashtra as compared to Nation

Agriculture (2013-14)	Unit	Maharashtra	India	Comparison with India (Percentage)
2.1 Net area sown	In'000ha	17,368	1,41,428	12.3
2.2 Gross cropped area	In'000ha	23,380	2,00,859	11.6
2.3 Gross irrigated area	In'000ha	NA	95,772	
2.4 Percentage of gross irrigated area to gross cropped area	Percent	NA	47	
2.5 Area under principal crops(average for years 2011-12 to 2013-14)				
(i) Rice	In'000ha	1,569	43,632	3.6
(ii) Wheat		897	30,111	3
(iii) Jowar		3,368	6,084	55.4

Agriculture (2013-14)	Unit	Maharashtra	India	Comparison with India (Percentage)
(iv) Bajra		796	7,962	10
(v) All cereals		7,705	99,359	7.8
(vi)All foodgrains(cereals and pulses)		11,129	1,23,524	9
(vii) Sugarcane Area		1,096	5,010	21.9
Harvested Area		966	NA	
(viii) Cotton		4,171	12,038	34.6
(ix) Groundnut		319	5,163	6.2

2.2. Agro-ecologies in the State

2.2.1. Soils

The soil status of Maharashtra is residual, derived from the underlying basalts. In the semi - dry plateau, the regur (black - cotton soil) is clayey, rich in iron and moisture - retentive, though poor in nitrogen and organic matter. When redeposited along the river valleys, the kali soils are deeper and heavier, better suited for *Rabi* crops. Farther away, with a better mixture of lime, the morand soils form the ideal *Kharif* zone. The higher plateau areas have pather soils, which contain more gravel. In the rainy Konkan, and the Sahyadri Range, the same basalts give rise to the brick - red laterites, which are productive under a forest - cover, but readily stripped into a sterile varkas when devoid of vegetative cover. By and large, the soils of Maharashtra are shallow and of somewhat poor quality. The soil and vegetation of Maharashtra are related to the climate and the geology. The soil in the Deccan plateau is made up of black basalt soil. This type of soil is rich in humus. The soil is commonly known as the black cotton soil because it is best suited for the cultivation of cotton. The volcanic action which had taken place in the Deccan region has given rise to the soil texture and composition. These igneous rocks break down into the black soil which is very fertile. The Wardha - Wainganga river valley has old crystalline rocks and saline soils which make the soil infertile. This type of soil has a natural resistance to wind and water erosion because it is rich in iron and granular in structure. A very important advantage of this type of soil is that it can retain moisture. This makes the soil very reactive to irrigation.

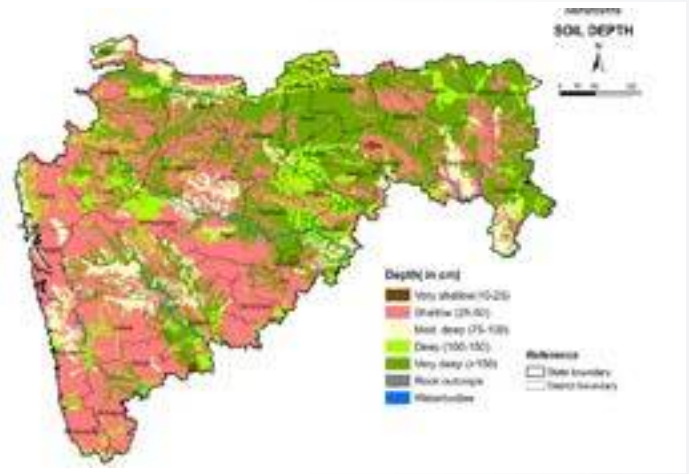


Figure 2.2 : Soil Depth in Maharashtra

Soils of drought prone areas of Maharashtra are derived from the basic igneous rock viz., basalt commonly known as Deccan trap. The colour of soil varies from reddish brown to dark grey black called Vertisol and associated groups. As the topography of this zone is of rolling type (1-3 per cent slope). About 10 per cent soils are marginal skeletal soils (<7.5 cm depth), 26 per cent shallow soils (< 22.5 cm) and 47 per cent medium deep (22.5 to 90 cm) and 17 per cent deep black soils (> 90 cm). The shallow and medium deep soils are classified as Lithic Ustorthents and Vertic Ustochrept (Entisols and Inceptisols). While deep soils, the typic chromusterts (Vertisols). Vertisols have high moisture content at 1/3 bar and 15 bar, i.e.. 48 and 25 per cent. The soils are low in organic carbon and available N content, low to medium in available P, and high in available K content. Most of soils of this zone are deficient in zinc and iron.

2.2.2. Climate

The climate of the State is tropical. The Western Ghats hill ranges run north to south separating the coastal districts of Thane, Mumbai, Raigarh, Ratnagiri and Sindhudurg from rest of the State. The average height of

these ranges is about 1000 m amsl form an important climatic divide. The coastal areas receive very high monsoon rains while to the east of the Ghats rainfall drops drastically within short distance from the Ghats. Towards further east, the rainfall once again gradually increases. The State experiences four seasons during a year. March to May is the summer season followed by rainy season from June to September. The post monsoon season is October and November. December to February is the MAHARASHTRA has got variable climate from continental to typical maritime depending upon the location and physiography. The coastal districts of Konkan experience heavy rains but mild winter. The weather, however, is mostly humid throughout the year. The maximum and minimum temperature varies between 27°C and 40°C & 14°C and 27°C respectively. The maximum summer temperature varies between 36°C and 41°C and during winter the temperature oscillates between 10°C and 16°C.

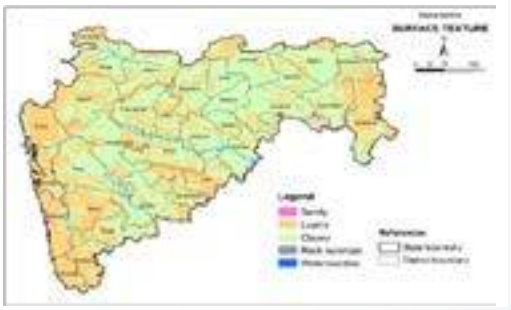


Figure 2.3 : Surface Texture of Maharashtra

Rainfall starts in the first week of June and July is the wettest month. Rainfall in Maharashtra differs from region to region. The State experiences extremes of rainfall ranging from 6000 mm over the Ghats to less than 500 mm in Madhya Maharashtra. The Konkan sub - division comprising of coastal districts and Western Ghats receive the heaviest rains, the Ghats receive more than 6000 mm and the plains 2500 mm. Rainfall decreases rapidly towards eastern slopes and plateau areas where it is minimum (less than 500 mm). It again increases towards east i.e. in the direction of Marathwada and Vidarbha and attains a second maximum of 1500 mm in the eastern parts of Vidarbha. Thus, the Madhya Maharashtra sub - division is the region of the lowest rainfall in the State. The State receives its rainfall chiefly during the south west monsoon season (June to September) while Konkan receives almost 94% of the annual rainfall during the monsoon season, The other sub - divisions namely Madhya Maharashtra, Marathwada and Vidarbha receive 83%, 83% and 87% respectively during this season. The number of rainy days have great significance in artificial recharge to ground water. These vary from 75 to 85 in Konkan and 30 to 40 days in Madhya Maharashtra and Marathwada. The number of rainy days in Vidarbha is around 40 to 50 days during south west monsoon season . The intensity of rainfall plays a vital role in artificial recharge to ground water. Though as such, not much data is available, the maximum rainfall recorded in 24 hrs in some selected stations have been presented in Table 2. In general, the intensity of rainfall is high in coastal and Ghat areas as compared to the other parts of the state. The intensity of rainfall varies from storm to storm and with occurrence of depression and low - pressure areas during monsoon season. The variability of annual rainfall over the state in general, is high. Only in the coastal areas, the variability is less than 20% otherwise the variability ranges between 20% and 35% over the state. On sub - divisional basis, the variability of annual rainfall in Konkan is the least (23%) while it is the maximum in Marathwada (31%). In Madhya Maharashtra and Vidarbha the variabilityis 30% and 26% respectively. (Source:http://nidm.gov.in/pdf/dp/Maharashtra.pdf.)

The identification of Agro-climatic zones for the purpose of developing location specific research and development strategies for increasing agricultural production has been given the due impetus recently. Planning Commission , Government of India has identified 15 Agro-climatic zones in the country primarily based on geographical basis for development purpose. Subsequently, the concept of homogenous Agro-ecological zones was initiated by the ICAR in 1979 under the National Agricultural Research Project (NARP) and the country was divided into 127 zones under NARP . These zones to a large extent have homogenous physical characteristics such as topography, rainfall, soils, cropping patterns and irrigation availability. Of the total 127 NARP zones, 73 are predominantly rainfed. While delineating zonal boundaries, the physiographic divisions of each state, its rainfall pattern, soil type, availability of irrigation water, existing cropping pattern and administrative units have been considered in such a manner that there are fewer variations on the parameters within a zone (Rao et al., 2013). There are nine Agro-climatic zones under NARP in Maharashtra based on the broad criteria of rainfall, topography, soils and cropping pattern.

Agro-climatic zonation's of Maharashtra

In order to maximize the production from the available resources and prevailing climatic conditions, need-based, location specific technologies need to be generated. Delineation of Agro-climatic zones based on soil, water, rainfall, temperature etc. is the first essential step for sustainable production. An "Agro-climatic zone" is a land unit in terms of major climates suitable for a certain range of crops and cultivars. The planning

aims at scientific management of regional resources to meet the food, fiber, fodder and fuel wood without adversely affecting natural resources and environment. Agro-climatic conditions mainly refer to soil types, rainfall, temperature and water availability which influences the type of vegetation.

2.2.3. Features of semiarid agriculture

The Agro-climate of semiarid region is characterized by hot and dry summer and mild winters. Due to high temperature, potential evapotranspiration is in excess than the precipitation. The average maximum temperature ranges from 29.9 to 40.1°C and minimum temperature ranges from 13.8 to 24.8°C. The mean annual rainfall at semiarid district like Solapur is 721.4 mm in 41 rainy days. However, in recent days, the rainy days are reduced up to 35 but same average rainfall is received. The rainfall is scanty, erratic and ill-distributed. September rains are assured. However, two peaks of rainfall are observed, first during July and second during September which results in bimodal pattern of rainfall.

Based on bimodal distribution of rainfall, two cropping seasons viz., *kharif* and *rabi* are noticed. During kharif season, shallow and low moisture retentive soils are cultivated whereas; medium deep and deep soils with fairly good moisture storage capacity are diverted to *rabi* crops. The proportion of *kharif* cropping is about 25-30 per cent leaving large portion of area to rabi cropping which is prominent.

The cropping pattern of region dominated by cereals. Pearl millet and sorghum are major cereals grown during kharif and rabi respectively. Pulses and oilseeds viz., pigeonpea, blackgram and sunflower are cultivated during kharif while sunflower, safflower and chickpea are cultivated during rabi season.

Figure 2.4 : Water scarcity zone of Maharashtra

In the Northern part of scarcity zone, Pearlmillet, sorghum, cotton, pigeonpea, blackgram, Greengram are the important crops for kharif. Sorghum, safflower, sunflower and chickpea are the rabi crops. Under irrigated farming situations the horticultural crops viz., pomegranate, ber, grape, banana, vegetables and sugarcane are cultivated. The irrigation (Canal + well) accounts for 12 per cent of cultivated area of the zone.

2.3. Land use and cropping pattern

Although Maharashtra is a highly industrialised state of India, agriculture continues to be the main occupation of the people. About 61% of the people directly or indirectly depend on agriculture and allied activities for their livelihood. Principal crops of the state are rice, jowar, bajra, wheat, tur, mung, urad, gram and other pulses. Maharashtra is a major producer of oilseeds like groundnut, sunflower, soybean etc. Major cash crops of the state are cotton, sugarcane, turmeric and vegetables. Horticulture has a very important place in this state. Varieties of fruits like mango, orange, banana, grape, cashew nut etc. are produced. Net sown area in Maharashtra is 56% of its geographical area while forest area is 17%.

Permanent pastures occupy 4% of the geographical area while barren land is about 6% state. The Nagpur oranges and Alphonso mangoes are very famous. There were about 10.91 lakh hectares of land under horticulture. Fishing is an important activity of this state.

In Western Maharashtra, farmers grow pomegranate, grapes, sugarcane, sorghum, onion, tomato, wheat, soybean, vegetables apart from rearing milch animals. In Marathawada, sorghum, cotton, pomegranate, sugarcane etc. apart from dairy is common. In Vidarbha, cotton, soybean, tur, wheat, citrus, mausambi etc. apart from Dairy are source of income for farmers. In Konkan, in addition to cereal crops like rice the horticultural crops including mango, coconut and cashew are the integral component of agricultural income. In addition, this region is dominated by fisheries as other major source of income. Area sown to Rabi crops is more than that of Kharif in Western Maharashtra and substantial area Marathwada is sown to Rabi crop. While other regions rely largely on kharif season.

Land is the basic resource for agriculture. Its quality and extent largely determine the variety and magnitude of agriculture production. The land utilisation statistics for 2015-16 depicts that out of the total 307.58 lakh ha geographical area of the State, the gross cropped area was 228.6 lakh ha while the net area sown was 171.92 lakh ha. The forested area was 51.95 lakh ha which is distributed in the western, northern and the eastern zones having relatively heavy rainfall in the state. The land not available for cultivation was 32.52 lakh ha, other uncultivated land was 23.87 lakh ha and fallow land was 27.32 lakh ha. During the period of five years from 2011-12 to 2015-16, land put to non-agricultural uses has increased by 4.9 per cent.

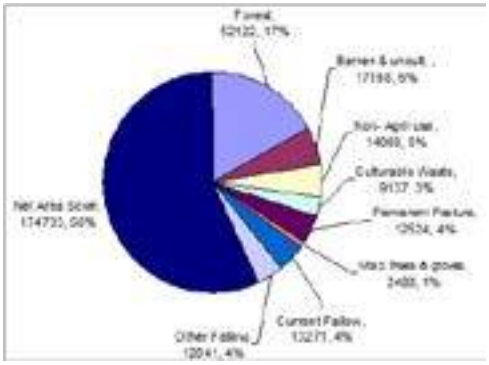


Figure 2.5 : Land use and cropping pattern

2.4. Distribution of soil types

The soil status of Maharashtra is residual, derived from the underlying basalts. In the semi-dry plateau, the regur (black-cotton soil) is clayey, rich in iron and moisture-retentive, though poor in nitrogen and organic matter. When re-deposited along the river valleys, the kali soils are deeper and heavier,better suited for Rabi crops. Farther away, with a better mixture of lime, the morand soils form the ideal Kharif zone. The higher plateau areas have pather soils, which contain more gravel. The soils of Maharashtra region belong to Entisol, Inceptisol, Alfisol, Vertisol and Mollisolorders. It has been observed that Entisols (36.8%), Inceptisols (30.9%) and Vertisols (26.3%) are the predominant soils followed by Alfisols (5.6%) and Mollisols (0.1%)(Challaetai, 2001).

2.4.1. Soil Depth

The depth of soil primarily helps plant growth for foot hold and spread of root system and it regulates nutrients and water storage and supply. Thus, it is a good indicator of water and nutrient supplying potential of soil. Based on its applications towards the crop growth, six depth classes are formed (Table 2).

Table 2.3 : Soil depth classes

Class	Area (OOO'ha)	%
Extremely shallow (<10 cm)	1885.3	6.1
Very shallow (10 to 25 cm)	8127.2	25.4
Shallow (25 to 50 cm)	4444.2	14.4
Slightly deep (50 to 75 cm)	4683.5	15.3
Moderately deep (75 to 100 cm)	1354.1	4.4
Deep (> 100 cm)	10274.6	33.4

Source : AGROCLIMATIC ATLAS OF MAHARASHTRA

2.4.2. Soil Drainage

Soil drain age both surface and subsurface, influence soil-air-water relationship, affects the oxygen availability, the redox potential and nutrient availability. Since the root proliferation is related to aeration, the drainage can form a limiting criteria for evaluating soil suitability for annual as well as the perennial crops including forest species. The drainage condition has been classified into six drainage classes. The extent of the area under each class is given in Table 3 and Fig 4. Majority of the soils in the state are well drained, followed

by moderately well drained class showing good aeration to plant roots. Somewhat excessive and excessively drained soils occur at higher topography. Poorly drained soils are in traces as scattered patches near creeks.

Table 2.4 : Soil drainage classes

Class	Area (OOO′ ha)	(%)
Poor	164.6	0.5
Imperfect	8.9	Negligible
Moderately well	10603.9	35.7
Well	14523.9	49.2
Some what excessive	3094	lOA
Excessive	1263.8	4.2

Source : AGROCLIMATIC ATLAS OF MAHARASHTRA

2.4.3. Soil pH

Soil reaction is a physico-chemical property which influences the availability of different plant nutrients. It is measure of acidity and alkalinity and reflects the base saturation. Soil pH value assumes importance in determining the amendments used for amelioration of soils. Soil reaction in the state ranges from moderately acidic class to slightly alkaline class (Table 4). The soils developed on alluvium parent material have a pH in neutral range and are dominant in montmorillonite minerals. The acid soils are developed from granite and sandstone and are dominant in kaolinite minerals.

Table 2.5 : Soil reaction (PH) classes

Class	Area (OOO′ ha)	(%)
Moderately acidic (4.5 to 5.5)	516.6	1.7
Slightly acidic (5.5 to 6.5)	5145	16.7
Neutral (6.5 to 7.5)	14928.5	48.5
Slightly to moderately alkaline (7.5 to 8.5)	10178.9	33.1

Source : AGROCLIMATIC ATLAS OF MAHARASHTRA

2.4.4. Soil slope

The length and gradient of slope affect the soil formation and soil depth in an area. It also affects the water retention and infiltration. Seven slope classes have been observed which is given in Table 5. The slope of soil is related to elevation and determines soil depth, degree of erosion, texture and pH, About 76.4 per cent of the area in the state falls under very gently (39.5%) and gently sloping (36.9%), usable for aerable lands. The major area in the state is below 1-3% slope. Across the districts, slope conditions vary.

Table 2.6 : Slope classes

Class	Area (000′ ha)	(%)
Class	Area (000′ ha)	(%)
Level to nearly level (0 to 1%)	113	0.4
Very gently sloping (1 to 3%)	12114.9	39.5
Gently sloping (3 to 8%)	11384.2	36.9
Moderately sloping (8 to 15%)	4182.9	13.6
Moderately steep sloping (15 to 30%)	2550.8	8.3
Steeply sloping (30 to 50%)	159.6	0.5
Very steep sloping (>50%)	263.6	0.8

Source : AGROCLIMATIC ATLAS OF MAHARASHTRA

2.4.5. Land Surface

Surface form is the resultant of the present and past climate in the area under natural conditions. Land surface tends to change with the human intervention resulting in denudation of the terrain. Land surface area is related to elevation and determines of geographical and surface distribution like as land slope, texture, plain, plateau and vegetation. The major area in the state is undulating (10.89 M ha, 35.4%) followed by valley land. Among the districts, slope conditions are of different categories.

- Valleys and dissected
- Gently sloping & valleys
- Hummocky and valleys
- Plateau
- Ridges
- Undulating and dissected
- Valleys
- Gently sloping
- Hummocky
- Level
- Plateau dissected
- Undulating
- Undulating and valleys

2.4.6. Soil Texture

Soil texture indicates the relative proportion of primary particles, such as sand, silt and clay. It is a permanent physical characteristic and directly related to structure, porosity adhesion and consistency. It affects the microbial activity and physico-chemical behaviour of the soils thus influencing plant growth directly or indirectly. It influences the water storage, nutrient holding, workability, infiltration and drainage conditions. The soils are dominantly clayey in texture (61.1%) in the region followed by loamy (38.9%). Clayey textures have high potential for nutrients and available water holding capacity.

Source : AGROCLIMATIC ATLAS OF MAHARASHTRA

2.4.7. Soil Erosion

The degree of erosion determines the suitability of a soil for agricultural use. It is an indication of how proper is the current land use and also determines the kind of management needed in a terrain for improving the land. As per the intensity, the erosion has been categorized into sheet, rill and gully erosion. Mere referring soil erosion does not convey purposeful meaning. It should be linked with the potential productivity of soil to evaluate its permanent effect. Improved management practices, besides controlling the erosion improves productivity and reduces the degradation. Soils in the state are grouped into four soil erosion classes (Table 6) namely slight, moderate, severe and very severe class. Majority of the area is under moderately eroded class (66.4%) followed by severe class (27.4%). The area under slight class is 4.2 per cent and that of very severe class is 2.0 per cent. Area under slight to moderately eroded classes have some what reduced agricultural productivity to greatly reduced (but economical) agricultural productivity. While severe and very severe classes are un-reclaimable and economically not feasible to reclaim.

Table 2.7 : Soil erosion classes

Class	Area (OOO'ha)	(%)
Slight	1278	4.2
Moderate	20448	66.5
Severe	844l.1	27.3
Very severe	601.1	2

Source : AGROCLIMATIC ATLAS OF MAHARASHTRA

2.5. Available Water Capacity

Available water capacity of the soils is dependent upon the intensity and distribution of rainfall, infiltration and permeability of the soils and type and amount of clay minerals, depth and volume of the soil. In the dry tract, the quantum and the regular soil moisture supply (available water) act as determinants for growing crops. This also helps in deciding the length of growing period (LGP) which is important parameter for crop planning in an area where the crops are grown under rainfed conditions. Based on the Awe, soils in the state are grouped under 5 classes. The extent of area under different classes is given in Table 7 and Fig 7.

Table 2.8 : Available water capacity (AWC) classes

Class	Area (000′ ha)	(%)
Very low (50 mm)	10643.9	34.7
low (50-100 mm)	4529.1	14.7
Moderate (100-150 mm)	3510.1	11.4
High (150-200 mm)	1140.9	3.7
Very high (>200 mm)	10698.6	34.8
Miscellaneous lands	236.4	0.7

Source : AGROCLIMATIC ATLAS OF MAHARASHTRA

2.6. Field Crops

AREA, PRODUCTION AND PRODUCTIVITY TRENDS OF MAJOR CROPS

On region basis, area, production and productivity trends are shown in Fig. 25-37 for the major field crops. Rice and maize showed increasing trend in area, production and productivity while in case of pearlmillet decreasing trend is noticed in area and production while productivity is showing increasing trend. Groundnut area and production is decreasing and productivity is increasing. This will give an insight to the planners to go further for micro-level analysis regarding sustainability and profitability of a particular crop and cropping system is a given area.

Pulses

Maharashtra is one of the leading state in India producing pulses ranking second after Madhya Pradesh. The total area under pulses in Maharashtra is 4.60 million ha with production of 4.47 million tons which accounts around 20.19% of the total production in the country, the state average productivity (973 kg/ha) is more than national average (838 kg/ha). Pulses are cultivated on marginal lands under rainfed conditions. Because of the high level of fluctuations in pulse production (due to biotic and abiotic stress) and prices (in the absence of an effective government price support mechanism) farmers are not very keen for taking up pulse cultivation despite high wholesale pulse prices in recent years.

The main pulses grown in kharif season are pigeonpea, mungbean, urdbean, whereas chickpea dominating in the rabi season. During 2013-14 in Maharashtra Chickpea is cultivated on 18.20 lakh ha area with production of 16.22 lakh tons. Ahmednagar (0.74 lakh ha), Solapur (0.62 lakh ha) and Jalgaon (0.51 lakh ha) are the leading districts. While the Chickpea productivity was ranged from 568 kg/ha (Solapur) to 1409 kg/ha (Dhule) in western Maharashtra region during 2013-14. Whereas Pigeonpea is cultivated over 0.39 lakh ha area with production of 0.25 lakh tons. However, the productivity of the Western Maharashtra region is less (610 kg/ha) than that of the state (881 kg/ha). The major pigeonpea growing districts of the region are Solapur (0.50 lakh ha), Ahmednagar (0.14 lakh ha) and Nandurbar (0.12 lakh ha). Among short duration pulse crop mungbean in 2013-14, country occupies 3.38 million ha area with production of 1.60 million tons. However, state shares 12.72% (4.31 lakh ha) with production of 2.38 lakh tons, whereas the productivity of the state is lower than Western Maharashtra region (665 kg/ha). Where the productivity of mungbean ranges from 383 kg/ha (Nandurbar) to 951 kg/ha (Nasik).

The major pulse crops of the state are red gram, black gram and green gram. Area under red gram has picked up in recent years since it is a good dry land pulse crop. Introduction of high yielding cultivars has raised productivity of the crop from 321 kg/ha during 1972 to 810 kg/ha in 2007 (Fig. 30). Red gram area has risen from 5.30 lakh ha during the period 1960-61 to 13.01 lakh ha in 2010. This rise is partly due to introduction of pulses improvement program and partly to market forces (Fig. 30). In other years, the inter-annual variability is largely weather driven. Area, production and productivity of blackgram varied over the years. Though there was a marginal rise in all the three parameters during the second part of the 1990s, the crop was replaced by other remunerative crops mainly due to the occurrence of terminal moisture stress (in paddy fallows) and the incidence of YMV disease (Fig. 31). Area and production under green gram showed a marginal ascent in recent years but productivity levels have been sustained due to the use of improved package of practices

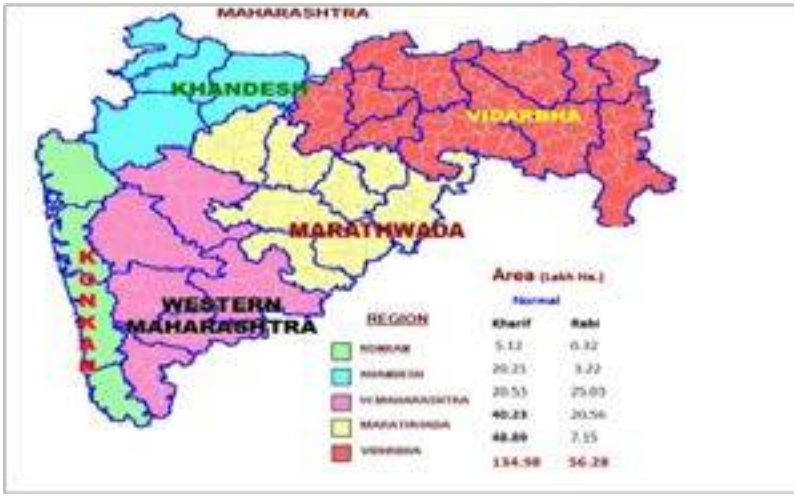


Figure 2.6 : Pulses sown

Source : AGROCLIMATIC ATLAS OF MAHARASHTRA

Table 2.9 : Area, production and productivity of pulses in Maharashtra (Area in ha., Production in Tons and Productivity in tons/ha.)

Crops	A	P	Py
Tur	12367	4443	359
Mung	3659	693	189.53
Udid	2856	612	214
Gr.Nut(Kh)	2244	2169	967

Cereals

Paddy, sorghum and pearl millet are the principal cereal crops of Maharashtra. The area under paddy is about 15 lakh ha and there is a marginal increase in area over the years (Fig. 25). The year to year fluctuations in area are mostly due to the drought and scanty rainfall. Drought conditions from 2010 onwards led to drastic reduction of the area. Paddy production has consistently increased @ 2.21 lakh tons per year. The paddy productivity has risen from 362 kg/ha to 1538 kg/ha during the 55 year period from 1960 to 2015. Sorghum is the second largest cereal crop due to its commercial value (as cattle feed). It is grown both in kharif and rabi season. The grown area under kharif sorghum has fallen from 31.1 lakh ha to 6.2 lakh ha in last 55 years (Fig. 26). Productivity level of kharif sorghum has increased from 305 kg/ha in 1972 to 1425 kg/ha in 2011. However, in case of rabi sorghum, the area has decreased from 37.8 lakh ha in the

1971 to 15.1 lakh ha in 2013 (Fig. 35). The steep increase in the productivity levels of the crop has to some extend has compensated the sharp decline in the area.

Pearl millet is another important cereal crop grown mostly in semi-arid region of Maharashtra. Area under pearl millet during 1960-2015 witnessed significant decrease. Maharashtra showed slight ups and downs in production but as such an overall increase in a production was observed from 1992 to 2000 and again there was decline in the production 2001 onwards (Fig. 27). Maharashtra showed steady increase in the pearl millet

productivity during the period of 1960 to 2015. Maharashtra showed slight variation in the wheat area but as such an overall increase in an area under wheat was observed from 1960 to 2015 (Fig 34). The area under wheat improved during 2006 to 2010 and decreased during the 2011-12 and 2013-14. Production of wheat showed increasing trend from 1960 to 2015. The yield of rabi sorghum improved steadily from 1960 to 2015, but the productivity trend was constant through the period.

Soybean

Among oilseed crops Soybean is grown on area of 39.07 lakh ha with a production of 46.15 lakh tons with an average productivity of 1161 kg/ha (table). There has been substantial increase to in area (11 lakh ha) under soybean during 2011, however the average productivity (1221 kg/ha) remains constant. This is mainly on account of very unusual weather conditions.

Source: MPKV

Commercial crops

Cotton is the principal commercial crop of the state. It is cultivated on more than 41 lakh/ha. Though productivity figures show large variability there has been a constant increase in area and production chiefly due to the introduction of Bt cotton. In years of early dry spells in the rainy season, more area is sown for cotton owing to its relative drought tolerance. The area marked to other crops which are moisture sensitive, are brought under cotton (Fig. 33). Apart from the spatial and temporal distribution of rainfall, insect pest damage is another important parameter that affects cotton productivity in Maharashtra. In tropical zone, Maharashtra is the major sugarcane growing state. The sugar industry is instrumental in generating sizable employment in the rural areas directly and through its ancillary units. It is estimated that about 50 million farmers and their dependents are engaged in the cultivation of sugarcane and about 0.5 million skilled and unskilled workers are engaged in sugar factories and its allied industries. The sugar industry in India has been a focal point for socio-economic development in the rural areas by mobilizing rural resources, generating employment and enhancing farm income. Some of the sugar factories have also diversified into by-products based industries and have put up distilleries, organic chemical plants, paper, ice board factories and cogeneration plants. A steep Increase in sugarcane area and production has come through with a concurrent increase in the area over the years (Fig. 37). Very small inter-annual variation in the productivity of the crop may be attributed primarily to the fact that large area under sugarcane crop is irrigated.

Sugarcane

Sugarcane is a unique crop which has been considered as an integral part of Agroindustry that contributes to the state's economy significantly. The sugarcane cooperatives transformed many of the regions economically with rapid adoption of innovations. However, huge consumption of scarce water for growing sugarcane is a recurring issue which is being addressed through water saving irrigation methods. Though there are many farmers who gain profusely with high yield of canes, the yield obtained by farmers is lower than actual yield potential.

Table 2.10. : District wise data on area, production and productivity of soybean (2016-17)

Sr. No.	Districts	A (00 ha)	P (00 tonnes)	Py (kg/ha)
1	Nashik	672	914	1359
2	Dhule	183	223	1218
3	Nandurbar	280	458	1637
4	Jalgaon	304	573	1882
5	Ahmednagar	890	942	1059
6	Pune	209	372	1778
7	Solapur	476	331	695
8	Satara	710	1307	1841
9	Sangli	573	1219	2128
10	Kolhapur	447	975	2182
	State Total	39.07	46.15	1161

Table 2.11. : **Districtwise data on area, production and productivity of sugarcane(2016-17)**

Sr. No.	District	A(00 ha)	P(00 tonnes)	Py(tons/ ha)	Potential yield (tons/ha)
1	Kolhapur	1326	119368	90	350
2	Satara	503	49322	98	300
3	Sangali	724	71634	99	300
4	Pune	959	83231	87	250
5	Solapur	647	43299	67	250
6	Ahmednagar	610	47154	77	300
7	Nasik	112	10655	95	200
8	Jalgaon	92	7972	87	150
9	Dhule	45	3606	80	150
10	Nandurbar	110	8825	81	150
State total		**633.50**	**506442**	**80**	

Source : Commissionarate of Agriculture, Pune

Cotton

Table 2.12 : **District wise area, production and productivity Cotton in Maharashtra (2014-15)**

Division	District	Area (000′ ha)	Production (000′tonnes)	Productivity (kg/ ha)
Nashik	Nashik	46.0	44.7	165
	Dhule	209.9	258.2	209
	Nadurbar	118.6	101.2	145
	Jalgaon	471.1	768.1	277
Pune	Ahmadnagar	102.6	96.7	160
	Pune	-	-	-
	Solapur	0.6	1.2	329
Kolhapur	Satara	0.1	0.1	171
	Sangli	1.4	1.4	167
	Kolhapur	-	-	-
Aurangabad	Aurangabad	422.6	244.3	98
	Jalna	294.2	159.1	92
	Beed	373.3	167.6	76
Latur	Latur	3.8	2.7	119
	Osmanabad	29.3	23.0	134
	Nanded	342.3	176.8	88
	Parbhani	273.5	204.8	127
	Hingoli	94.7	85.4	153

Division	District	Area (000' ha)	Production (000'tonnes)	Productivity (kg/ ha)
Amravati	Buldhana	174.3	132.5	129
	Akola	147.0	122.6	142
	Washim	20.2	16.8	141
	Amravati	196.5	196.2	170
	Yavatmal	421.0	287.4	116
Nagpur	Wardha	207.7	184.6	151
	Nagpur	111.3	150.2	229
	Bhandara	-	-	-
	Gondia	-	-	-
	Chandrapur	123.7	143.9	198
	Gadchiroli	4.2	7.6	309
	State Total	4189.9	3576.9	145

Source : www.mahaagri.gov.in accessed on 10/10/2017

2.6.1. Horticulture:

- Maharashtra State is on the front in implementing new techniques.
- Export of grapes, mango, vegetables & flowers has increased
- Considering the development in respect of Horticulture crops in past few years the state is emerging as a Horticulture state.
- Flower crops:- rose, marigold, chrysanthemum, aster, carnations etc.
- Floriculture area is 0.18 lakh ha
- The current growth rate of agriculture sector is 3.5 % & it is targeted to 4% in which horticulture crops has greater contribution of 6%
- Value of output of flower crops in a state: 212826 lakhs in 2010-11

Pomegranate

Pomegranate is an important fruit crop of arid and semiarid regions of the world. India is one of the largest producers of pomegranate in the world. India is the only country in the world where pomegranate is available throughout the year (January – December).

At present, Maharashtra is the leading state in acreage covering about 68.7 per cent of the area under pomegranate. Similarly around 70.2 per cent of total production comes from Maharashtra.

Table 2.13 : Area and production of Pomegranate (Maharashtra)

Year	A (000ha.)	P (000MT)
2012-13	78.0	408.00
2013-14	90.00	945.00
2014-15	99.14	1313.70

Source : NRCP

Grapes

Majority of the grape growing regions in the state suffer from salinity and sodicity. Sixty three per cent of the salt affected soil in Maharashtra is distributed in the Lower Maharashtra (Deccan) Plateau covering Satara, Kolhapur, Sangli, and Solapur districts and 27% in the Upper Maharashtra (Deccan) Plateau covering

Jalgaon, Nasik, Ahmednagar, and Pune districts (Mandal, 2008), primary grape growing areas of the state. The unfavorable physiographic and rainfall, presence of black (vertisol) soil, absence of natural drainage (Balpande et al. 1996), and lack of proper infrastructure and irrigation facilities may explain the higher extent of salt affected soils in the Deccan Plateau (Challa et al. 1995).

Bhargava et al. (2006) reported that out of 1742 bore water samples (used for irrigating vineyards) tested, 852 had EC less than 1.0 dSm^{-1}, which is safe for growth and productivity of grapevines; 536 were within EC range of 1.0 to 2.0 dSm^{-1}, where growth is restricted due to salinity; 310 with EC more than 2.0 dSm^{-1}, where rootstock is necessary, and 44 were found with EC more than 4.0 dSm^{-1}, where even the tolerance limit of most commonly used rootstock will be a failure. Forty five per cent of the water samples analyzed had more than 3 $meql^{-1}$ chloride content, making them unsafe for growing grapes on rootstocks. They also reported that forty eight per cent of the samples analyzed, had NO_3-N content in the water above the safe limit (>10 ppm of NO_3-N) for drinking purpose. The Na content (0.20 to 10.78 $meql^{-1}$) during 1980 - 1981 also increased between 0.20 to 70.74 $meql^{-1}$ during 1999 - 2004. In many grape growing areas sugarcane fields are in close proximity to vineyards where use of chloride containing fertilizers like muriate of potash and ammonium chloride is a common practice (Bhargava et al. 2006). This may be one of the probable reasons for increases in chloride content in ground waters. Consequences of salinity will become all the more significant when grapes are grown in hot, dry climate compared to cool humid climate (Walker et al. 2003). In fact, many of the grape growing regions of Maharashtra, experience hot and dry climate except from June - August (monsoon season) with the minimum temperature as low as 5°C in winter to as high as 42 to 47°C in summer.

Vegetable Crops

Tomato, Bt. brinjal, cabbage, cauliflower and okra are grown largely to meet the demand for vegetables. They are grown both in natural field conditions and recently under protected cultivation. There has been increasing demand for organic vegetables and this can provide scope for farmers to earn more income.

Table 2.14. : Area, Production and Productivity of Vegetables in Maharashtra (2014-15)

Crop	A (000'ha)	P(000' MT)	Py (t/ha)
Tomato	47.00	1120.0	24.12
Brinjal	27.10	546.80	20.55
Cabbage	8.20	173.00	21.74
Cauliflower	10.60	238.20	18.75
Okra	23.00	241.50	10.50
Potato	15.39	331.64	21.55

Source : NHB- Database 2014-15

Onion

The major onion growing districts of Maharashtra viz., Nashik, Ahmednagar, Pune, Aurangabad, Jalgaon, Dhule, Solapur, Buldhana, Beed, Satara, Nandurbar, Osmanabad, Akola, Amravati, Jalna, Latur, Washim, Wardha, Yavatmal and Sangli may be selected for intervention of onion technologies. ICAR-DOGR red onion varieties viz., Bhima Dark Red (Kharif), Bhima Raj (Kharif and Late Kharif), Bhima Super (Kharif and Late Kharif), Bhima Shakti (Late Kharif and Rabi), Bhima Kiran (Rabi) and Bhima Red (Kharif, Late Kharif and Rabi) are suitable for the districts viz., Nashik, Ahmednagar, Pune, Aurangabad, Jalgaon, Dhule, Solapur, Beed, Satara, Nandurbar, Osmanabad, Jalna, Latur, and Sangli. ICAR-DOGR white onion varieties viz., Bhima Safed (Kharif), Bhima Shubhra (Kharif and Late Kharif) and Bhima Shweta (Kharif and Rabi) are suitable for the districts viz., Akola, Amravati, Buldhana, Washim, Wardha and Yavatmal.

Floriculture

Flowers are grown both in natural field and protected environments in Maharashtra and is observed there is significant scope for expanding this sector for enhancing income of farmers. The potential for expansion has been described in the subsequent sessions.

Table 2.15 : Area under protected cultivation of cut flower crops in Maharashtra

Sr. No.	Crop	Area (ha.)	
		India	Maharashtra
1	Rose	390	150
2	Gerbera	370	150
3	Carnation	400	180
4	Anthurium	40	02
	Total	1200	482

Table 2.16. : Area, production and productivity of tuberose in Maharashtra (Area in ha. Production in Tons and Productivity in tons/ha.)

Sr. No.	Divisions	Tuberose			Phule Rajani		
		A	P	Y	A	P	Y
1	Nasik	78	369.72	4.74	16	133.36	8.33
2	Pune	160	880.1	5.50	42	349.31	8.31
3	Kolhapur	131	662.95	5.06	27	229.1	8.48
4	Aurangabad	81	368.33	4.54	13	98.08	7.54
5	Latur	52	244.06	4.69	8	55.34	6.91
6	Amravati	94	442.24	4.70	20	147.01	7.35
7	Nagpur	84	376.7	4.48	9	66.62	7.40
	Maharashtra	680	3159.01	4.65	135	1008.45	7.47

2.6.2. Livestock

The livestock sector alone contributes approximately 24.7% of value of output and agriculture and allied sectors at current price. The total livestock in the State is 324.89 Lakh numbers in 2012 and ranks 6th at National Level. There is an overall decrease of 9.6% over the previous census. Nashik region recorded least decrease of 5.2% over the last census.The total bovine (Cattle and Buffalo) population is 210.79 Lakh numbers which accounts to 65% of total livestock. The bovines declined by 5.3% over the last census. An increase over the previous census is seen in the districts Solapur (8%), Aurangabad (7.6%), Sangali (4.3%), Satara (3.4%), Nashik (3%), Ahmadnagar (1.4%), and Jalna (0.5%).The total cattle population is 154.84 Lakh numbers and it has declined by 4.3% as compared to 2007 census. Maharashtra State has 4th position at the National Level in total cattle. The contribution of Exotic/Crossbred is 23.6%. The contribution of EX/CB increased from 19.3% in 2007 to 23.6% in 2012 showing an increase of 16.9% in the State. The Exotic/Crossbred is 36.51 Lakh number in 2012.

Cattle and Buffaloes

The indigenous cattle declined from 130.61 Lakh in number in 2007 to 118.33 lakh number in 2012 showing a decline of 9.4% as seen with previous census. The number of milch animals in cows is 50.9 Lakh number and has increased by 3.8% over the last census. There is increase in in-milk animals by 2% over the last census. The total Beddable cattle in the State have increased by 3.2% whereas the total female has increased by 3.1%.

The Buffalo Population is found to be 55.94 Lakh in number and ranks 8th at National Level. The total Buffalo population has declined by 7.9%, but for the first time in the history of Maharashtra the female buffalo population has declined by 3.9% and breed able population by 4.75% with respect to previous census.

The total breed able bovines are found to be 86.8 Lakh numbers out of which 53.2 Lakh numbers are In-milk bovines.

Sheep, goats and pigs

The total sheep in the State is 25.80 Lakh numbers in 2012 and has decreased by 11.3% over the 2007 census. The Goat population has declined by 18.8 % over the previous census and the total Goat in the State is 84.35 Lakh numbers in 2012. The total Pigs in the State have undergone a slight decline of 0.3% and the number of Pigs is 3.26 Lakh in 2012.

Sheep: The total Sheep contributes 7.9 % of total livestock population in the State. The total Sheep in the State is 23.7 Lakh numbers. The Sheep population has declined by 11.3% as compared to previous census The Exotic/Crossbred is 3% to the Total Sheep population in the State. The male-female are 20% and 80% respectively. In Maharashtra sheep populated districts are Ahmadnagar (14.2%), Nashik (13.82%), Pune (11.78%), Satara (10.24%), Dhule (8.01%), Solapur (7.21%), Sangli (6.10%), Jalgaon (1.48%).

Goat: The Goat Population is 84.35 lakh numbers and it has declined by 18.8% as compared to previous Census. The Female Goats are 71.4% of Total Goats of which 31.3% are In milk Goats The In-milk Goats are 26.41 lakh numbers and has decreased by 20.9% as compared to 2007 Census. In Maharashtra goat populated districts are Ahmadnagar (9.4%), Solapur (8.4%), Nashik (7.8%), Pune (7.4%), Jalgaon (4.8%), Sangli (3.8%), Satara (3.7%), Dhule (3.3%), Nandurbar (3.2%) and Kolhapur (1.9%).

Pigs: The Total Pigs in the State is 3.26 Lakh numbers. There is a marginal decline of 0.3% in the State. The female and male are 59% and 41% respectively. The Exotic/Crossbred contribute 11.5% of the total Pig population.

Poultry

The total poultry population in the state has increased by 20.1 % whereas the farm poultry have shown 34.7% increase over the last census. The total poultry birds in numbers are 777.94 Lakh in 2012. The backyard poultry has shown a decline of 12.5% as compared to last census.

Poultry : Poultry includes Fowls, Ducks, Turkey and other birds. The Total Poultry Population in the State is 777.95 Lakh birds. The farm poultry contributes 77.5% whereas the backyard contributes 22.5%. Percentage share of poultry population is Pune (23.83%), Nashik (20.41%), Nagar (11.54%), Satara (5.12%), Kolhapur (4.11%), Sangli (3.89%), Solapur (2.90%), Dhule (1.39%), and Nandurbar (1.24%). Livestock sector grew at an annual rate of 3.6%. The growth in livestock sector is about 1.5 times than crop sector. Growth rate recorded for different livestock products is; for meat (7.87%), egg (4.94%), milk (3.54%), wool (2.95%).

Table 2.17 : Livestock statistics

Particulars	Units	Year	Maharashtra	India
Livestock population	Millions	2012	32.5	512.0
Bovine	Millions	2012	21.1	299.9
Indigenous cattle	Millions	2012	11.8	151.2
Crossbred cattle	Millions	2012	3.7	39.7
Buffalo	Millions	2012	5.6	108.7
Small ruminants	Millions	2012	11.0	200.2
Poultry	Millions	2012	77.8	729.2
No. of Major Cattle Breeds	no's	2015	05	39
No. of major buffalo breeds	no's	2015	03	13
Milk production				
Total	000'MT	2015	9542	146313
Crossbreed	000'MT	2015	9998	36939
Indigenous	000'MT	2015	1270	29484
Buffalo	000'MT	2015	4027	74710

Goats	000'MT	2015	247	5180
Per capita milk availability	Gm/day	2015	222	315
Egg production	Millions	2015	5079	78484
Estimated meat production	000'MT	2015	631	6691
Wool	000 Kg	2015	1385	48139
Veterinary infrastructure				
Veterinary institutes	No's	2013-14	4861	60896
Semen stations	No's	2013-14	3	57
AI centers- Govt.	No's	2013-14	4861	83796
Veterinary services				
AI Done -Govt.	000'	2013-14	2361	58532
Vaccination done				
HS	000'	2013-14	3921	-
BQ	000'	2013-14	4032	-
FMD	000'	2013-14	28552	-

2.6.3. Fisheries

The present components of agriculture in the area are marine capture fishery in coastal districts and some fresh water culture practices in reservoirs. There is scope for carp cultivation in small ponds. Increase in fresh water fish production by adapting prawn species like Litopenaeus vannamei commonly known as white legged shrimp. There is scope for crab fattening in the coastal areas and fish processing units and small scale industrial development through trainings

Table 2.18 : Water resources for fisheries

Details	No.	Area in Ha
State Irrigation Tank Above 200 Ha.	192	1,85,887
State Irrigation Tank Below 200 Ha.	2065	1,01,896
Zilla Parishad & Other Tanks	31425	90,122
Total No of Tanks	33740	3,77,905
Length of river	19456 kms	

Table 2.19 : Brackish Water Aquaculture Resources of Maharashtra

Brackish water Land for shrimp culture	12445 ha.
Distributed Brackish water Land	3067 ha.
Area Under Shrimp culture	1056 ha.
Shrimp Project	222

Source : http://fisheries.maharashtra.gov.in

Fisheries sector is one the major source of livelihood for economically backward population. Fishing is one of the traditional activities of Maharashtra which is bestowed with 720 km. coast line. Since 1950 nature of this traditional activity has rapidly changed into commercial activity. Modernization of fishing methods, mechanization, use of fish finders, and methods of fish preservation has changed the scenario. To meet the increasing demand for marine fish, fishermen have concentrated their attention to increase marine fish production which ultimately increased fish production.

Table 2.20 : Trend in fish production in Maharashtra

Fish Production (LakhM.T.)				
Year	**Marine**	**Inland**	**Brackish Water**	**Total**
2004-05	4.18	1.21	0.002	5.392
2005-06	4.45	1.35	0.004	5.804
2006-07	4.65	1.32	0.008	5.978
2007-08	4.20	1.37	1.37	0.008
2008-09	4.19	1.10	0.009	5.299

Source : http://fisheries.maharashtra.gov.in

Table 2.21 : Agroecologies and suitability of crops for the best use of land

Agroecological Sub Region (6.1)	**Deccan Plateau, Hot Semi Arid Eco Region**
District	Solapur, Osmanabad, Ahmadnagar, Beed, Pune, Satara, Sangli
Climate	Hot dry semi-arid
Soil	Shallow and medium loamy Black soils (deep clayey Black soils as inclusion),
AWC	Medium to high
LGP days	90-120
Dominant crops	Cotton, Soybean, Kharif Jowar, Green gram, Black gram, Pigeon pea, Gram, Wheat, Safflower, Pearlmillet, Rabi, Sorghum, Wheat, Chickpea, Sugarcane Groundnut, Rabi Jowar
Suited crops for use of Land	Sorghum(all except costal area) Mung, Cotton, Blackgram,
Agroecological Sub Region(6.2)	**Deccan Plateau, Hot Semi Arid Eco Region**
District	Amednagar, Aurangabad, Dhule, Nandurbar, Nasik, Jalna, Parbhani, Hingoli, Latur, Nanded
Climate	Hot moist semi-arid
Soil	Shallow and medium loamy to clayey Black soils (medium land deep clayey Black soils as inclusion)
Available water content	Medium to high
LGP days	120-150
Dominant crops	Rabi Sorghum, Soybean, Gram, Peagen pea, Sorghum, Gram, Sunflower, Safflower, Cotton,pearl millet, maize, Sugarcane, wheat, Gram, Maize(rabi), Groundnut, Paddy, Maize, Peagenpea, Bengal gram, Kharif Sorghum, Rabi Sorghum, Finger millet,
Suited crops for use of Land	Cotton, Piegen Pea, Mung, Surghum, Soybean, Udid
Agroecological Sub Region(6.3)	**Deccan Plateau, Hot Semi Arid Eco Region**
District	Jalgaon, Buldhana, Washi, Akola, Amarawati, Yavatmal
Climate	Hot moist semi-arid
Soil	Medium land deep clayey Black soils (shallow loamy to clayey Black soils as inclusion)
AWC	Medium to high

LGP days	120- 150			
Dominant crops	Sorghum, Cotton, Maize, Black Gram,Wheat, Groundnut, Sesamum Soybean, Green gram, Black gram, Pigeon pea Gram, Kharif Maize, Kharif Jowar, Safflower, Cotton Lint, Kharif Sorghum			
Suited crops for use of Land	Sunflower, Sorghum, Mung,Cotton, Soybean, Piigen Pea			
Agroecological Sub Region (6.4)	**North Sahyadri and Western Karnataka Plateau, Hot Dry Sub Humid Eco Region**			
District	Kolahpur	Satara	Sangli	Pune
Climate	hot dry Subhumid			
Dominant crops	Sugarcane,Paddy- Rainfed, Kharif orghum, Groundnut, ingermillet, Soybean, Maize, Wheat, Chickpea, Sorghum, Pearlmillet, Kharif Jowar, Paddy, Rabi Jowar, Pigeon pea, Chick pea			
Suited crops for use of Land	Rice, Soybean, Sorghum, Sugarcane			
Agroecological Sub Region(10.2)	**Central Highlands, Hot Subhumid (Dry/Moist) Eco Region**			
District	Nagpur, Wardha			
Climate	Hot dry subhumid			
Soil	Shallow and medium loamy to clayey Black soils (deep clayey Black soils as inclusion)			
AWC	Medium to high			
LGP days	150-180			
Dominant crops	Cotton Lint, Soybean, Green, Gram, Black gram, Pigeon Pea, Paddy, Groundnut, Moong, Urd, Sesamum, Sugar cane, Jowar, Cotton, Sorghum, Chick Pea			
Suited crops for use of Land	Sorghum, Udid			
Agroecological Sub Region	**Satpura Range and Wainganga Valley, Hot Moist Subhumid Eco Region (10.4)**			
District	Bhandara, Gondia			
Climate	Hot moist subhumid			
Soil	Shallow to deep loamy to clayey mixed Red and Black soils, low to medium			
AWC	180-210			
Dominant crops	Paddy, Soybean, Pigeon pea,Wheat			
Suited crops for use of Land	Rice, Mung, Udid, Pigenpea			
Agroecological Sub Region(12.1)	**Eastern Plateau and Eastern Ghats, hot Subhumid Eco Region**			
District	Chandrapur, Gadchiroli			
Climate	Hot moist subhumid			
Soil	Deep loamy Red and Lateritic soils			
AWC	Low to medium			
LGP days	180-210			
Dominant crops	Paddy, Maize, Rabi Sorghum, Green gram, Black gram, Pigeon pea, wheat, Gram, Linseed, Rice, Cotton, Soybea			
Suited crops for use of Land	Sorghum, Mung, Udid			

Agroecological Sub Region(19.1)	North Sahyadri, Konkan Coast Hot Humid, Perhumid Eco Region
District	Raigad, Thane
Climate	Hot humid
Soil	ESR with medium to deep loamy to clayey mixed Red and Black soils,
AWC	Medium to high
LGP days	210-240
Dominant crops	Rice, Finger millets, Prosomillet, Pulses (Cowpea, blackgram, pigeon pea, chick pea, etc.), Groundnut, Musterd, Sesamum
Suited crops for use of Land	Rice, Mung
Agroecological Sub Region(19.2)	**Central and South Sahyadri**
District	Ratnagiri Sindhudurg
Climate	Hot moist subhumid to humid transitional
Soil	Deep, loamy to clayey Red and Lateritic soils
AWC	Low to medium
LGP days	210-270
Dominant crops	Rice, Finger millets, Prosomillet, Pulses((Lab lab, bean, black, gram, horse, gram, cowpea,, etc.), Groundnut niger, Musterd
Suited crops for use of Land	Mung
Agroecological Sub Region	**Konkan Coastal Plain, Hot Humid Perhumid Eco Region (19.3)**
District	Ratnagiri, Sindhudurg, Thane, Mumbai
Climate	Hot humid to per humid transitional
Soil	Deep, clayey to loamy acidic coastal alluvium-derived soils
AWC	Low
LGP days	240-270
Dominant crops	Rice, Finger millets, Prosomillet, Pulses (Lab lab bean, black gram, horse gram, cowpea, etc.), Groundnut niger,Musterd,
Suited crops for use of Land	Mung

2.6.4. Organic Farming

Organic farming is gaining significance as concern over the excess use of pesticides in agriculture is increasing and health conscious citizens who can afford to buy the vegetables at higher rates have also increased. Some of the facts about the organic agriculture in the state are as below.

- Area under Organic cultivation 6.500 Lakh Ha.
- Area Registered for Certification 1.14 Lakh Ha.
- Certified 0.42 lakh Ha.
- Under conversion 0.72 lakh Ha.
- Total Vermicomposting units 1.26 lakh
- Total Biodynamic compost depot 2.02 lakh
- Identified Service Provider 91 N.G.O.
- Developed Model Organic Farm 37 farms
- Major Crops Cotton, Cereals, Fruits & Vegetables etc.

Source : PDKV

2.7. Natural resource endowments

Maharashtra is located in the north centre of Peninsular India. It links the north to the south and the plains of India to the southern peninsula. The state is bound on west by Arabian Sea, on north - west by Gujarat, on north by Madhya Pradesh, on southeast by Andhra Pradesh and on south by Karnataka and Goa. It is the third largest state in terms of area in the country. Dominant physical trait of the state is its plateau character. Physiographically this state may be divided into three natural divisions - the coastal strip (the Konkan), the Sahyadri or the Western Ghat and the plateau. The Konkan consists undulating low lands. North Konkan has the vast hinterlands. The Western Ghats running almost parallel to the sea coast. The average height of Sahyadri is 1,200 meters. The slopes of the Sahyadri gently descending towards the east and south - east. Tapi, Godavari, Bhima and Krishna are the main rivers of the state. Maharashtra receives its rainfall mainly from south - west monsoon. The rainfall in state varies considerably. There is heavy rainfall in the coastal region, scanty rains in rain shadow areas in the central part and moderate rains in eastern parts of the state.

Physical divisions of the State comprise of three parts based on its physical features, viz, Maharashtra Plateau, the Sahyadri Range and the Konkan Coastal Strip as explained below.

Maharashtra Plateau: The major physical characteristics of the state include many small plateaux and river valleys. In the north the plateau is flanked by Satpuda ranges, which run in the East - West direction in Maharashtra. The river Narmada flows along the north boundary of Maharashtra, and other major rivers like Krishna, Godavari, Bhima, Penganga - Wardha, and Tapi - Purna have carved the plateau in alternating broad river valleys and intervening highlands.

The Sahyadri Range: The Western Ghats of Maharashtra known as the 'Sahyadri' mountain ranges have an average elevation of 1000 - 1200 m above the MSL. The Sahyadri hills run parallel to the seacoast, with many offshoots branching eastwards from the main ranges (Satmala, Ajanta, Harishchandra, Balaghat and Mahadeo). The special features are the hills of Trimbakeshwar, Matheran and the Mahableshwar plateau. Its highest peak is Kalsubai at an altitude of 1650 m. Most of the rivers in Maharashtra originate in the Sahyadri and then divide to join the eastward and westward flowing rivers. These ranges are also characterised by a number of ghats, the important ones being Thal, Bor, Kumbharli, Amba, Phonda and Amboli.

The Konkan Coastal Strip: The narrow strip of coastal land between the Sahyadri and the Arabian Sea is called the Konkan coastal strip. It is barely 50 km in width; it is wider in the north and narrows down in the south. River creeks and branches of the Sahyadri, which reach right up to the coast, dissect this coastline. The important Creeks in Konkan are Terekhol, Vijaydurg, Rajapuri, Raigad, Dabhol, Daramthar, Thane and Vasai. The rivers of Konkan rise from the cliffs of Sahyadri and have a short swift flow into the Arabian Sea. Some important rivers are Ulhas, Savitri, Vashishthi and Shastri.

2.7.1. Natural endowment favouring horticulture

Semi-arid climate is essential for crops like pomegranate, custard apple and grapes. Climate existing in western Maharashtra and part of Vidarbha and Marathwada are endowed with such climate. Climate prevailing in Vidarbha and Marathwada are highly suited to citrus crops which are abundant in Maharashtra. The state is blessed with congenial climatic conditions for cultivation of most of flower crops. Enormous natural resource is available for the cultivation of flower crops in the state. State is having the huge mountainous ranges of Western Ghats with required optimum temperature and light for quality production of flowers. Foothills of Sahyadri and Satpura ranges are ideal for the cultivation of flower crops especially under protected cultivation. Although quality of water for agriculture is a major challenge in the state but with constant efforts of government and innovative farmers have developed many strategies to mitigate the problem. Most of the flowers crops are grown under drip irrigation as the farmers were educated about the techniques of judicious use of water and other resources. The state is having huge market potential with well-developed markets in Pune, Mumbai, and Nashik, Nagpur, and Aurangabad cities.

2.7.2. River Basin Map

Figure 2.7 : River Basin Map

2.7.3. Natural endowment for inland fisheries

District wise area under reservoirs and lakes is given in Table 1 which in total is 2,73,750 ha, out of which 5,69,200 ha is inland saline affected water body

Table 2.22 : District wise area estimates of different categories of water bodies in Maharashtra

Name of the district	Area under reservoirs and lakes			
	10–500 ha	500–1000 ha	>1000 ha (10)	Total
Greater Bombay	200	-	-	200
Bombay Suburban	-			
Thane	2 487	800	2 274	5 561
Raigad	817	-	-	817
Ratnagiri	239	-	-	239
Sindhudurg	226	-	-	226
Nashik	3 700	1 885	5 000	10 585
Dhule	3 317	737	-	4 054
Jalgaon	9 372	1 316	6 500	17 188

Ahmednagar	3 238	632	12 075	15 945
Pune	3 026	904	13 417	17 347
Satara	1 995	679	9 002	11 676
Sangali	4 277	1 015	-	5 292
Solapur	4 752	1 509	20 551	26 812
Kolhapur	1 143	617	1 204	2 964
Aurangabad	3 372	802	42 887	47 061
Jalna	2 997	586	-	3 583
Parbhani	2 190	455	8 846	11 491
Beed	1 769	150	7 800	9 719
Nanded	3 809	-	1 560	5 369
Osmanabad	3 022	1 221	-	4 243
Latur	4 488	1 061	-	5 549
Buldhana	4 126	1 467	-	5 593
Akola	4 402	1 215	-	5 617
Yavatmal	2 967	118	9 595	12 680
Amravati	1 370	-	-	1 370
Wardha	1 706	1 131	-	2 837
Nagpur	4 958	1 198	1 605	7 761
Bhandara	8 162	1 419	6 693	16 274
Chandrapur	5 399	1 008	5 226	11 633
Gadchiroli	3 650	414	-	4 064
Total	97 176	22 339	154 205	273 750

Source : Compiled by CIFE

2.8. Important development indicator

Maharashtra is one of most vibrant states with respect to development in agriculture. Despite the constraints such as drought that occurs once in three to five years and minimum irrigation resources, the state contributes significantly to national agricultural system. This can be attributed to diversity in crops matching with Agro climatic conditions. However, there is a lot of scope for further improvement. Recent changes in agricultural scenarios are presented in the following session.

- First State to adopt Dry Land Farming Technology
- Emphasis on the development of horticulture along with Agriculture
- State Seed Corporation – First farmers company in seed sector
- Pioneers in Co-operative network - Sugar factories, Dairies, Water user associations
- Four State Agricultural Universities and one for animal and fisheries
- Presence of very effective and research based Farmers Organisations
- Acceptance of latest technology by Grape farmers like Eurepgap, Agmark, Bar-coding & Residue Monitoring system etc.
- Concept of contract farming & corporate farming is in the way of promotion
- An area of 13.66 lakh hectares under horticultural and 4 lakh ha under vegetables

- Largest producer of seedless Grapes (78%) banana (75%) Mandarin oranges (75%) Onion (63%), Tomatoes (42%) of the total production in India. Alphanso Mangoes accounts for 90% of India's export in mangoes.
- The highest number of poly houses (1271) owned by small farmers for cultivation of flowers
- Leads the sugar industry sector with 200 sanctioned and 150 productive cooperative sugar mills
- 40% turnover of the seed industry in the country
- More than 60% of the area under drip irrigation, thus stands first in the country
- Implementation of Agriculture Export Zones
- (Source: MPKV Rahuri)

2.8.1. Agricultural Growth and Performance of State

Overall, growth in the real gross state value added (GSVA) of 'Agriculture & Allied Activities sector was about 4.6 per cent mainly due to low intensity and deficit monsoon for two consecutive years, the production of major crops was decreased substantially during 2015-16. Production of food grains was declined by 27.0 per cent over the previous year. Production of oilseeds was dropped by nearly 9.1 per cent. Production of sugarcane was also decreased by 21.1 per cent during 2015-16.

Figure 2.8 : Annual growth rate of real GSVA of different agriculture sectors

In the backdrop of deficit monsoon of last couple of years, the State witnessed satisfactory rains during 2016-17. In the current series (Base year 2011-12), from 2011-12 to 2016-17, the GSVA of 'Agriculture & Allied Activities sector has average share of 11.8 per cent in the total GSVA and is growing at an average annual rate of 1.7 per cent. The average share of 'Agriculture & Allied Activities' sector in GVA is 18.0 percent and it is growing at an average annual rate of 2.4 percent.

Table 2.23 : Annual growth rates of real GSDP and sectoral real GSVA

Sector	Growth rate (percent)				
	2012-13	2013-14	2014-15	2015-16	2016-17
GSDP	6.0	7.3	5.4	8.5	9.4
GSVA	5.2	7.6	5.8	7.9	9.6
Agriculture and Allied Activities	(-) 0.5	12.5	(-) 11.2	(-) 4.6	12.5
Crops	(-) 2.0	19.0	(-) 17.5	(-) 10.3	19.3
Livestock	3.8	1.1	4.0	9.0	2.0
Fishing and Aquaculture	0.9	2.0	7.0	(-) 4.2	1.8

(Derived from economic survey of Maharashtra)

2.8.2. Field crops

There was significant reduction in the area sown to most of the cereal crops during 2015-16 as compared to 2001-2002 (Table). The reduction in area sown to rice was as high as 88% and 62% for rice and kharif sorghum respectively. In contrast, the area sown to maize and gram were doubled. There has been remarkable increase in area sown to soybean in the state as evident from the fact that it increased more than three fold in 2015-16 as compared to 2001-2002. Area sown to cotton and sugarcane also increased recently while the area sown to sunflower and safflower significantly decreased.

Table 2.24 : Per cent changes in Major crops in Marathwada (2000-01 to 2015-16)

Crops	Area (00 ha.) 2000-2001	Area (00ha) 2015-16	% Change
Rice	942	107	-88.64
Kharif Jowar	8023	2970	-62.98
Rabi Jowar	10760	8805	-18.17
Bajara	5074	2194	-56.76
Wheat	2438	1979	-18.83
Maize	1487	3518	136.58
Tur	4422	5288	19.58
Gram	2224	4501	102.38
Mung	2781	1582	-64.22
Safflower	3752	511	-86.35
Soybean	633	13146	1976.77
Sunflower	2229	259	-88.38
Sugarcane	1664	2042	22.72
Cotton	9550	18058	89.09

Sorghum

Sorghum is an important food and fodder crop of Vidarbha region of Maharashtra state. In Vidarbha region it is cultivated in three agro-ecological zones viz. Western Vidarbha zone with 600 to 750 mm rainfall, central Vidarbha zone with 750 – 1100mm rainfall and eastern Vidarbha zone above 11mm rainfall. The cultivation of kharif sorghum is mostly concentrated in Buldhana, Akola, Washim, Amravati, Yavatmal, and Wardha& Nagpur Districts of western and central Vidarbha zone. Whereas, rabi sorghum is cultivated in Gondia Chandrapur, Gadchiroli, Washim and Buldhana district of Eastern and western Vidarbha zone. In changing scenario of Agriculture, the area under sorghum crop has been reduced and shifted to high valued crop. In last decade the area under sorghum crop is by and large consistent with an average productivity of 746 kh/ha. The sustenance of sorghum crop in cropping pattern is certainty due to dual purpose utility and high per day productivity under rainfed situation Nevertheless sorghum crop is a well rooted crop Vidarbha region under rainfed cropping pattern, the crop need to be looked for its commercial exploitation through alternate uses. Rabi sorghum is another area which realized its importance as grain for consumption and fodder for cattle.

In Maharashtra, kahrif sorghum area has reducing trend as compared to rabi sorghum. However, the productivity of the crop has been maintained since from the year 1990 on onward. (Table: 1) It indicates the production potential of the crop under rainfed condition. During the year 2008, Maharashtra state occupies an area of 4167200 ha under sorghum. Out of this about 22.63% area (943000 ha) is under kahrif sorghum and 77.34% area (3224200 ha) is under rabi sorghum. However, the productivity of kahrif sorghum (1246 kg/ha) is higher as compare to rabi sorghum (881 kg/ha).

Table 2.25 : The area, production and productivity of kharif and rabi sorghum during 1985, 1990, 1995, 2000, 2005 & 2008 in Maharashtra state under.

Year	Area ('00' ha)			Production '00' MT			Productivity kg/ha		
	Kharif	Rabi	Total	Kharif	Rabi	Total	Kharif	Rabi	Total
1985	28693	34655	63348	21106	9813	30919	735	283	488
1990	2768	35310	62990	38170	21115	59285	1379	598	941
1995	20334	35251	55585	28874	20974	49848	1420	595	896
2000	19100	31835	50935	23988	15890	39878	1256	499	783

2005	14724	32676	47400	17641	19470	37111	1198.1	595.8	782.93
2008	9430	32242	41672	11752	24961	36713	1246.0	774	881.00

2.8.3. Dry land crops

The dryland area of scarcity zone of Maharashtra is facing many more natural calamities. Repeated drought conditions and dry spells in project area resulted in reduction in the number of draft animals, diversion of farm labourers to non-agricultural work and poor economic condition of farmers. The soils are less fertile and severely eroded. The low farm productivity in the area resulted in poor economic condition of farmers. The cash input use is very low due to uncertainty in rainfall and production. Lack of appropriate machinery and implements for use by small farmers is serious concern for successful operations. The exodus of rural labourer to urban areas, high cost labourer and decreasing availability of animal draft power are also affecting the dry land agriculture. Maximum number of land holding in the zone is marginal (37.7%) and small (31.3%), while medium to large number of holdings is only 9.3% and 1.0 percent.

Table 2.26 : Production and productivity of major crops (Average of last 5 years: 2010-11 to 2015-16) in dryland

S. No	Crop	Kharif		Rabi		Total	
		P	Py	P	Py	P	Py
Major Field crops							
1	Sorghum	-	-	427.88	395	427.88	395
2	Chickpea	-	-	33.61	716	33.61	716
3	Safflower	-	-	4.37	583	5.2	520
4	Sunflower	0.58	595	11.25	676	15.64	600
5	Pigeonpea	6.98	666	-	-	6.98	666
P: Production '000 tonnes; Py: Productivity Kg/ha							

Table 2.27 : Production and productivity of horticultural crops (Average of last 5 years: 2010-11 to 2015-16) in dryland

S. No.	Crop	Total	
		P	Py
1	Pomegranate	261.88	9000
2	Ber	45.6	17000
3	Custard apple	10.82	7000
4	Grape	242.75	20000
5	Banana	284.54	60000
P: Production '000 tonnes; Py: Productivity Kg/ha			

2.8.4. Status of Livestock sector

Table 2.28 : Livestock Population (In lakhs)

Name of District	Indigenous cattle		Crossbred cattle		Total cattle		Buffalo	
	2007	2012	2007	2012	2007	2012	2007	2012
Ahmednagar	5.65	5.45	8.18	8.82	13.83	14.27	2.41	2.21
Dhule	3.14	3.16	0.47	0.41	3.61	3.57	1.04	1.00
Jalgaon	4.87	4.66	0.68	0.86	5.55	5.52	3.01	2.57
Kolhapur	1.24	1.02	1.29	1.73	2.53	2.75	6.42	6.13

Nandurbar	4.05	3.22	0.14	0.15	4.19	3.37	0.95	0.72
Nashik	7.99	7.52	2.64	2.62	10.63	10.14	2.42	2.38
Pune	3.67	3.07	4.17	4.56	7.84	7.63	3.00	2.94
Sangli	1.82	1.70	0.98	1.71	2.8	3.41	5.19	4.93
Satara	2.00	1.82	1.58	1.95	3.58	3.77	3.47	3.53
Solapur	4.08	3.90	2.77	3.40	6.85	7.3	4.08	4.50
Total	2045.51	2047.52	2029.9	2038.21	61.41	61.73	2038.99	2042.91
Maharashtra	130.61	118.33	31.22	36.51	161.83	154.84	60.72	55.94
Per cent contribution	29.48	30.02	73.35	71.79	37.95	39.87	52.68	55.26

Table 2.29 : Status of sheep, goat and poultry

Name of District	Sheep		Goat		Poultry	
	2007	2012	2007	2012	2007	2012
Ahmednagar	3.35	3.61	9.16	7.92	16.80	17.38
Dhule	3.02	2.07	2.89	2.76	3.42	3.07
Jalgaon	0.30	0.38	4.21	3.49	2.48	2.60
Kolhapur	1.66	1.04	1.89	1.62	8.83	6.60
Nandurbar	0.15	0.15	3.21	2.72	9.92	4.91
Nashik	3.55	3.56	6.47	5.99	11.20	8.75
Pune	3.80	3.04	5.35	3.95	5.99	11.93
Sangli	1.95	1.57	3.88	3.25	9.24	8.88
Satara	3.12	2.64	3.91	3.09	15.09	12.14
Solapur	2.16	1.86	8.44	7.06	16.59	16.30
Total	2030.06	2031.92	2056.41	2053.85	2106.56	2104.56
Maharashtra	29.09	25.80	103.91	84.35	200.11	175.07
Per cent contribution	79.27	77.21	47.55	49.61	49.75	52.87

2.8.5. Horticulture

The trend in changes in production and productivity major horticultural crops are presented in Table 2.27. Though there has been increasing trend in fruit cultivation recently there is a decrease in growth rate of both production and productivity of fruit crops when compared with corresponding previous years during the period 2010-11 to 2014-15. This can be partly attributed to the dry spells. On the other hand, there has been constant positive growth rage with respect to vegetables, flower, aromatic plants and plantation crops. There has been significant increase in area sown to flower crops.

Table 2.30 : Area and Production and Yield gap of Flower Crops for Maharashtra

	A ('000 ha)		P ('000 MT)	A ('000 ha)	P ('000 MT)		Yield Gap (Kg/ha)
Fruits	Maharashtra	National	Maharashtra	National	Maharashtra	National	
Aonla/ gooseberry	0.35	95.09	3.44	1173.33	9.75	12.34	2589
Banana	74.03	821.80	4030.58	29221.47	54.44	35.56	-18885

Ber	0.06	42.12	0.20	400.67	3.64	9.51	5870
Custard apple	8.66	29.87	59.33	228.37	6.85	7.65	792
Grapes	93.26	122.96	2292.53	2822.78	24.58	22.96	-1626
Guava	16.38	246.24	277.36	3993.50	16.93	16.22	-716
Kiwi		4.63		8.50		1.84	1835
Mango	157.77	2163.47		18526.98		8.56	8564
Papaya	7.64	114.97	542.01	4912.67	70.98	42.73	-28250
Pomegranate	180.64		1789.31		9.91	9906	
Sapota	17.60	106.49	179.46	1339.01	10.20	12.57	2376

Table 2.31 : Annual Growth Trends of Area and Production of Horticultural Crops, 2010-11 to 2014-15

Crops	Area	Prdn	Area	Prdn	Area	Prdn	Area	Prdn	Area	Prdn
Fruits	–1.4	4.4	5	2.1	4.1	6.4	3.4	9.5	–11.9	–0.2
Vegetables	6.4	9.6	5.8	6.7	2.4	3.7	2.1	0.4	1.5	3.3
Flowers	4.4	1	33	60.2	–8.3	4.7	9.5	1.5	24.4	0.4
Aromatics	0.2	5.6	–0.8	–6.4	10.1	62.2	–11.4	–2.5	1.2	3.4
Plantation Crops	1.3	0.7	8.2	36.2	1.8	3.8	0.9	–4.0	–3.7	5.1
Spices	19.3	33.2	9.3	11.2	–4.2	–3.5	2.8	2.9	0	0
Total Horticulture Crops	4.5	7.8	6.5	7	1.9	4.5	2.1	3.2	–3.2	2.2

Source : Horticulture Statistics Division, DAC & FW.

Table 2.32 : District wise Area and Production of Plantation Crops Crops for Maharashtra: 2016-17

District	Arecanut			Cashew nut		
	Area	Production	Productivity	Area	Production	Productivity
SINDHUDURG	1.065	0.975	0.92	44.300	53.160	1.20
RATNAGIRI	0.680	0.880	1.29	83.500	116.900	1.40
RAIGAD	0.765	1.185	1.55	3.142	4.725	1.50
THANE	-	-	0.00	0.084	0.008	0.10
SATARA	0.000	0.000	1.30	0.017	0.021	1.25
SANGLI	-	-	0.00	-	-	0.00
NASHIK	-	-	0.00	0.985	1.463	1.49
NANDURBAR	-	-	0.00	0.013	0.073	5.55
KOLHAPUR	0.007	0.006	0.86	3.070	4.545	1.48
BHANDARA	-	-	0	-	-	0.00
AURANGABAD	-	-	0	-	-	0.00
BEED	-	-	0	-	-	0.00
LATUR	-	-	0.00	-	-	0.00
PALGHAR	-	-	0.00	0.831	0.748	0.90
Total	2.517	3.046	1.21	135.942	181.644	1.34

Table 2.33 : District wise Area and Production of Plantation Crops Crops for Maharashtra: 2016-17

District	Coconut			Oilpalm			Total		
	A	Pn	Py	A	P	Py	A	P	Py
SINDHUDURG	17.929	121.659	6.79	0.012	0.012	1.00	63.306	175.806	2.78
RATNAGIRI	4.640	35.438	7.64	0	-	0.00	88.820	153.218	1.73
RAIGAD	2.248	15.827	7.04	0	-	0.00	6.155	21.737	3.53
THANE	0.125	0.482	3.84	-	-	0.00	0.209	0.490	2.34
SATARA	0.379	-	0.00	-	-	0.00	0.395	0.021	0.05
SANGLI	0.260	1.101	4.23	-	-	0.00	0.260	1.101	4.23
NASHIK	-	-	0.00	-	-	0.00	0.985	1.463	1.49
NANDURBAR	0.023	0.138	5.96	-	-	0.00	0.036	0.211	5.81
KOLHAPUR	0.599	2.477	4.13	0.350	0.351	1.00	4.036	7.379	1.83
BHANDARA	0.001	-	0.00	-	-	0.00	0.001	-	0
AURANGABAD	0.060	0.482	8.05	-	-	0.00	0.060	0.482	8.05
BEED	0.009	0.069	7.73	-	-	0.00	0.009	0.069	7.73
LATUR	0.020	0.206	10.48	-	-	0.00	0.020	0.206	10.48
PALGHAR	1.474	10.391	7.05	-	-	0.00	2.365	11.209	4.74
Total	27.766	188.269	6.78	0.362	0.363	1.00	166.657	373.392	2.24

Pomegranate

Pomegranate is an important fruit crop of arid and semiarid regions of the world. India is one of the largest producers of pomegranate in the world. India is the only country in the world where pomegranate is available throughout the year (January – December). At present, Maharashtra is the leading state in acreage covering about 68.7 per cent of the area under pomegranate. Similarly around 70.2 per cent of total production comes from Maharashtra. The area under pomegranate has increased from 78000 ha to 99.14 ha and production increased three times during 2012-13 to 2014-15 (Table 1.11) clearly indicating that the farmers are increasingly opting for crops like pomegranate which provide more profit with less water.

Table 2.34 : Changes in are and production of pomegranate in Maharashtra

Year	Area (000ha.)	Production (000MT)
2012-13	78.0	408.00
2013-14	90.00	945.00
2014-15	99.14	1313.70

Grapes

Out of total grape acreage (1.36 lakh ha) in the country, more than 80 % is concentrated in the state of Maharashtra. The average productivity is 20.4 t/ha (NHB database). In Maharashtra, more than 90 % of the area is concentrated in Western Maharashtra followed by Marathawada. Except for Konkan region where rainfall and relative humidity are very high, grape can be cultivated in almost all the areas where assured irrigation water (350 – 600 mm) is available throughout the dry period. Since 2001, the area under grapes has increased by more than two times

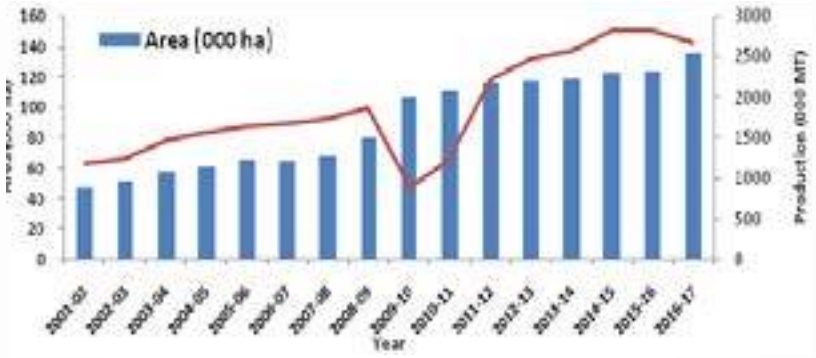


Figure 2.9 : Trend in changes in area sown to grapes in Maharashtra

Flowers

Statistic of Maharashtra reveals that there has been increasing trend both in area and production of flowers. However, there is a remarkable decrease in production of cut flowers (Table).

Table 2.35 : Changes in production of and productivity of flower crops

Production			
Year	Area (ha)	Loose flowers (tonnes)	Cut flowers (lakh numbers)
2014-15	23000	122700	44.0
2013-14	23000	122650	44.0
2012-13	22000	119000	7914.0

Source : NHB Database

2.8.6. Changes in Livestock and Poultry in Rural and Urban area

In comparison to year 2007, there was decrease in number of animals in the year 2012 both in rural and urban areas. Number of goats decreased by 19.2 and 11.9% in rural and urban areas respectively while the poultry birds increase by 29.6 %.

Table 2.36 : Changes in total number of animals in rural and urban areas

Species	Rural			Urban		
	2007	2012	Change %	2007	2012	Change %
Cattle	15727017	15089655	-4.1	456510	394552	-13.6
Buffalo	5682305	5209994	-8.3	390312	384398	-1.5
Sheep	2862955	2533961	-11.5	46405	46420	0.0
Goat	9864825	7971842	-19.2	526343	463465	-11.9
Pig	237791	232683	-2.1	88952	93073	4.6
Poultry	58415419	75696120	29.6	6340616	2098451	-66.9

Table 2.37 : Trend in production of desi and commercial birds and egg production

Year	Layer Birds (Lakh)		Egg production (Crore)		
	Deshi	Commercial	Deshi	Commercial	Total
2006-07	129.95	69.23	156.56	183.43	339.99
2007-08	130.61	70.32	159.02	186.76	345.78
2008-09	136.39	71.18	166.01	188.59	354.6
Source:http://ahd.maharashtra.gov.in					

2.8.7. Fisheries growth

Maharashtra is now the 7th largest producer of fish producer and contributes almost 5.38% of country's fish production. Fish production has decreased from 608064 tonnes in 2014-15 to 579685 tonnes in 2015-16. States like Andhra Pradesh, West Bengal, Kerala and Gujarat. The historical scenario of Indian fisheries reveals a paradigm shift from marine dominated fisheries to a scenario where inland fisheries has emerged as a major contributor to the overall fish production in the country. It is looking to interesting in Maharashtra Marine fisheries dominated by all time. As seen in the table and figures 1 & 2, marine fisheries presently have a share of 74.89% in total fish production of the state.

Table 2.38 : Fish production trend in Maharashtra State

Year	Inland (lakh tons)	Marine (lakh tons)	Total production (lakh tons)
2006-07	1.32	4.64	5.96
2007-08	1.42	4.20	5.62
2008-09	1.36	3.96	5.31
2009-10	1.23	4.16	5.38
2010-11	1.30	4.47	5.77
2011-12	1.45	4.34	5.79
2012-13	1.37	4.49	5.86
2013-14	1.35	4.67	6.03
2014-15	1.44	4.64	6.08
2015-16	1.46	4.34	5.80

Source : Dept. of Fisheries, Govt. of Maharashtra, 2017

Marine Fisheries Census-2010 was carried out in five districts of the State viz . Thane, Greater Mumbai, Raigad, Ratnagiri and Sindhudurg during April-May 2010. Highlights of this census are as follows: Number of marine fishing villages/localities wherein fishermen reside is 456. Fishermen families are 0.81 lakh with population of 3.86 lakh. Traditional fishermen families are 91 percent. Among the occupied 1.93 lakh, 39.5 per cent of the fisher folk were engaged in active fishing, 57.6 per cent in fishing allied activities and remaining in other activities of the total 0.76lakh active fishermen 0.63 lakh were full-time, 0.11 lakh part-time and the rest were engaged in fish seed collection.

2.8.8. Processing industries

The scope of the Agro-processing industry encompasses all operations from the stage of harvest till the material reaches the end users in the desired form, packaging, quantity, quality and price. Agro-processing is now regarded as the sunrise sector of the Indian economy in view of its large potential for growth and likely socioeconomic impact specifically on employment and income generation. Some estimates suggest that in developed countries, more than 18 per cent of the total work force is engaged in Agro-processing sector directly or indirectly. However, in India, only about 4-5 per cent of the work force finds employment in this sector revealing its underdeveloped state and vast untapped potential for employment. Properly developed, Agro-processing sector can make India a major player at the global level for marketing and supply of processed food, feed and a wide range of other plant product

Currently of the total production, only 4.4 per cent of fruits and vegetables (F&V), 26 per cent of marine, 6 per cent of poultry, 20 per cent of buffalo meat and 35 per cent of milk is processed. As compared to the food processed in developed countries in India there is quite low value addition because of meager processing and storage facilities. This is resulting in huge post harvest losses to the tune of approximately Rs 55000 crorer per annum which eventually responsible for lowering the farmers income. The increase in value addition will result in prevention of losses and improving income of farmers.

Post Harvest Technology involves primary, secondary and tertiary processing. India's food processing mainly involves primary processing which accounts for 80% of the value. As much as 42% of the food industry is in the unorganized sector, 25 % of the food industry is in the organized sector and 33% in the small scale, tiny and cottage sectors. The value addition to agricultural commodities is less than 10%.

Maharashtra is one of the country's leaders in agro-industry in general, and in food processing in particular. However, the current level of processing in the State, as in the rest of India, is very low by international standards. There is tremendous potential for much higher value addition through processing.

In the field of agro-industry and food processing, additional clusters may be initiated for processing of mango (Nashik), Grape and raisin (Nashik and Sangli), soybean (Satara), Custard apple (Pune), Banana (Jalgaon), Pomegranate (Solapur, Nashik), Guava (Ahmednagar) etc.

Agro-processing co-operatives play an important role in the development of rural economy, ensuring reasonable returns to the farmers and also in development of rural industry, there by generating employment. The State provides financial assistance to societies for setting up agro processing units. Co-operative sugar factories, cotton ginning & pressing, spinning mills, handloom & power loom, dairy societies & dairy unions and fisheries societies are the major constituents of agro-processing co-operatives. However, many of these units were under loss and this needs attention.

Of the total sugar factories in the country, 31 per cent are located in the State followed by 23 per cent in Uttar Pradesh. As on 31st March, 2014, out of the total sugar production in the country, the share of State was 32 per cent followed by 27 per cent of Uttar Pradesh.

At the end of March, 2014, there were 26,577 co-operative dairy societies and 78 co-operative dairy unions in the State. About 46.3 percent co-operative dairy societies and about 43.6 percent dairy unions were in loss.

There are 3,391 primary fisheries co-operative societies, 16 fisheries co-operative unions and two federations working in the State as on 31st March, 2014. Number of members in these institutions is 3.40 lakh with working capital of 248.16 crore. These societies sold fish and fish products worth Rs 519.13 crore in 2013-14, as against Rs 441.48 crore in 2012-13.

2.8.9. Agriculture growth and employment

The growth rate of the agriculture and allied activities sector was 7.7 per cent at constant (2004-05) prices during 2013-14 as against 0.5 per cent in the previous year. The proportions of cultivators and agricultural labours in total workers were 24.8 and 20.3 per cent during Census 2001(Table 2 33). The share of agriculture was 11.3 per cent in GSDP at prices in 2013-14 while its share in employment was 52.7 per cent as per Census 2011 (Error! Reference source not found.) which was raised to 25.4 per cent during Census 2011. The proportion of small and marginal farmers was 78.6 per cent as per Agriculture Census 2010-11.

Table 2.39 : Percentage Distribution of Works

	1961	1971	1981	1991	2001
Cultivators	46.1	35.5	31.9	30	24.8
Agriculture Labourers & fishing	23.8	30.9	26	25.9	20.3

Source : http://www.internationalseminar.org

Table 2.40 : Share of non-agricultural sector in rural employment (%)

	1983	1993-94	2004-05	2009-10
Maharashtra	14.3	20.3	20.1	20.6
All India	18.6	21.7	27.4	32.1

Source : htttp://www.internationalseminar.org

2.8.10. Sources of farmers income

Among the various sources of farmers income in the state, share from crop cultivation is 51% while the same from Livestock, Nonfarm business and wages/salary is 10, 11 and 28% of annual income respectively as reported for the year 2013. This indicates that much of the house hold income emerges from crop cultivation and wages relative to other major sources such as farming of animals and non-farm business and there was no much change in this trend except that income from animal farms increased. This clearly also hints at a

scope for enhancing income from livestock which is supported by the data that among different components of income, livestock had significant growth rate to an extent of 8.96% as compared to crop cultivation (3.32%) and nonfarm business(3.97%). The annual growth rate of household income from all sources was 3.46%.

Table 2.41 : Income status (average monthly income check if it is per crop season or monthly

Income	Legumes (Tur, gram)	Cereal (Jowar, Wheat)	Sugarcane	Grapes	Banana	Pomegranate
a	26,000.00	9,000.00	75,000.00	1.95	1.4 lakh	1.3 lakh
b	32,000.00	11,000.00	65,000.00	2.15 lakh	1.6 lakh	1.6 lakh
a. Income (Rs)/acre Including labour charges; b. Excluding labour charges						

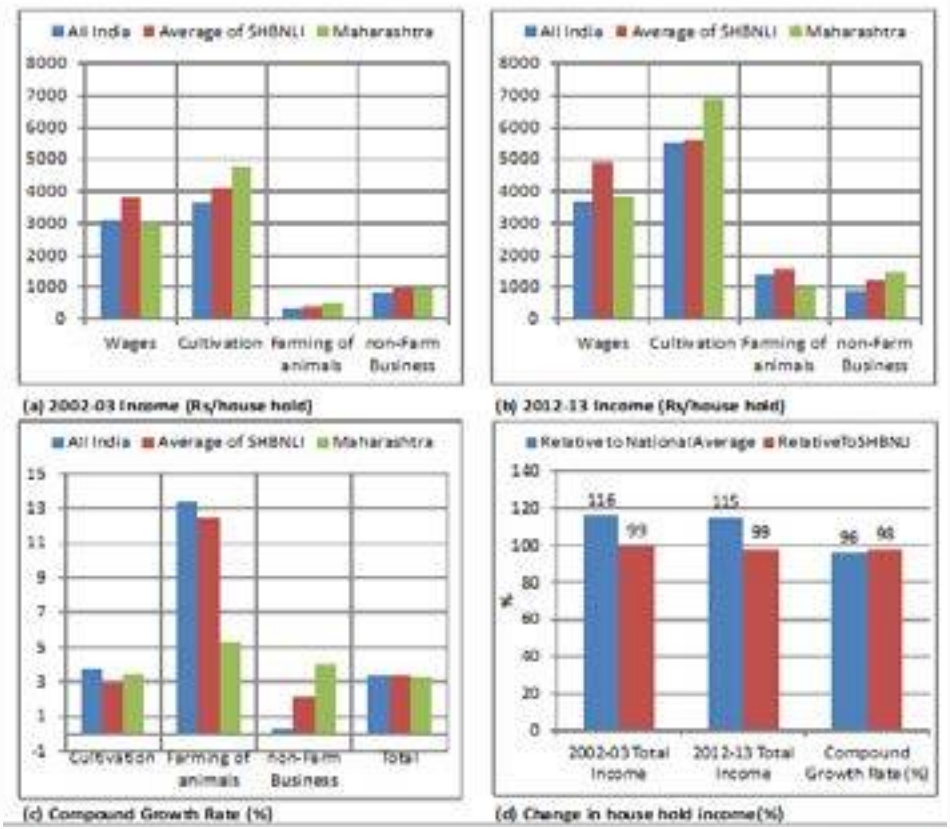


Figure 2.10 : (a) 2002-03 Income (b) 2012-13 Income (c) Compound Growth Rate (d) Change in house hold income

Table 2.42 : Sources of income

Source	Annual Income (Rs)	% of Annual Income
Farming	46385	51
Livestock	9308	10
Nonfarm Business	10044	11
Wages/Salary	25764	28

Source : Agro-Economic Research Farmers Income in India: Evidence from Secondary Data

One of the important trends to note that change in income of farmer relative to national average was higher in 2002-03 but slightly lower at later stages when compared with overall and with average of states having irrigation below national level (Agri Situation India, June 2015). Agricultural labour gets somewhere between Rs.250/- to 400/-(Depends on the skill of the person) in Maharashtra. Shortage of labours for agricultural operation is often experienced by the farmers and often it is being attributed to their engagement with

MNREGA scheme. Data reveal that proportion of leasing in land in the year 2015 has decreased by 1.22% relative that recorded in the year 2003.

Average monthly income of rich farmers engaged in onion farming is Rs. 30,000 to 50,000. In case of medium farmers, it is Rs. 10,000 to 30,000. Poor onion grower gets average monthly income of Rs. 1,000 to 10,000. Average monthly income of landless agricultural labourers engaged in onion farming is below Rs. 1,000 (Source: DOGR, Pune)

2.8.11. Tenancy of agricultural land

In Maharashtra about 5.21% of the land is on tenancy and mainly due to leasing in from the farmers with more land. About 25% of the land owners who leased out their land had more than 4 ha of land (Error! Reference source not found.). On the other hand, very few of the farmers leased out the land when the size of the land holding were below or equal to 2 ha indicating that much of the farm labours were engaged by large farmers

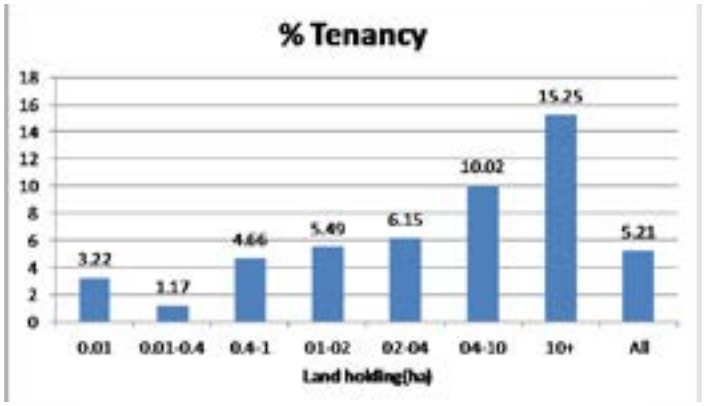


Figure 2.11 : Tenancy across different sizes of land holding

2.8.12. Other allied activities

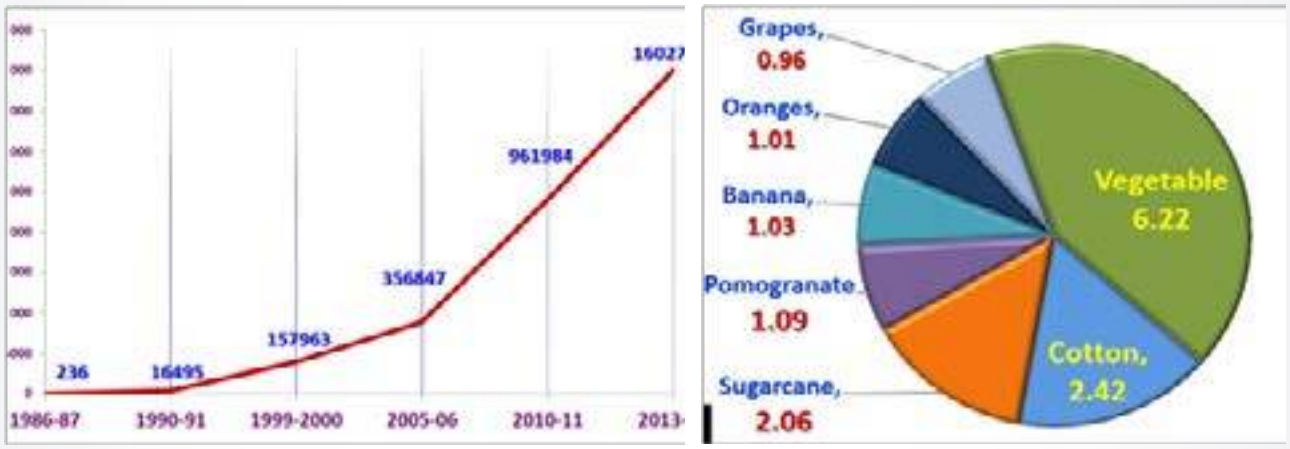
Sericulture has potential to generate employment opportunities in rural areas. It is the cultivation of silk through rearing of silkworms involving raising of mulberry plants for silkworms, rearing of silkworms for production of cocoons, reeling & spinning of cocoons for production of yarn, etc. for value added benefits such as processing and weaving. Mulberry silk development programme is implemented in 24 districts of the State. During 2013-14, area under mulberry plantation was 1,488.10 ha less by 15.2 percent while production of raw silk was 111.52 MT which was more by 27.5 percent over 2012-13. During 2014-15, up to January, production of raw silk was 149.60 MT. During 2014-15 up to January, employment of 34.81 lakh man days was generate das against 18.67 lakh man days during the same period of the previous year. Tasar silk development programme is implemented in four districts viz. Gadchiroli, Chandrapur, Bhandara and Gondia. Area under plantation of Ain and Arjun trees (on which Tasar silkworms are grown) is 18,866 ha in these four districts. During 2013-14, production of raw Tasar silk was 10.20 MT. During 2014-15 up to January, 5.28 MT raw Tasar silk was produced. During 2015-16, production of raw Tasar silk was 21.50 MT while during 2016-17 up to December it was 9.09 MT.

- The state produced 170 MT of Mulberry raw silk & 13 MT of Tasar silk during 2015-2016.
- Promoting the development of Silk Industry by such measures to create scope and opportunity
- To create greater opportunities for gainful employment and improved levels of income in sericulture through spread of scientific sericulture practices
- Undertaking, assisting or encouraging scientific, technological and economic research.
- Devising means for improved methods of mulberry cultivation, silkworm rearing, developing and distribution of healthy silkworm seeds, improved methods of silk reeling and spinning of the cocoons and silk-waste, improving the quality and production of raw silk, if necessary by making it compulsory, for all the raw silk to be marketed, only after the same has been tested and graded in properly quipped raw Silk Testing and Conditioning Houses
- Improving the collection of cocoon and proper market linkage of raw silk.

2.8.13. Irrigation

The irrigated area in command area under the jurisdiction of Water Resources Department, GoM increased from 24.48 lakh ha in 2012-13 to 32.60 lakh ha in 2013-14. At present the state has only about 21.89 % of cultivated area under irrigation while ultimate potential can be only 58%. Increase in area under irrigation can substantially transform agriculture in the state and hence the farmers income.

Taking into consideration water scarcity, micro irrigation technology has been adopted by 62.5% farmers of Akola and Wardha district and 58.66% farmers of major onion growing districts viz., Pune, Ahmednagar and Nashik of Maharashtra. It is also becoming popular in other parts of Maharashtra. So far, about 33, 938 farmers were benefited from scheme of government to promote irrigation technologies such as drip irrigation and sprinkler. These interventions have now increased the area under micro irrigation from mere 288 ha in 1986-87 to as high as 1.6 million ha in 2013-14.



(a) (b)

Figure 2.12 : Crop wise area covered under micro irrigation in Maharashtra till 2014

State Govt. has decided to bring 100 % Sugarcane (10 Lakh ha.) under micro irrigation during next 5 years through joint efforts of GoI and GoM financial institutions, sugar factories, irrigation department, technology transfer through SAUs. In addition, water saving technologies will be extended to cotton and vegetables.

Table 2.43 : Status of irrigation in Maharashtra

Geographical Area (GA)	307 Lac ha
Cultivable Area (CA)	225 Lac ha (73% GA)
Annual Rainfall	400 to 6000 mm
Ultimate Potential	
Through Surface Water	85 Lac ha (38% CA)
Through Surface& G.W.	126 Lac ha (56 % CA)
Potential created 06/2012	49.26 Lac ha
Percentage of IP wrt. CA	21.89%
Percentage of IP wrt. Ultimate potential	58%

Figure 2.13 : Sources of irrigation

Irrigation technologies can save Up to 47 % of water as demonstrated in grape orchards of drought-prone areas. Subsurface irrigation can increase in productivity of vine yard and can reduce the cost of production (Water tanker cost) and the area under vineyard can be increased and hence the farmers income can be increased.

2.8.14. Watershed Development

Table 2.44 : Watershed Development in Maharashtra

Total geographical area	307 lakh Ha.
Area available for S&WC treatment	241 lakh Ha.
Area Treated so far	110 lakh Ha.
Balance Area	131 lakh Ha
Total no. of micro watershed -	44185
Micro Watershed started no. -	27573
Micro Watershed Completed no-	10900
Ongoing micro watersheds no -	16673

2.8.15. Agricultural Marketing

Infrastructure

Market infrastructure is an important tool to facilitate the trade of harvested produce. The National Agricultural Commission, 1976, reported the existence of 22,000 haats or mandies, where farmers exchanged their produce for cash. On average, these mandies serviced an area in a radius of 8 to 16 kms. The Commission informed there existed 4145 larger markets at tehsil headquarters, large villages and towns. These were at that time variously classified as secondary markets or wholesale markets or assembling markets. The Commission took into account ongoing development and projected that there would be about 30,000 assembly markets and sub-markets in the country by the year 2000. It envisaged each having minimum physical facilities to handle and arrange the marketing the produce at the next point.

- 294 APMC's, 608 sub-markets - Turnover - Rs. 50000 cr.
- MoU with REUTERS for information dissemination through SMS, 50000 customer base
- Two wine parks at Nashik & Sangli: 54 wineries in production.
- Floriculture Park near Pune : 24 units in production.

- Established 10 Export Facility Centres under 6 AEZs.
- Vapour Heat Treatment facility developed at Navi Mumbai - more than 8000 MTs fruits & veg. Exported.
- Trained 40000 farmers enabling an export of more than 5000 MTs of horticulture produce.

Implementation of Agricultural Marketing Reforms

- Direct marketing- 72 Licensees issued
- Private markets- 07 approvals given
- Farmer-Consumer Markets- 33 locations
- Contract farming- 1 lakh Ha under various crops
- Single License System - 09 private players
- Special Commodity Markets-20 Festivals organized

District Agricultural Marketing Structure

- DAMS - For strengthening agriculture marketing system, for creating storage & processing infrastructural facilities and for better market price to farmers
- The total outlay for all the districts for next 3 years – Rs 1018 Crs.
- Financial Assistance - Expected from various schemes of Central & State Govt. such as RKVY, NHM, DMI, APEDA, NHB, NABARD, NCDC, MOFP
- Activities included in DAMS-
- Pledge Loan Scheme
- Fruit Festival Scheme
- Rural Godawn Scheme
- Onion storage structure scheme
- Onion transport /Ship transport freight subsidy scheme for exports
- Setting up of Cold Storage and other related infrastructural projects
- MARKNET / market information Project
- Farmers Market

Infrastructure Development for Exports and Domestic Marketing

- MSAMB as Nodal Agency for Agri Export Zone
- Established six Export Facility Centers with financial help of APEDA
- Facilities include Pre-cooling, Cold storage, Pack House, Material Handling Line, Ripening chambers
- Banana - 2 Nos
- Pomegranate - 1 No
- Keshar Mango - 1 No
- Orange - 1 No
- Fruits & Veg. - 1 No
- Total Investment – Rs. 25 crores
- Exports done from facilities – 5000 MT

Marketing, Rural Credit and Investment in Agriculture.

The Maharashtra State Agricultural Marketing Board is mainly entrusted with activities such as keeping necessary co-ordination in working of market committees, development & promotional activities of Agriculture Produce Marketing Committees (APMCs), establishment of agro-export zones, horticultural training centres and grading & packing facilities, etc. The State has launched the Sant Shiromani Shri Savata Mali Shetkari Athavade Baajar Abhiyaan from 12th August 2016 to reduce the post-harvest losses by way of

direct sell of agriculture produce from farmers to consumers on the basis of farm-to-fork model. Under this Abhiyaan, 48 weekly markets for farmers have been started in the State and farmers are expected to directly sell fruits & vegetables to consumers, without any middleman. Various departments of the State Government, Municipal Corporations/Councils are directed to make available land for these weekly markets for farmers. Farmers, groups of farmers, farmers production companies, consumer co-operative societies and producers' co-operative societies are free to sell their agriculture produce (fresh, clean and properly weighed) in these markets at appropriate rates to consumers.

Under the National Agricultural Insurance Scheme (NAIS), 16 kharif and 8 rabi crops are covered. Number of farmers receiving the benefit of this scheme has increased from about 3.55 in 2013-14 to 98.28 lakhs in 2016-17.

2.8.16. Formation of Self Help Groups

The process of social mobilization and introduction of the concept of participatory development by forming SHGs is creating a positive transformation. The SHGs can be formed in major onion growing areas of Maharashtra. The union of Self Help Groups can act as a pressure groups and can put pressure for minimum price fixation in case of price fall in the market at the time of selling onion. These groups together can also manufacture motorized onion graders which costs Rs. 80,000 for grading their onions in a large scale. The majority of the onions are still stored in traditional type of storage structures where storage losses are high. The union of groups can also construct the permanent storage structures like bottom ventilated double row storage structure with asbestos roof which have 50 tonnes capacity of storage and costs near about 1.5 lakhs. The union of groups can contact the banks and get subsidies on graders or storage structures. Success depends on the marketing of products after value addition. The groups can also think about seed village concept to get pure seed from their village itself. It will save their cost of cultivation and also get assured market for their produce. The village groups can also form a commodity group for onion for export of fresh produce and processed products.

3 Infrastructure for Agriculture and Government Programmes

Diverse agro-climatic conditions are overall strength of the state which has strong agricultural research support from five Sate Agricultural Universities and 12 National Research Institute under ICAR. The state has approximately 15,500 field level staff and known for its strong co-operative network. Further, proximity to international airport & sea port provide logistic advantages for crop based farmers organizations and innovative farmers. The state has a large coastal area and scope for primary industries. There is a huge market potential for many crops if value chain is properly organized. Krishi Vigyan Kendras are very active and have optimized technology transfer models. In the state there are about 48 KVK involved in extending technology transfer for productivity enhancement. Yield gaps have been identified for pulses and soybean in Vidarbha and Marathwada. All the KVKs farming system modules serve as models for integration of technology and choice of commodities. These KVKs have developed skill development training centers and certified courses.

3.1. Institutes for agricultural research, education and extension

The state has 05 agricultural universities viz. Dr. Balaesaheb Sawant Kokan Krishi Vidyapeeth, Dapoli, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola and Animal & Fisheries Sciences University, Nagpur. Maharashtra has two national research centre's viz. National Research Centre for Pomegranate, Solapur and National Research Centre for Grapes, Pune, one ICAR institute "ICAR-National Institue of Abiotic Stress Management, Malegaon, Maharashtra" and one deemed university viz. ICAR-Central Institute on Fisheries Education, Mumbai. Among thirteen agricultural directorates, two directorates viz. Directorate on Onion and Garlic Research, Pune and Directorate of Floricultural Research, Pune, Maharashtra present in Maharashtra. Brief information about the institutes are presented in the following section.

3.1.1. Dr. Balasaheb Sawant Kokan Krishi Vidyapeeth, Dapoli

Government of Maharashtra established the Konkan Krishi Vidyapeeth on the 18th May 1972 to impart education, conduct research on location specific problems and disseminate the improved crop production technologies amongst the farming community. The mandate of university is to cater the need of the Konkan region with regards to Education, research and Extension Education in Agriculture.

3.1.2. Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri

Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri established in 1969 for the western Maharashtra having jurisdiction spread over 10 districts viz. Jalgaon, Nandurbar, Dhule, Nashik, Ahmednagar,Pune, Solapur, Satara, Sangli and Kolhapur. The University is named after the great social reformer "Mahatma Jyotiba Phule" with mandates to provide education, research and extension in agriculture and allied sciences.

3.1.3. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani

Established in 1972, on Land grant pattern, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani is one of the four Agril. universities in state of Maharashtra. Except some industrialization around Aurangabad and Nanded, the entire region has rural setting. The objectives of the University are : Education in agriculture & Allied Sciences, Undertake Research based on regional needs and facilitate Technology transfer etc.

3.1.4. Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola

Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola was established on 20th October, 1969 with its head-quarter at Akola. This Agricultural University was named after the illustrious son of Vidarbha Dr. Panjabrao

(alias Bhausaheb) Deshmukh, who was the Minister for Agriculture,Govt. of India. The jurisdiction of this university is spread over the eleven districts of Vidarbha. According to the University Act 1983 (of the Government of Maharashtra), the University is entrusted with the responsibility of agricultural education, research and extension education alongwith breeder and foundation seed programme.

3.1.5. Animal & Fisheries Sciences University, Nagpur.

The Maharashtra Animal & Fishery Sciences University (MAFSU) was formally notified on November 17th, 2000 and was established under the State Act No. 1998 (MAH.XVII of 1998) on December 03rd, 2000 with its headquarter at Nagpur. The University has been carved out of the four Agriculture Universities in the state by transferring five Veterinary Colleges, one Post Graduate Institute of Veterinary & Animal Sciences and one Dairy Technology College. Although the University is in its infancy, the constituent colleges were quite old.

3.1.6. National Research Centre for Pomegranate, Solapur

National Research Centre for Pomegranate, Solapur was established in 2005 for development of scientific management practices. The package of practices developed for scientific pomegranate cultivation is available for the pomegranate growers and other stakeholders.

3.1.7. National Research Centre for Grapes, Pune

National Research Centre for Grapes, Pune established on 18th January 1997 at Manjri, Pune, with mandate strategic and applied research on safe grape production and productivity, transfer of technology and capacity building of stakeholders for enhanced and sustained production of grapes.

3.1.8. ICAR- National Institutes of Abiotic Stress Management

ICAR-NIASM, a unique institute of Indian Council of Agricultural Research (ICAR), was established in 2009 at Malegaon Khurd, Baramati. The institute aims at exploring the avenues for management of abiotic stresses affecting the very sustainability of national food production systems. It specifically addresses the aberration induced stresses due to atmospheric, water and edaphic factors, which are estimated to cause 50 per cent losses in crop productivity. Since these stresses are predicted to amplify due to climate change and land degradation, the primary task for the institute is to evolve alleviation techniques through advances in frontier science research. The institute is being structured to enhance capacity of scientists and policy makers mainly by imparting knowledge and by providing the state-of-art facilities for multidisciplinary and multi-commodity research.

3.1.9. ICAR- Central Institute for Cotton Research

The ICAR-Central Institute for Cotton Research was established at Nagpur, in 1976 with mandates of basic, strategic and adaptive research on production, fibre quality and by products of cotton. Creation of new genetic variability for location specific adoption in cotton based cropping system. Coordination and monitoring of applied research on national and regional issues to develop improved varieties and technologies. Dissemination of technologies and capacity building.

3.1.10. ICAR-Central Citrus Research Institute, Nagpur

The ICAR-Central Citrus Research Institute was established at Nagpur, in 1985. The mandate at the time of establishment of the Centre was to undertake research on mandarin and acid lime to increase the productivity through developing better varieties, standardizing appropriate agrotechniques, integrated pest and disease management and developing technologies for improved storage, packing processing and waste utilization.

3.1.11. Central Institute on Fisheries Education, Mumbai Deemed Universities

The Institute was established on 6th June 1961, under the Ministry of Agriculture, Govt. of India with assistance from FAO/UNDP. It came under the administrative control of Indian Council of Agricultural Research (ICAR) on 16th April 1979 and subsequently, the scope and mandate have been widened to include education, research and extension. CIFE has created an ecosystem of teaching and research excellence making it a preferred destination of students.

3.1.12. Directorate of Onion and Garlic Research, Pune

ICAR established National Research Centre for Onion and Garlic in VIII Plan with it's headquartering at Nasik in 1994. However, due to some working constraints, the Centre was shifted to Rajgurunagar on 16 June 1998. The centre has been upgraded to Directorate of Onion and Garlic Research in December 2008. It also has an All India Network Research Project on Onion & Garlic with 25 participating centres all over the country. The mandate of this institute is to promote overall growth of onion and garlic in terms of enhancement of quality production, export and processing.

3.1.13. Directorate of Floricultural Research, Pune

ICAR- Directorate of Floricultural Research (DFR) is an exclusive R & D Institute of GoI for flower crops. It was established in the year 2009 (December 10) at New Delhi and relocated to Pune in 2014 with mandate on commercial flower crops. Institute is working on the development of various technologies (including varieties) for the betterment of floriculture in the state as well as in country.

3.1.14. ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur

Government launched All-India Soil Survey Scheme in 1956, which expanded in 1959 as the All-India Soil and Land Use Survey Organisation (AIS & LUS). In 1969, the AIS & LUS was bifurcated into two wings, one being under the Indian Council of Agricultural Research (ICAR). It was later in 1973 reconstituted as a Directorate through a Presidential Notification. The Directorate was accorded the status of a Bureau in 1976 and was named as National Bureau of Soil Survey and Land Use Planning (NBSS & LUP) with its Hqrs. at Nagpur, Maharashtra. It is one of the fourteen Natural Resource Management (NRM) institutes of the ICAR entrusted to conduct RD&T activities mainly in soil survey, remote sensing applications, land evaluation and land use planning.

3.1.15. Krishi Vigyan Kendras

Maharashtra has 45 KVK's working for transfer of technology from research centres to farmers field. The KVK scheme is 100% financed by Govt. of India and the KVKs are sanctioned to Agricultural Universities, ICAR institutes, related Government Departments and Non Government Organizations (NGOs) working in Agriculture. KVK is an integral part of the National Agricultural Research System (NARS), aims at assessment of location specific technology modules in agriculture and allied enterprises, through technology assessment, refinement and demonstrations. KVKs have been functioning as Knowledge and Resource Centre of agricultural technology supporting initiatives of public, private and voluntary sector for improving the agricultural economy of the district and are linking the NARS with extension system and farmers.

3.1.16. Mission for Integrated Development of Horticulture

Mission for Integrated Development of Horticulture (MIDH), a scheme of Government of. The NHM was introduced from 2005, through state governments for bringing awareness and promoting horticultural crops in the country. Floriculture is the part of horticulture, which got more attention recently. It is observed that agro-climatic condition of Maharashtra is suitable for flower crops and the Government of Maharashtra (GoM) is supporting hi-tech floriculture substantially. Many greenhouse projects are being funded by the NHB at different levels. From 2015-16, the MIDH is implemented in 34 districts and the sharing pattern of GoI & GoM is 60:40. It also gives fund for promotion of horticulture, quality planting material, area expansion, post harvest management, cold chain management, etc. in state.

3.1.17. Rashtriya Krishi Vikas Yojana

Rashtiy Krishi Vikas Yojana (RKVY) started by the Department of Agriculture and Cooperation (DAC), and Ministry of Agriculture, GoI provides financial support for the various floricultural activities/projects in the state. RKVY has funded various projects to bring out quantifiable changes in the production and productivity of various components of agriculture and allied sectors by addressing them in a holistic manner.

3.1.18. Marketing, Rural Credit and Investment in Agriculture

Financial assistance is provided to farmers by way of short-term loans, credit, etc. by government through various banks and co-operative agencies. The National Bank for Agriculture and Rural Development (NABARD) is the apex bank for agricultural & rural development in the country. The loans are disbursed

through Commercial Banks (CB), Regional Rural Banks (RRB), Maharashtra State Co-operative Bank (MSCB), District Central Co-operative Banks (DCCB) and Land Development Banks (LDB). The financial institutions directly associated with agricultural finance at grass root level in the State are Primary Agricultural Credit Co-operative Societies (PACS) which provide short-term crop loans to their cultivator members. The PACS advanced loan of Rs 13,293 crore during 2015-16, of which loan advanced to small & marginal farmers was Rs 7,089 crore. The corresponding figures during 2014-15 were Rs 13,777 crore and Rs 5,961 crore respectively. The Maharashtra State Co-operative Bank and Regional Rural Banks issued 2.37 lakh and 0.75 lakh new Kisan Credit Cards (KCC) respectively in the State during 2015-16. The amount of loan sanctioned to new KCC holders during 2015-16 by these banks was Rs 44,919 lakh and Rs 14,927 lakh respectively.

3.1.19. Agri-Export Zone -Talegoan Floriculture Park

There has been phenomenal growth of floriculture in Maharashtra after the establishment of Agri-Export Zone (AEZ) at Talegaon. The establishment of Floriculture Training Centre (FTC) and Floriculture Park at Talegaon as an AEZ with in an area of 210.00 ha is serving as model training centre for resource poor farmers and plays significant role in floricultural growth in the state. The idea of Floriculture Park is unique and it's one of its kind in country. The vision of state government to promote the floriculture in state and to have all required facilities at one place paved the way to work on the lines of commercial heavy industries. For the said park, state government has worked very closely with the Maharashtra Industrial Development Corporation (MIDC) and outline of various components were prepared. Talegaon Floriculture Park, the result of that in an area of 210 ha is now a reality and serving as a hub. Flower production for domestic and export markets provides an opportunity for higher returns per unit area and also requires higher inputs including labour. By establishing such a park, state government has provided a lifestyle business opportunity to the investors in floriculture units and excellent business opportunity to service providers who would set up common facilities like nursery, greenhouse materials & manufacturing, and post harvest center at par with international standards. To some extent it has served its purpose and over the period has emerged as the centre of excellence not only for producing quality flowers but also as knowledge base. It is one of the places in India where industry is nurtured and trained manpower is generated on whose shoulder future floriculture industry shall reside.

3.1.20. National Institute of Post Harvest Technology

State government policies have always promoted horticulture and due to constant efforts of state government and hardworking farmers, Maharashtra has become leading state in horticulture in the country. Looking into importance of horticultural crops and its highly perishable nature the National Institute of Post-Harvest Technology (NIPHT) has been established for developing the infrastructural facilities and agricultural marketing linkages viz. setting up of cold chain, collection centers and dissemination of post-harvest technologies among farmers etc. Flowers being highly perishable in nature have benefited most due to this institute in the region. The key aim of the Institute is to take relevant agricultural research from lab to land for competency development in production and marketing.

3.1.21. Other facilities

Nurseries play an important role in development of orchards in Maharashtra. Maharashtra is a leading state in nurseries and horticultural crops. The Nursery Regulation Act is in force in the state by which it is possible to control the quality of planting material given to farmers. Maharashtra State is leading in area under protected cultivation. Model Floriculture Unit (started two decades back); Hi-tech floriculture unit at College of Agriculture, Pune; and Fruit Research Centre, Himayatbag Aurangabad; and Horticulture Training Centre (now known as NIPHT), Talegaon lead to boosting of commercial horticulture in the state. Other marketing initiatives like e-Trading Platform, Atomization of working of APMCs, Computerized Auctioning System (CAS), Interlinking of markets, Economic and Market Intelligence Services (EMIS), Virtual Market (VM) Agribusiness Promotion Facility (ABPF), Warehouse Receipt & E-trading, etc. would certainly strengthen horticultural development in the state.

Source : http://ahd.maharashtra.gov.in/index.php?option=com_lstock

3.2. An overview of agricultural infrastructure

- Villages (40412) connected by
  - ✓ All weather roads - 38483 km

- ✓ Fair weather roads - 1397 km
- APMCs - 294
- Cotton Ginning Units - 459
- Ginning & pressing Units - 405
- Primary Agril. Societies - 21000 (Members- 120 lakh)
- Agricultural Universities - 4
- Agricultural colleges - 88 (25 Govt. & 61 Pvt., 2 aided)
- Centers for capacity Building –
  - ✓ State Agril. Extension Management Training Institute –SAMETI, Nagpur
  - ✓ Regional Agril. Extension Management Training Institute– RAMETI (7)
- Crop based organisations – MAHA GRAPE, MAHA MANGO, MAHA BANANA, MAHAGRAPE, Pomegranate, Floriculture association, Orange
- Soil Testing Labs – 118 (29 Public, 89 Private)
- Residue Testing Labs – 2
- Seed Testing Labs - 3
- Agro polyclinic - 231
- Taluka Seed Farm - 194
- Horticulture nurseries - 1373
- Bio- control lab - 10
- Fertilizer testing labs - 5
- Pesticide Testing Labs - 4

3.2.1. Cold storage

Table 3.1 : Cold Storage

Name of the State	NHB		NHM		MoFPI		Total	
	No.	Capacity (MT)	No.	Capacity (MT)	No.	Capacity (MT)	No.	Capacity (MT)
Maharashtra	30	106860	58	151122	50	173662	604	978392
All India Total	886	4567886	1142	5170946	236	767507	7645	34956991

Source : Directorate of Marketing and Inspection (DMI) upto 2009, National Horticulture Board (NHB), National Horticulture Mission (NHM) & Ministry of Food Processing Industries (MoFPI)

3.2.2. Veterinary Dispensaries

Table 3.2 : Veterinary Dispensaries

Total Veterinary Institutes	4858
District Veterinary Polyclinic	30
Total Taluka Mini Veterinary Polyclinics	170
Total State VD Grade I Institutes	85
Total State VD Grade II Institutes	586
Total ZP VD Grade I Institutes	1643
Total ZP VD Grade II Institutes	2280
Total ZP Mobile Veterinary Clinics	64

3.2.3. Farm Poultry & Hatcheries

Table 3.3 : Farm Poultry & Hatcheries in Maharashtra

Layer	8029893
Broiler	50866466
Duck	777685
Emu	23439
Others	590205
Total Poultry Farm & Hatcheries Birds	60287688
Total Poultry	**77794571**

3.2.4. Backyard Poultry

Table 3.4 : Backyard Poultry

State	Maharashtra
Fowls	17423501
Ducks	57834
Turkeys	1551
Quails	7404
Other poultry birds	16593
Total Backyard Poultry	**17506883**

Source : MASFU

3.2.5. Govt. Hatcheries,Fish Seed Centers and Rearing Units in Maharashtra

Table 3.5 : Govt. Hatcheries, Fish Seed Centers and Rearing Units in Maharashtra

Fish Seed Centers	43
Hatcheries (Out Of 43 Fish Seed Centers)	28
Rearing Units (Out Of 43 Fish Seed Centers)	15
Freshwater Prawn Hatchery	1

3.2.6. Fisheries Co-Operative Network of Maharashtra

Table 3.6 : Fisheries Co-Operative Network of Maharashtra

	Marine	Inland
Primary Societies	370	2603
District Federation	5	24
Regional Federation	3	2
State Federation	2	
Apex Federation	1	

3.3. Government Programmes

- Fasal Bima Yojna : Now, crop insurance scheme is applicable to Nagpur mandarin, Mosambi orange and acid lime.

- More Crop per Drop :The cost of production can be reduced using drip and fertigation, bio-pesticides, compost from agro-waste, microbial cultures, vermicompost.
- Pradhanmantri Sinchai Yojna
- Pressurized irrigation systems may be adapted at places where water resources structures have been created through government schemes like Jal Shivar Yojna of Govt. of Maharashtra. With this system area under irrigation can be increased with available water resources.
- e-NAM
- National Agriculture Market (NAM) is a pan-India electronic trading portal which networks the existing APMC mandis to create a unified national market for agricultural commodities. All the cotton mandis shall be brought under this system so that adequate information will be available to all the stakeholders.
- Organic Farming: Organically grown and properly certified crops can fetc.h better price if sold packaged with a logo.
- E-Marketing : It is must to connect citrus growers with distant markets to get better prices.
- Mobile apps/ICTC etc. : Mobile App "CCRI-Citrus" has been developed by the Institute and farmers can download it from the website of the Institute. This mobile App provides detailed information about citrus cultivation, nursery practices and monthly calendar of operations in Hindi, Marathi and English.

3.3.1. State schemes of animal husbandry department

- Navinypuarn Scheme - 06/04/02 milch animal group distribution scheme.
- Navinypuarn Scheme- Semi: Stallfed 10 goats and 1 male goat group distribution.
- Navinypuarn Scheme - 1000 starting poultry farming (avocation) in Maharashtra state by rearing 1000 broiler birds.

3.3.2. District planning committee schemes

- 02 Milch animals group distribution to District's Schedule cast Beneficiary.
- Fooder supply to livestock of beneficiary for draught (Bhakad) milch animals of Schedule cast Beneficiary.
- Training to schedule cast beneficiaries regarding Animal Husbandry.
- 10 Goats & 1 male goat group specific mineral mixture/feed processing units.
- Establishment of Bypass protein/fat Making units.

3.3.3. To promote Backyard poultry rearing.Centrally sponsored schemes

- Fodder seed production, collection and distribution scheme
- Fodder production from Nan forest wasteland/rangelands/grassland/non-arable land.
- Incentive for hand driven chaff cutter machine
- Incentive for power driven chaff cutter machine
- Establishment of silage making units
- Establishment of high capacity fodder block making units.
- Distribution of low capacity tractor mountable fodder block making units/ Hay Bailing Machine/ Reaper/ Forage Harvester
- Establishment of area specific mineral mixture/feed processing units.
- Establishment of Bypass protein/fat Making units.
- To promote Backyard poultry rearing.

3.3.4. Mahatma Gandhi National Rural Employment Guarantee Schemes

- Poultry farming shed
- Goat farming shed
- In the sheds of cow / buffalo pucca bottom, crib, & tank for storage of urine
- Supplementary feed for livestock / animals (Azola)

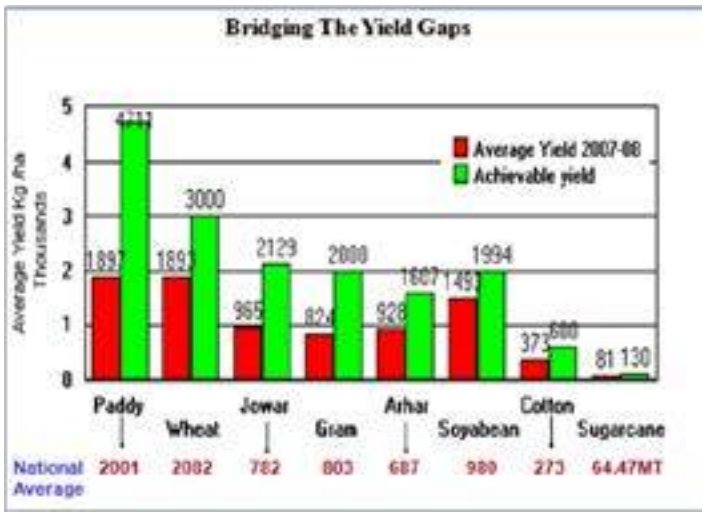
3.3.5. Seed Infrastructure Facilities

- MSSCL & NSC is major public sector organization in seed production and distribution
- 156 Private seed producers
- Private & Public sector produces 18 lakh qtls. seed
- 150 Seed processing Plants
- Average Capacity – 400 qtls/day
- 4 SAUS are engaged in Breeder & Foundation seed production.
- Director, Seed Certification – agency for Seed certification

4 Productivity Gaps and Major Constraints

4.1. Agricultural crops

Despite significant advances in agricultural sciences there is a significant yield gaps in many of the crops in Maharashtra. Though not a major rice growing state, the productivity of rice is marginally less than the national average and less than 50% of the achievable yield/ha. There is at least 1000 kg/ha gap in wheat productivity relative to achievable yield. Though more than the national average the productivity of sorghum is less than 50% of the achievable yield. Only 40% and 60% of the achievable yield is obtained by chickpea (gram) and pigeonpea (arahar) farmers respectively. Though soybean productivity is higher than the national average the productivity gap relative to achievable yield is nearly 500 kg/ha. Similarly, the productivity of cotton and sugarcane fall short of achievable yield by 227 kg/ha and 49 MT/ha respectively. These data clearly indicate scope for enhancing the productivity and hence the income of farmers.



Source : PDKV, Akola

Figure 4.1 : Yield Gaps in foodgrain crops

Yield gap analysis between potential productivity of a region and actual crop yields are necessary. The ultimate target is to tap the maximum potential of a crop from a particular region and do the suitability analysis for that purpose. Though the yield gap analysis is generally done using experimental data, an attempt is made here to identify the regions with low productivity retaining heterogeneity of practical farming at district level. The criteria adopted in the demarcation of the zones are based on area as well as yield of different crops. District is placed indifferent categories depending on the area and productivity levels. Nine categories are considered viz., High area-High yield (HH), High area - Medium yield (HM), High area - Low yield (HL), Medium area - High yield (MH), Medium area- Medium yield (MM), Medium area - Low yield (ML), Low area - High yield (LH), Low area - Medium yield (LM) and Low area - Low yield (LL). Depending upon the availability of water resources, management strategies may have to be evolved to bridge the yield gap in different regions.

This comparison may ultimately result in identifying production constraints so as to bring all the zones to higher productivity level. Production constraints can be identified crop diversification efforts can be made to

replace the low yielding crops by the high potential crops. The productivity level of crops has to be enhanced and sustained and this is possible only when efficient locations have been identified for the crops. This information would help to replace the uneconomical crop in the identified zones. Criterion adopted for 34 percent districts of Maharashtra are given below for delineation of productivity zones of major field crops in Table 10.

In case of paddy, scope for the improvement of productivity exists in Sangli, Satara, Pune and Nashik districts (Fig. 38). Depending upon the availability of water resources, management strategies may have to be evolved to bridge the gap in yield levels. The area under kharif sorghum is sufficiently large in Jalgaon and Latur. There is a need to improve its productivity by implementing efficient production techniques in Nanded, Yavatmal, Sangli and Satara districts (Fig. 39). In case of pearl millet area is sufficiently large in Ahmednagar, Nashik and Beed districts. Area and productivity in Jalgaon, Dhule, Pune, Aurangabad districts is medium hence there is large scope to increase area and productivity in these districts by providing suitable varieties performing better under rainfed conditions (Fig. 40). In case of wheat crop, there is large scope to increase productivity in Ahemadnagar, Solapur, Nahsik, Pune, Amravati, Buldana, Nagpur, Beed districts which are high in area but medium in productivity by implementing suitable package of practices (Fig. 47). Area under rabi sorghum is more in Solapur, Ahmednagar and Pune districts (Fig. 48). There is great scope to increase productivity of rabi sorghum in Dhule, Jalgaon, Akola, Washim, Buldhana and Kolhapur districts.

Production and productivity of pulses like red gram, black gram and green gram indicate that more area under pigeon pea may be encouraged in the Vidarbha and Marathwada districts (Fig. 43). The area of black gram in paddy growing district in konkan region declined in recent years, and the introduction of high yielding and disease resistant cultivars may help to bridge the yield gap compared to that in the adjacent Western Maharashtra districts (Fig. 44). However, scope exists to improve the productivity of black gram growing areas in Latur, Nanded and Osmanabad districts. In case of green gram, Akola, Amravati, Buldana and Washim areleading inproduction (Fig. 45). There is large scope to increase area and production of Dhule, Nandurbar, Nahsik, Pune, Wardha, Aurangabad, Beed and Hingoli districts by implementing pulses development programmmes. Among oilseed crops, groundnut a conventional crop grown largely in Kolhapur, Satara, Pune and Sangli districts (Fig. 41). In Dhule, Nandurbar, Nahsik, Nagpur, Aurangabad, Beed, Latur and Nanded districts yield levels can be improved through the adoption of rain water conservation and introduction of cultivars which can stand mid-season dry spells as the rainfall is highly erratic in these districts during the SW monsoon season. During recent years, soybean is replacing groundnut in western Maharashtra districts (Fig. 42). Soybean productivity is high in Satara, Sangli, Kolhapur and Pune districts and there is great scope to increase area under this crop. While, Amravati, Nagpur, Washim and Yavatrnal and districts have large area but low in productivity hence adoption of proper package of practices for soybean is necessary in these districts.

Productivity levels of sugarcane are highly variable among the major cane growing districts; the low productivity levels in Beed, Jalana, Osmanabad and Parbhani districts require a special attention (Fig. 50). Cotton, another commercial crop shows wide scope for yield improvement in Ahmednagar, Nanded, Buldhana and Yavatmal and to some extent in Jalgaon, Aurangabad and Jalana districts (Fig. 46).

Table 4.1 : Criterion adopted for categorization of productivity zones of major field crops

Crop	Area ("00"ha)			Yield (Kg/ha)		
	High	Medium	Low	High	Medium	Low
Paddy	>1400	700-1400	<700	>2000	1000-2000	<1000
Kharif sorghum	>1000	500-1000	<500	>1500	1000-1500	<1000
Pearl millet	>1500	600-1500	<600	>750	500-750	<500
Ground nut	>400	400-100	<100	>1000	750-1000	<750
Soybean	>2000	1000-2000	<1000	>2000	1000-2000	<1000
Red gram	>600	300-600	<300	>1000	500-1000	<500
Black gram	>300	150-300	<150	>750	500-750	<500
Green gram	>300	150-300	<150	>750	500-750	<500

Cotton	>2250	800-2250	<800	>500	250-500	<250
Wheat	>550	350-550	<350	>2250	1250-2250	<1250
Rabi sorghum	>2800	1400-2800	<1400	>1200	600-1200	<600
Safflower	>250	100-250	<100	>800	500-800	<500
Sugarcane	>900	300-900	<300	>75000	50000-75000	<50000

Source : Dr. PDKV, Akola

4.1.1. Constraints in rice cultivation

- Inadequate irrigation
- Uncertainty in monsoon i.e. early and late start
- Irratic rains
- Less no. of rainy days compare to normal viz., booting, flowering and grain filling stage in September-October
- Dry spell during critical crop growth stages
- Change in climatic condition- Drought, Heavy rains, flood, cloudy weather for longer time, sudden increase/decrease in temperature.
- Low organic carbon, deficiency of Nitrogen, Phosphorous, Zinc and Sulphur in soil
- Insects – Gall midge, Stem borer, Brown plant hoppers, White backed plant hoppers, Green leaf hoppers, Leaf Folder, Case Worm, Army Worm, Gundhi Bug, Sheath mite.
- Diseases – Blast, Bacterial leaf blight, Sheath Blight, Sheath Rot, Stem rot, Brown spot, False smut

Source : PDKV

4.1.2. Constraints for Soybean

- Almost rainfed crop, therefore influenced by vagaries of monsoon.
- Lack of diversification in varieties cultivated.
- Lack of technical knows how.
- Lack of adoption of improved technology
- Lack of timely availability of appropriate quantity and quality of agriculture input.
- Lack of varieties resistant to biotic and abiotic stresses.

4.1.3. Constriants for safflower

The National and International scenario indicates an yield gap of >21% over World Average and >100% yield gap over highest yield of 1564 kg/ha in USA. FLD organized by Institutions of ICAR/SAUs during Rabi 2012-13 indicates an average yield gap of 109% over National Average Yield (NAY) and 21% to 300% over SAY under irrigated/rainfed conditions in the safflower growing States (Table 65), which could be minimized by adoption of improved package of practices including application of protective irrigation.

Table 4.2 : Safflower yield gap in 2012-13

State	Yield kg/ha		Yield gap %
	SAY	FLD	
Rabi 2012-13 (Irrigated)			
Maharashtra	544	1079	98
Rabi-2012-13 (Rainfed)			
Maharashtra	544	1038	91
All India	576	1203	109

4.1.4. Constraints in Sugarcane

- Lack of scientific varietal and seasonal planning for planting and harvesting by the sugar mills.
- Lack of consideration of varieties according to maturity group and genetic characters.
- No implementation of three phase / tier quality seed production (B, F, C) chain.
- Over irrigation/moisture stress (Load shedding, uncertain monsoon).
- Non adoption of INM, IPM, IDM and Weed Management technology.
- No proper crop rotation.
- Improper intercropping.
- Poor and neglected ratoon management.
- No adoption of improved farm implements and machinery and advanced technology.
- Over number of sugar mills without considering ecological jurisdiction and potential.
- Fluctuating / Non assurance of cane prices.
- Unforeseen natural calamities namely drought, excess rains, outbreak of pests- diseases, uncertain climate (temperature) etc.

Source : MPKV, Rahuri

4.1.5. Constraints in Cotton

- More than 95% area is under rainfed cultivation
- Growing of cotton on low fertile and shallow soils.
- Due to erratic and irregular rainfall pattern, crops suffer and there is also a risk of crop failure under aberrant weather situation.
- Sometime due to delayed onset of monsoon and early withdrawal, prospects of good crop cannot be assured.
- Intermittent dry spells during July and August followed by cessation of monsoon activity usually by the middle of September leads to non-availability of requisite moisture and concomitantly nutrients at the later stage of boll development usually in the latter part of October.
- Non availability of quality seed of promising cultivars.
- Gap in adoption of improved production technologies like IPM, IRM and intercropping etc.
- Losses due to pest and diseases.
- Temperature increased during square & flowering resulted into dropping of square & flowering of bolls.
- Para-wilting and reddening in Bt cotton increasing day by day.
- Crop rotation not followed by farmers, facing N, P, K,S, Fe and Zn deficiency in soils.
- Lack of irrigation facilities.
- High incidence of Pink boll worm drastically reduces the yield.

Source : MPKV, Rahuri

4.2. Horticulture

Data reveal that productivity of many of the horticultural crops grown in Maharashtra are less than the achievable yield. Though the yield gaps are less for crops like grape, productivity of guava is less than 50% of the achievable yield. As per potential reported by SAUs nearly 5 times more mango and cashew can be obtained when compared to present average yield. The yield gap for banana is nearly 30 MT /ha. For other fruit crops the productivity gap ranges from 2 to 5 MT/ha.

Table 4.3 : Yield Gap Analysis For Major Fruit Crops(MT/Ha)

Sr. No.	Crop	State Average	Potential reported by SAU
1	Mango	3.50	15.00
2	Pomegranate	10.20	15.00
3	Mandarin Orange	9.10	15.00
4	Sweet Orange	13.00	15.00
5	Cashew	1.14	5.00
6	Banana	58.00	87.50
7	Kagzi Lime	9.65	10.00
8	Guava	12.15	25.00
9	Grapes	28.20	30.00

Source : PDKV

4.2.1. Constraints for grape cultivation

Although hot extremes and heat waves are set to become more frequent over the course of this century (IPCC, 2007), the most imminent challenges facing the wine, table grape and raisin industries in arid and semiarid regions are probably not heat waves per se, but increasing drought and salinity because of higher evaporation coupled with declining water availability (Schultz, 2000; Stevens and Walker, 2002). The precipitation patterns are changing, perhaps raining at undesirable times, and encouraging excessive vigour during early period after fruit pruning and increase loses due to downy mildew. Warming climates are sure to encourage new pests and diseases, notably insects following their habitat change. They may also affect the natural parasites and predators increasing pest attack due to change in the natural ecosystem. There may be changes in pathogen populations and introduction of new pathogens to new areas (Garrett, 2006). Further, seasonal changes in climatic conditions, too, are impacting grape productivity either in terms of reduced fruitfulness due to high temperature, increased disease and pest problems due to unseasonal rainfalls and/ or salinity due to reduced rainfall. In fact, the seasonal changes can also influence the formation and ratio (at favourable levels) of sugar and pro-phenols in grapes, thereby affecting the quality of produce.

- Thompson seedless is main variety under cultivation contributing 80% share in national grape export. But it consumes substantial amount of plant growth regulators to achieve bold size and intercultural operations in this variety are very labor intensive which has to be carried out frequently to get better crop. Grape grower has to invest Rs. 50,000 - 60,000 per acre per season on such inputs which leads to huge rise in cost of cultivation. This situation is the representative picture of all the varieties grown in country. Such a expenditure can be saved by introducing new varieties which will give desired quality grapes without use of growth regulators.
- Despite of intensive efforts export quality produce of grape was only 1.98 lakh MT during 2016-17 (APEDA, 2017) which is merely about 7% of total grape production. There is a scope to increase exports.
- Only handful varieties under cultivation in country leads to monotony leaving us with fewer options for grape marketing. At international level consumers demand for new varieties with vivid berry colour (white, red and black), aromas (muscat, vanessa and foxy) and seediness (seeded as well as seedless) is increasing. This is why India is at seventh position when it comes to export in spite of being second largest producer of table grapes in world. With increase in new varieties cultivation in table grape growing countries like Chile, South Africa, Peru, Australia, Spain, Italy etc., exports from India will be in trouble. At present more than 85 % of our exports are Thompson Seedless. There is a demand for red variety for export in most countries including EU.
- For distant transportation or export, better shelf life is a prerequisite but feeble storage ability of Indian cultivar is main concern which restricts our export to neighboring countries only. Moreover colored cultivars like Red Globe, Crimson Seedless, Flame Seedless which are under cultivation in India faces difficulty in uniform colour development under hot climate.

- Varieties with export quality are globally available with different private firms such as International Fruit Genetics (IFG), California; GRAPA, California; Special New Fruit Licensing (SNFL) Group, USA; Sun World group etc. There is urgent need to intensify the efforts for bringing new varieties in country which will bring sustainability in export potential of India. Introduction of varieties with great market potential like Prime seedless, Ivory, Melanie, Timpson, Autumn King, ARRA 15 (white) and Scarlet Royal, Allison, Timco, ARRA 19 (red)) in India can help to increase our export share of table grape in global market. All these promising varieties are patented ones, in order to bring these varieties in India for their commercial cultivation, it is required to pay royalty to the owners of these varieties. Thus the fund availability in order to get the legal rights of these cultivars is need to be ensured.

4.2.2. Constraints for vegetable production

- Semi perishability of Potato's and harvesting of about 90% Potatos in the country at the beginning of summer possess major problems in post-harvest managements.
- Narrow genetic base.
- Inadequate arability of processing varieties.
- Inadequate quantity of quality planting material.
- High cost of production.
- Potential water scarcity.
- Potato productivity gaps across country.
- Little awareness about its nutritional and medicinal values and taboos and superstition about mushrooms.
- Illegal and unrecognized mushroom training centers.
- Low domestic consumption of mushrooms.
- Less number of recognised mushroom labs in the states.
- Low and inconsistent yield due to non availability of high yielder and good quality strains.
- High input cost due to non availability of abundant indigenous technologies.
- Lack of marketing channels and proper prices.
- Lack of coordination and collaborations among growers and researchers.
- Regular supply of energy at affordable costs is one of the constraints in commercial production of mushrooms.
- Hygiene is perhaps the single most important issue to ensure adequate production of quality mushrooms.

Source : MPKV, Rahuri

4.2.3. Dryland Agriculture constraints

- Lack of new implement for soil and water conservation measures. New implements are not available at village level or watershed level, so the adoption of new technologies especially soil and water conservation measures are very poor in small and marginal farmers.
- The project implementing agencies should involve the farmers / beneficiaries in design of plan. Common interest group of farmers should be formed and strengthened through P.I.A.
- Labourers in village prefer EGS and other similar Govt. schemes rather than working in farmers field . For working labourer on the field, it is necessary to have a group of major crop-wise unemployer which will monitor the availability of work, provide labour service to the small and marginal farmers.
- Poverty and seasonal adversity resulted in negative attitude towards developmental activities.
- Fragmentation of land and availability of water, electricity and other important inputs i.e.. compost, FYM, herbicides, bio-fertilizer.

Source : MPKV, Rahuri

4.2.4. Salt affected soils

In Maharashtra, total area of salt affected soil is 6.06 lakh ha. Out of this, 4.23 lakh ha area is sodic soils and 1.84 lakh ha. Area is saline soils. In Maharashtra 10 per cent soils of canal command area of western Maharashtra deteriorated every year due to excess use of irrigation water and mono-cropping system like sugarcane

Table 4.4 : District wise area of salt affected soil in Maharashtra.

District	Saline soils (ha)	Sodic soils (ha)	Total(ha)
Western Maharashtra			
Ahmednagar	-	142160	142160
Sangali	18169	4746	22915
Satara	16814	-	16814
Solapur	-	38263	38263
Pune	66250	6645	72895
Nashik	-	17234	17234
Kolhapur	13612	13239	26851
Dhule	1792	-	1792
Jalgaon	12587	76836	89423
Vidharbha Region			
Akola	-	46733	46733
Amrawati	-	31702	31702
Buldhana	-	32127	32127
Yavatmal	-	1462	1462
Marathawada Region			
Aurangabad	-	11523	11523
Beed	216	-	
Konkan Region			
Mumbai	3268	-	
Raigad	16416	-	
Thane	34967	-	
Total	**184089**	**422670**	**606759**

4.3. Animal husbandry

A study conducted on contribution of livestock production system to farmers livelihood in western region of Maharashtra reveals that major constraints for livestock farmers are lack of the manpower in family, lack of required number of availability of hired labour and scarcity of water to maintain livestock. These were followed by high prices of livestock to buy (21.00%), high wages of labour (20.00%), lack of capital to invest (19.00%). Inadequate space to house livestock (17.00%), inadequate veterinary facility (14.00%) and lack of space to store FYM (12.00%). Very few respondents mentioned transport problem to directly sell milk (6.00%), non availability of green fodder (5.00%) and diseases for small ruminants (3.00%) (Thesiss submitted by Desai (2009) to UAS, Dharwad).

4.4. Fisheries

Fish seed :

- The paucity of quality and quantity of fish seed of desired size (On demand) is the most important constrain faced by the fish farmer.
- The fish farmer are being duped by private fish seed supplier selling adulterated seed, small sized seed, exotic species, unwanted species seed.

Fish feed :

- In aquaculture production, feed is the single most important input (share by 60% of the total cost). Availability of formulated commercial feed for carp fry is still constrain for which farmer resort to use traditional feed mixture. Supply of least-cost feed ration to achieve a certain production target, which could be represented in a model by a cost-minimization.

Lack of awareness of Modern technology :

- Lack of scientific aquaculture know how the pond culture activities.
- Aquaculture technology is not adopted by farmers leading to meagre production level.
- Dependency for quality seed, feed and other inputs on state agency.

Resources :

- Low productivity due to aquatic vegetation in small reservoirs, lack of capital and insufficient credit facilities, life insurance.
- Multi-ownership of natural water bodies like reservoir, lakes
- The estimation of catch and catch composition in riverine fisheries poses considerable problem due to the geographical coverage and remoteness of fishing activity with no specific landing centre and markets in comparison to marine fisheries sector.

Marketing :

- Fish marketing differs from that of marketing of agricultural product. Innovative marketing arrangement need to be development to ensure that farmers get remunerative price with development of local market and cold chain.
- Most of the aquaculture production sites are small and remotely located and hence farmers have problem in sending their small produce to city markets for fetching better price.

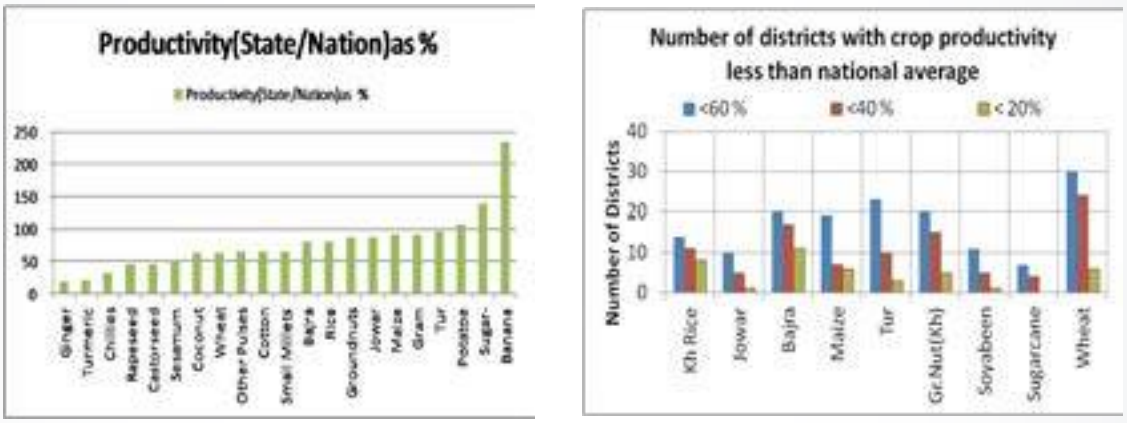
Policy and legislation :

- Lack of coordination or linkage between financial institution and fishermen cooperative societies.
- Policies need to be opened up for cross border exchanges especially at the grass root levels.
- Increasing dominance of political factions in fishermen cooperative societies.
- Concurrence of fishermen cooperative society on leasing water bodies rights policy guidelines.
- Apart from development of technology a holistic approach taking into consideration technical, environmental and socioeconomic factors needs to be taken.

5 Potential for Development

5.1. Scope for enhancing productivity of field crops

Despite all developmental progress, the productivity of many of the crops are below that of national average except for field crop like soybean and commercial crops like sugarcane and banana which are water intensive (Figure 5 1). This indicates that there is scope for enhancing the productivity of farmers if they are addressed at local level. There are more than 20 districts in Maharashtra where the productivity of bajra, tur, ground nut, wheat and cotton lint is less than 60% of national average while 15 out of 32 districts considered for the analysis had productivity of these crops less than 40% of national average. This suggests that there is scope for improving the productivity through existing technologies optimised for each of the districts.



(a) (b)

Figure 5.1 : Productivity of different crops (a) and number of districts with crops productivity less than national average (b)

5.2. Field crops

Sorghum

Pulses

- Pulses can be grown in medium to deep soils with minimum effort.
- There is scope for increasing area and production through aggressive transfer of technology and critical input supply.
- Proper planning should be done before execution of seed production. Involvement of Public-Private Partnership in seed business.
- For medium to deep black soil mid late cultivar (165-180 days) like Vipula, Rajeshwari, BSMR-736, BDN-711 and BDN 716 etc. and on medium soil mid early (150-165 days maturity) with protective irrigation need to be promoted varieties viz; AKT-8811, Rajeshwari, BDN-711 proves advantageous.
- Digging farm ponds/community reservoirs for providing supplemental irrigations through micro-irrigation system at critical growth stages of pigeonpea and chickpea.

- Integrated soil-water-irrigation-nutrient management should be aggressively promoted to bridge the yield gaps in most pulse crops.
- Adoption of moisture conservation practices like sowing across the slope, sowing on BBF or Ridges and Furrows.
- To ensure good germination and optimum plant stand seed priming 4-5 hrs in water for desi chickpea under rainfed condition is advised. Deep sowing of chickpea with zero tillage after harvest of soybean should be followed which save the soil moisture under rainfed conditions.
- Fungicides/biofertilizers pelleted seed should be made available to the farmers. 100% seed treatment campaign through Mobile Seed Treatment Machines to facilitate seed treatment at the door-steps of the farmers.
- Attention should be given to balanced use of nutrients through soil test based fertilizer management. Phosphorus deficiency is now the most widespread soil fertility problem in both irrigated and unirrigated areas. Research on efficient fertilizer practices (such as balanced use of nutrients, correct timing and placement of fertilizers and wherever necessary, use of micronutrient and soil amendments), improvement in soil testing services, development of improved fertilizer supply and distribution systems.
- Calendar based insecticides application for management of pod borer complex.
- Development of varieties having resistance to both wilt and SMD in pigeonpea and MYMV resistant in mungbean for summer cultivation.
- There is need to develop the varieties of mungbean, urdbean and chickpea suitable for mechanical harvesting. Mechanical threshing needs to be promoted by providing incentives for purchase of threshers. Availability of cultivars suited to mechanical harvesting will reduce production cost and attract farmers towards increased pulses cultivation. Promoting custom hiring of farm machineries.
- Creation of cover storage facility and platform made of cement concrete for keeping harvested crops cover with tarpaulin to avoid losses from weather phenomenon like unseasonal rains and hailstorm. Providing safe storage structures like Pusa Bin or Metallic bin and warehouse facility or procurement of pulses grains by Govt. authorized organizations will considerably reduce the need for storage at farmers level.
- Pulse growers continue to suffer heavy economic losses due to damages caused by wild animals. The issue is very serious and warrants attention of the policy makers, administrators, social workers, as it has assumed social, economic and ecological dimensions.
- New Niches: Utilization of rice fallow area of Western Maharashtra Ghat Zone for rabi crops. Other minor pulses (Cowpea, Horsegram and Rajmah) can be exploited provided attractive minimum support price. Promotion of summer mungbean cultivation where adequate irrigation facilities exists and pigeonpea on rice bunds.
- Supply and demand should be taken into account for fixing of MSP and provision of procurement of pulses should be created.
- There is a need to strengthen adaptive research and technology assessment, refinement and transfer capabilities of the country so that the existing technology transfer gaps are bridged.

Oilseeds

Sunflower

- In Vidarbha region some part of Buldana and Akola district have saline track in tahasils viz; Jalgaon Jamod, Sangrampur, Telhara and Akot. In this area Oilseeds Research Unit, Dr. PDKV, Akola is already conducting the front line demonstrations from last five to six years on High yielding hybrids, improved package of practices, need based plant protection etc. On an average the yield level of farmers of this area is increased up to %.
- For next two-three years honey bee keeping will be promoted in this area to increase the income of farmers.
- Small scale oil extraction unit will be promoted in this area for value addition of their produce with ultimate aim to increase the farmers income.

- In the district Nagpur, Gadchiroli, Bhandara, Chandrapur and Gondia, after kharif paddy, farmers are growing linseed, latharus in rainfed and wheatin irrigated condition. In rainfed condition the yield from linseed and latharus is very low. During Rabi 2016-17, Oilseeds Research Unit, Dr. PDKV, Akola has taken the initiation to introduce the Sunflower crop as a substitute crop for linseed and latharus in Bhandara District by conducting Front Line Demonstrations.
- During 2017-18 to 2020-21, Front Line Demonstrations on Sunflower regarding improved package of practices, high yielding hybrids, INM, need based plant Protection etc. have to be conducted to disseminate the improved knowledge of Sunflower production technology among the farmers of Nagpur, Gadchiroli, Bhandara, Chandrapur and Gondia district.
- Along with these activities training programmes, field days will be organized to give the technical knowhow to the practicing farmers as well as extension functionaries.

Source : PDKV

5.3. Horticulture

Maharashtra is the leader in production of grapes, pomegranate, onion, cashew and second largest producer of guava, sapota in the country. The Centrally Sponsored Scheme of National Horticulture Mission (NHM) is being implemented in Maharashtra since 2005-06. From April, 2014 onwards, NHM has been subsumed under Mission for Integrated Development of Horticulture (MIDH) for holistic growth of the horticulture sector covering fruits, vegetables, root and tuber crops, mushrooms, spices, flowers, aromatic plants and plantation crops.

The finalized area under various fruit crops during 2015-16 was 9.09 lakh ha, of which the area under mango was 1.62 lakh ha, orange 1.07 lakh ha, sweet orange 0.54 lakh ha, pomegranate 1.21 lakh ha, banana 0.70 lakh ha, sapota 0.18 lakh ha and grapes 0.90 lakh ha. Mission for Integrated Development of Horticulture (MIDH) is implemented in 34 districts and the sharing pattern of GoI & GoM is 60:40. Since inception upto October 2016, the MSHMPB received total grants of Rs 1,598 crore under MIDH and total expenditure incurred is Rs 1,539 crore. The Government of Maharashtra has undertaken a programme to promote horticulture development through establishment of nurseries and granting capital subsidy to small & marginal as well as SC & ST farmers, to encourage them to grow selected fruit crops. This programme has been linked with Employment Gurantee Scheme (EGS) since 1990-91. As a result, the area under fruit crops has increased from 2.42 lakh ha in 1990-91 to 18.52 lakh ha upto December 2016. Grapes, mango, pomegranate and banana are the major fruits being exported from the State.

Despite harsh agroclimatic conditions horticulture sector is emerging as most remunerative for farmers. Pomegranate area is expanding rapidly and there is substantial increase in the production and export. Technologies developed and strategies for post harvest opportunities make it possible to achieve the target of doubling the pomegranate farmers income. There are opportunities to expand grape cultivation which is remunerative than traditional crops. Varieties of grape that are popular in international market, if domesticated can lead to remarkable improvement in the farmers income. The indigenously developed varieties of grape with high medicinal value have potential to enhance the income of farmer. Decision support system for grapes/viticulture developed can serve as an effective tool for reducing the cost of production/optimization of input use. There is a great scope for promoting kharif onion. Regulated production and supply of onion in consultation with national institute can prevent the losses in income due to market glut.

5.3.1. Available Horticulture Setup

- Total area under fruit crops : 16.64 lakh ha
- Area under Vegetable Crops : 4.77 lakh ha.
- Area under Spices crops : 2.10 lakh ha.
- Area under floriculture : 0.16 lakh ha.
- Area under Protected Floriculture : 375 ha.
- One Floriculture park.
- One Mega Food Park and Three Food parks.
- Two Wine Parks - 54 wineries

- One Vapour Heat Treatment Plant
- One Eradiation Plant
- Four PEQ facility centres
- 136 Government, 42 SAUs, 1195 private registered nurseries.
- 4 Residue Testing Labs accredited by APEDA
- 130 Integrated Pack Houses accredited by APEDA.
- 7 Phyto-sanitary Certification Authorities for Export

5.3.2. Scope for citrus

Nagpur mandarin (a loose jacket easily peelable orange), Mosambi (tight jacket orange) and acid lime (Nimbu) are main citrus crops of Maharashtra. Division/Region-wise citrus crops grown in Maharashtra

- Vidarbha - Nagpur mandarin, Mosambi and acid Lime
- Marathwada - Mosambi and acid lime
- North Maharashtra - Mosambi and acid lime
- Western Maharashtra - Mosambi and acid lime
- Konkan - Lemon

In Maharashtra, citrus is cultivated on 2.88 lakh ha (bearing and non-bearing orchards) with a production of 14.4 lakh tonne. The average productivity from bearing orchards is nearly 7.0 tonnes/ha. The Nagpur mandarin is grown on 1,07,590 ha area with 7,95,210 tonne production while Mosambi is grown on 54,990 ha area with 6,63,960 tonne production. Acid lime is grown on 27,090 ha area with 2,44,500 tonne production. The income from citrus cultivation depends on crop season. If crop is bumper, prices would be low as Rs. 4000-5000/tonne. If crop is less, prices would be Rs. 25,000-30,000/tonne. In well maintained orchards, in normal season 15-20 tonne production can be achieved. Therefore, on average in bumper crop season farmers can get 76,500/- per hectare while in low cropping season he can get Rs. 4,50,000/- per hectare provided crop is good in his orchard. The monthly, income would be Rs. 6,300 to 37,500/-. In bumper crop season, if farmers do the direct retail selling of their produce, the income is far better as compared to selling in wholesale market or selling to pre-harvest contractor. The per hectare cost of production with conventional practices is generally Rs. 72,000/-. Therefore, in bumper crop season farmers have to take extra efforts to get good price for his produce.

Scope for floriculture

Floriculture Through the sole crop or combination of cropping/farming system

The potential of flower crops (as sole crops) in income generation along with details of income (based on various published reports and research articles) are furnished below.

Table 5.1 : Potential of Sole Cropping

Name of Flower	Condition	Area (ha)	Gross Income (Rs) in Lakh
Rose	Open Field	1.00	3.80-4.00
Rose	Protected	1.00	30.00-40.00
Jasmine	Open Field	1.00	2.50-3.50
Chrysanthemum	Open field	1.00	2.00-4.00
Aster	Open field	1.00	1.50-2.50
Marigold	Open field	1.00	2.00-4.00
Tuberose	Open field	1.00	3.00-5.00
Gerbera	Protected	1.00	20.00-30.00
Gladiolus	Open field	1.00	3.00-4.00

Table 5.2 : Region wise Existing flower growing and New target area

Regions	Existing flower growing area	New target area
Konkan	Thane, Lonavala, Dapoli	Ratnagiri, Raigarh,
Western Maharashtra	Pune, Sangali, Satara, Ahmednagar, Kolhapur, Solapur	Parts of Ahmednagar and Solapur
Khandesh (North Maharashtra)	Nashik and Jalgaon (partly)	Nandurbar and Dhule
Vidarbha	Nagpur and Amaravati	Gadchiroli
Marathwada	Parbhani and Nanded	Beed

Table 5.3 : Present income in flower crops

Name of Flower	Condition	Area (ha)	Gross Income (Rs) in Lakh
Rose	Open Field	1.00	3.80-4.00
Rose	Protected	1.00	30.00-40.00
Jasmine	Open Field	1.00	2.50-3.50
Chrysanthemum	Open field	1.00	2.00-4.00
Aster	Open field	1.00	1.50-2.50
Marigold	Open field	1.00	2.00-4.00
Tuberose	Open field	1.00	3.00-5.00
Gerbera	Protected	1.00	20.00-30.00
Gladiolus	Open field	1.00	3.00-4.00
Based on various published reports and research articles			

Present components of floriculture in area

Loose flowers:

Presently various loose flowers such as marigold, tuberose, aster, jasmine, gaillardia chrysanthemum, annual chrysanthemum are grown for loose flower production in different districts of Maharashtra.

Besides Maharashtra is also rich in native flowers that are concentrated in Western Ghats and Kaas platue. Identification and domestication of native flower crops can create a niche market.

Diversification of crops: Intensification of cultivation of crossandra, spider lily, gaillardia, nerium, hibiscus, Jasminium humile (yellow jasmine at higher altitudes) in non-traditional areas.

Cut Flowers

In Western Maharashtra region and few other districts of Khandesh and Konkan regions mostly located on either side of Sahyadri hills are grow various cut flowers successfully. Rose, gerbera, carnation, chrysanthemum, lilium, orchids, anthurium, etc. are the major cut flowers grown under protected conditions.

Intensification of cultivation of bird of paradise, heliconia, ornamental ginger, ornamental pineapple, ornamental banana, lisianthus, limonium, rose hip stems, alstroemeria, annual flowers like calendula, stock, rice flower, corn flower etc. can diversify the basket of cut flowers.

Nursery Plants

With increased demand for greenery in most of cities of Maharashtra the nursery industry with quality plants is going to be a good source of income generation. Already nursery industry has emerged in sub-urban areas of Pune and Mumbai which fetches good returns.

Intensification of cultivation of indoor ornamental plants like English Ivy, golden pothos, Boston Fern, dracaena, bamboo palm, spathyphyllum, agave, sansevieria, chlorophytum, as a green walss/vertical gardens is smart citites like Pune, Solapur, Aurangabad etc. that are proven to mitigate the indoor pollution, has greater potential.

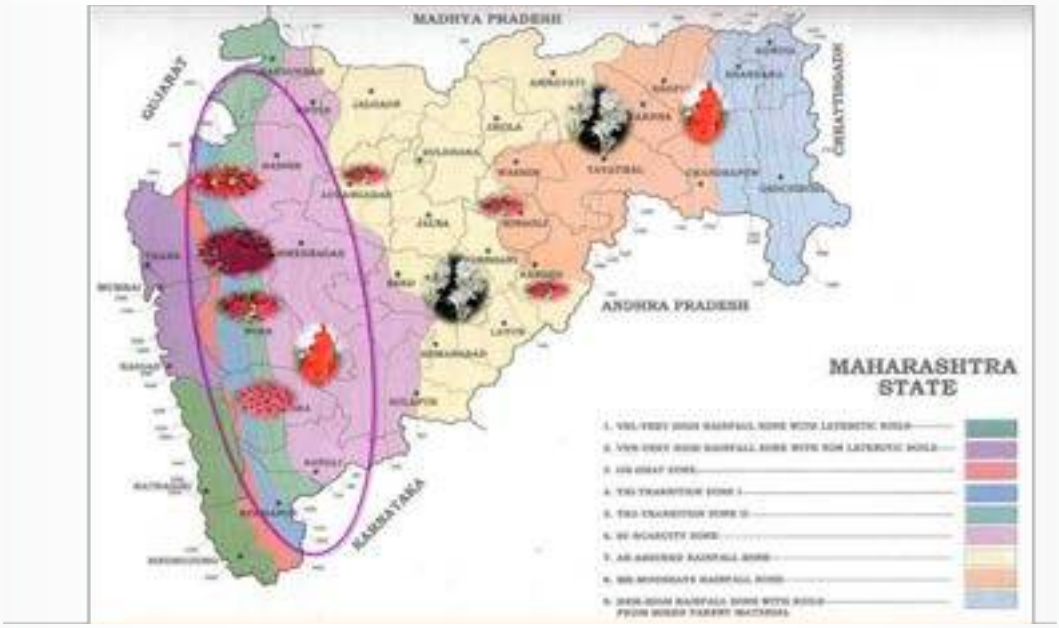
Cut Foliage and Fillers

Demand for flowers is increasing every day due to present day customs of 'saying it with flowers'. Flower arrangements and bouquets are value added options to generate more income and for that the cut foliage and fillers are required.

Intensification of cultivation of foliage ornamental including dracaena, anthurium, spathyphyllum, areca palm, monster, sansiveria, golden bamboo, callistemon, alpinia, etc. has greater potential.

Potential for floriculture in the state

There is a significant potential for floriculture in the state. Realizing the fact the Government of Maharashtra is supporting the cause of floriculture by means of R & D (technological) support, strengthening of agril. Extension, providing infrastructure, etc. A list of commercial floricultural activities suitable in an Integrate Farming System (IFS) in the respective region/zone of the state of Maharashtra.



Source : DFR

Figure 5.2 : Flower Crop Clusters

Mushroom

In Maharashtra the mushroom production systems are mixed type i.e.. small scale as well as high-tech industry. Mushroom production in the state started in the 70s but growth rate, both in terms of productivity as well as production has been phenomenal. Today, commercially grown species are button and oyster mushrooms, followed by other tropical mushrooms like milky mushroom.

Among different agri-based enterprises, mushroom cultivation is one of the enterprises which has the vast potential to double the existing income level of farmers and this enterprise can easily be adopted by any category of farmers irrespective of their landholding size. Mushroom cultivation is a strong means to diversify

livelihoods and strengthen the resilience of farmers. Mushrooms can be grown at a very low cost and in relatively short period as compared to conventional crops. For taking up this enterprise, farmers need very less investment, meager inputs but compulsory training and commitment to work. These resources for mushroom cultivation are easily available. Further more mushroom cultivation uses a limited amount of natural resources such as water and land, compared to other crops being cultivated in the area. Oyster mushroom cultivation can be done at cottage and small scale level besides large scale farming. Mushroom cultivation not only imparts diversification of agriculture but also helps in addressing the problems of quality food, health and environment related issues. Mushroom cultivation can be taken up by the farmers throughout the year and farmers can earn good profit from this enterprise. But following are some constraints in mushroom business popularization.

Source : MPKV

5.4. Livestock

Animal Husbandry plays a very important part of the agriculture in Maharashtra. Animal husbandry plays a very important part in the rural economy. Cattle rearing for milk and milk product s, leather and flesh are an important occupation for most of the people living in the state. Since animal husbandry is included in the state list, the responsibility of taking care of the cattle belongs to the state. The schemes are related to sheep development, poultry, piggery, fodder development and livestock health. The Department of Animal Husbandry has taken the responsibility of advising the people about taking care of their cattle and treatment of the sick cattle. Apart from that there are cattle breeding farms in the districts and the talukas under the districts. There are veterinary dispensaries, livestock supervisors, District Animal Husbandry officers and Extension Officers for Animal Husbandry. In the State of Maharashtra.

Table 5.4 : District officers and Extension Officers for Animal Husbandry of Maharashtra.

Year	Deshi	Commercial	Deshi	Commercial	Total
2006-07	129.95	69.23	156.56	183.43	339.99
2007-08	130.61	70.32	159.02	186.76	345.78
2008-09	136.39	71.18	166.01	188.59	354.60

Source : http://ahd.maharashtra.gov.in

The Agriculture, Animal Husbandry, Dairy Development and Fisheries Department are the administrative departments. A Minister of Cabinet rank who is assisted by Minister of State, heads the Department of Animal Husbandry. Secretary(ADF) heads the executive wing of the Department. The Field machinery is headed by an officer designated as Commissioner, Animal Husbandry. Under this administrative set-up, Commissioner, Animal Husbandry Maharashtra State, is functioning at Pune. He is assisted by one Additional Commissioner and one Joint Commissioner at the headquarter and 7 Joint Commissioners at the Regional Levels. Joint Commissioner in charge IVBP (Institute of Veterinary Biological Products, Aundh) & Disease Investigation Section are also functioning under Commissioner, Animal Husbandry.

5.4.1. Action points for promotion of livestock

- To achieve level of 60% in Genetic Improvement of Cattle and Buffalo
- To effectively control dreadful contagious diseases like PPR (Pestis Des Petits ruminants), Foot and Mouth disease, Brucellosis, Rabies, Haemorrhagic Septicaemia, Black Quarter in livestock as well as Ranikhet Disease, Salmonellosis in poultry
- To provide effective and efficient health coverage to the livestock and poultry through existing network of veterinary institutions, covering both preventive and curative aspects
- To bring about a balanced regional development in animal husbandry sector, amongst all the regions of State through implementation of special area specific programs and by means of need based expansion and strengthening of the veterinary infrastructure
- To organize Animal Health Camps, Work-Campaigns, Beneficiary-Training Programs as tools of extension

- To update human resources of the department through various trainings and keep them highly motivated
- To encourage development and growth of Poultry industry in back yard poultry and self help groups through Co-operative initiative
- To coordinate and thus consolidate the work of Non-Government Organizations in Livestock Development and conservation of Native breeds of animals
- To ensure availability of fodder for fulfillment of its requirement within the state
- To ensure slaughter of disease free 'Scheduled' animals for the sake of wholesome and hygienic meat production at the same time prevent the loss of useful and high genetic material as well as livestock wealth
- To ensure E-governance and concept of paperless office with necessary and fortified I-T support
- To ensure strict adherence to quality standards in delivery of veterinary service and also in respect of the education in veterinary science, as per the mandate of Indian Veterinary Council Act 1984.

5.5. Fisheries

5.5.1. Coastal brackish water resources of Maharashtra

The present components of agriculture in the area are marine capture fishery in coastal districts and some fresh water culture practices in reservoirs. There is scope for carp cultivation in small ponds. Increase in fresh water fish production by adapting prawn species like Litopenaeus vannamei commonly known as white legged shrimp. There is scope for crab fattening in the coastal areas and fish processing units and small scale industrial development through trainings.

Table 5.5 : Shrimp cultivation in Maharashtra

Sl. No.	Name of District	Total area (ha)	Suitable for aquaculture (ha)	Area under utilization for shrimp culture (ha)	Shrimp production (Tons)
1	Mumbai	10,000	----	1,047	3,513
2	Thane	35,000	5,490		
3	Raigad	15,000	3,655		
4	Ratnagiri	12,000	1,682		
5	Sindhurg	8,000	1,268		
	Total	**80,000**	**12,095**		

Table 5 6. : Inland saline soils of Western Maharashtra Districts and Vidarba Region of Maharashtra

Sl. No.	Name of District	Area (ha)
1	Pune, Satara, Sangli, Kolhapur	1,00,000
2	Vidarba Region	5,69,200
• 892 villages affected. Mostly Purna River basin		

Source : ICAR-CIFE, Mumbai

5.5.2. Post-harvest management

Tomato

Off seasonal crop production in such way that the fruits should be ready for harvesting in the month of March, April, May, June, July and August to get better market price. Post harvest management practices include cleaning, grading, sorting and packaging. This can facilitate preparation of processed products such as ketchup, sauce, juice, puree and paste.

Onion

For crops like onion storage loss of product is a major concern. Various storage structures have been designed and tested at ICAR-DOGR which helps in reduction of storage losses by 20 to 50%. More than 31,000 storage structures are available with farmers of Maharashtra. Till now storage capacity of 7.70 Lakh Metric tonnes available with the farmers and in the current year there is a plan to increase this capacity by 1.40 Lakh Metric tons. These storage structures were subsidized by Department of Agriculture, Govt. of Maharashtra. Onion

Curing : Onion crop should be harvested after 50 percent top neck fall, which is an indicator of crop maturity. Harvested bulbs may be left in the field for three days for curing which makes bulbs firm and dry and helps in improving their shelf life. After three days, the top of bulbs should be removed leaving 2.0-2.5 cm stalk above the bulbs and bulbs should be shade cured for 10-12 days for better storage.

Grading : Bulbs should be graded before storage. The grading with machine reduces labour charges and also increases precision. ICAR-DOGR has developed manual and motorized grading machines for grading of onion bulbs. The efficiency of manually operated grading machine is five times of manual grading while the efficiency is almost 20 times with motorized grading machine. The accuracy of grading of onion with grading machine is around 90% as against 70% with manual grading.

Storage : Almost 40-50% onion produce is lost in storage. These losses need to be reduced if farmers income is to be increased. The produce should be stored in bottom and side ventilated storage structures. The optimum conditions for storage are 30-350 C with 65-70% relative humidity under ambient condition.

5.5.3. Machines for post harvest management

Most of the products are marketed without processing mainly due to labour and cost involved in this process. Mechanisation can be a solution for suh constraints. SAUs have developed machines to solve these problems

PKV waste fired dryer

Generally at the time of harvesting the kharif crops, the humidity in the environment is higher. Also non availability of bright sun during the time of drying of poses the problem. Waste fired dryer has been developed which uses the agricultural waste material available at farmers field. This dryer is useful for drying approximately 6 q grains, 4 q groundnut pods, 2.5 q sorghum cobs as well as 2 q red chillies. The cost of the dryer is approximately Rs. 75,000/-.

PKV Mini dal mill operating on 3 hp electric motor can be used for milling of all type of pulses with a very low investment. For pigeon pea grains the capacity of PKV Mini dal mill is 8-10 q/day with 72-75% dal recovery and for green gram and black gram the capacity of the machine is 10-12 q/day with 75-78% dal recovery. The whole grain, dal, broken, husk and powder are separated mechanically, hence the dusty atmosphere is avoided. Also the arrangement for oil and water treatment is available on the machine. Hence the unit suitable for entrepreneurship development as cottage industry at rural level. Bengal gram, soybean, lathyrus, etc. can be dehulled using the same machine. The versatility of PKV Mini dal mill can be increased by changing the roller for polishing of black sorghum, cleaning and polishing of rain touched mung and for cleaning of wheat. The cost of the machine is approximately Rs. 72,000/-.

(a) (b)

Figure 5.3 : Plate - PKV Waste fired dryer (a) and PKV mini dal mill (b)

PKV Cleaner-grader

Since the physiological maturity of pigeon pea grains in the field does not occur at one time, contamination of small immature grain is unavoidable. Such grains, twigs, foreign matter, stones, dirt, etc. can be eliminated by cleaning and grading the raw grains before dehulling with the help of rotary cleaner cum grader. It consists of a hopper, blower and rotary sieves. Hopper with feeding mechanism is provided for proper feeding of grains to rotary sieve. Before the grain reaches to sieve it is cleaned by blower and size graded through different sizes of sieves arranged in series. The machine can grade pigeon pea, green gram and black gram grains. Other pulses can also be graded by using proper size sieve. The capacity of the machine is 2 to 2.5 q/h. It operates on 1 hp single phase electric motor. The cost of the unit is Rs. 35,000/-.The cost of cleaning and grading of grains is approximately Rs 20-25/q.

PKV Screw polisher

A simple mechanism consists of hopper, oil-water tank and screw wound with nylon rope is provided for polishing of dal. The thorough stirring of dal with traces of oil and water with the help of worm along with nylon rope provides luster to dal. The capacity of the machine is 1.5-2 q/h. It operates on 1 hp single phase electric motor. The cost of the unit is Rs. 30,000/-. The cost of polishing of dal is Rs. 25-30/q.

(a) (b)

Figure 5.4 : Plate - PKV cleaner-grader (a) and PKV screw polisher (b)

PKV Buff polisher

Dal is polished by pressure by using a leather belt in PKV Buff polisher. Thus white dust on dal surface is removed and dal gets polished. Such type of dal has a great demand in market. The capacity of the machine is 2 q/h and the cost of the machine is Rs. 30,000/- approximately.

PKV Chilli seed extractor

PKV Chilli seed extractor operates on 2 hp electric motor has been developed. Its capacity is 100-125 kg chilli fruits/h and extracts 94-98% seed. Seed germination is not affected by mechanical extraction. As the machine is completely closed, continuous sneezing and irritation of labours body is avoided. The cost of the machine is approximately Rs. 72,000/-.

(a) (b)

Figure 5.5 : PKV Buff Polisher (a) and PKV screw polisher (b)

PDKV Fruit grader

PDKV Fruit grader operates on 1 hp single phase electric motor. It facilitates the grading of spherical fruits of into three to four grades as per desired. The grading efficiency of the machine varies from 70-90% depending on the sphericity of fruit. The capacity of the machine is 10-12 t/day. The cost of the machine is Rs. 81,000/- The cost of grading is Rs. 100/ton.

PKV Evaporatively cooled storage structure

Evaporatively cooled storage structure is developed to store the fruits and vegetables for short duration. Its capacity for orange is 2-4 tonnes and the method is easy to handle and low cost compared to cold storage structure. The temperature inside the structure is 18-20°C less compared to ambient and the relative humidity is in the range of 85-95%. Oranges can be stored in good condition up to 20-21 days in this structure. The structure can constructed on the farm or in the market. The structure has flexibility in design and suitable for storage of other perishables. The cost of construction for 4 tonnes capacity is approximately Rs. 85,000/-.

(a)

(b)

Figure 5.6 : PDKV Fruit grader (a) PKV Evaporatively cooled storage structure (b)

PKV Onion storage structure

For bulk storage of onions Nashik type storage structure was modified by providing false bottom raised 45 cm above the ground level in order to provide aeration to onion from bottom. It consists of two parts each of 5 x 1.5 m and 1.00 m height. Its orientation is East-West so as to facilitate good aeration along the length. One meter gangway is provided to facilitate loading, unloading and proper ventilation. Keeping hollow cylindrical shape structure 250 mm diameter made of bamboo towards the direction of air results in good quality onions up to 3-4 months. The capacity of the structure is 10 tonnes and the cost is approximately Rs. 85,000/-.

PKV Onion seed extractor

Onion seed extractor operating on 1 hp electric motor has been developed. The working capacity of onion seed extractor is 105 kg/h of umbels with recovery of 54.54 kg seed per 100 kg of umbels. The cost of the machine is approximately Rs. 65,000/-.

(a)

(b)

Figure 5.7 : Onion storage (a) PKV Onion seed extractor (b)

Roselle calyces detacher

Manually hand operated Roselle calyces detacher has been developed. It can detach 6 kg/h whole roselle calyces from the roselle fruit without any damage. The cost of the unit is approximately Rs. 100/-.

PDKV Continuous hot air puffing system

The continuous hot air puffing system has been developed for puffing of commercially available fryums, maize, raw potato chips, etc. using hot air instead of frying in oil. Fryums can be well puffed in Continuous hot air puffing system continuously at the rate of 6 kg/h. The cost of the unit is approximately Rs. 50,000/-.

PDKV Pilot plant for tender wheat shoot powder

The process technology for preparation of tender wheat shoot powder has been developed with respect to growing of tender wheat shoots, drying of tender wheat shoots and grinding of dried wheat shoots. The plant layout comprising of units for wheat shoot growing, drying and grinding to obtain wheat shoot powder at the rate of 1 kg/day can be accommodated on about 150 m^2 area and the cost of product Rs 1500 per kg. is reduced by about 40 to 50% than that of commercially available product besides superior quality in terms of colour, texture and contents.

Technology for making ambil powder

Process technology for ready to cook instant Ambil powder was developed. Instant Ambil can be prepared by mixing the Ambil powder with warm water and thus time can be saved.

Technology for making sandoli and bibadi (sorgo papad)

Process technology for sorgo papad viz. Sandoli and Bibadi was standardized and modified. The process time for preparation of Sandoliwas reduced from 8 days to 2 days only and the process time for preparation of Bibadi was reduced from 9 days to 3 days only in modified process technology.

Hand operated papad cutter

Papad cutter (Manually operated) was developed for providing convenience in packaging, handling, transportation, as well as consumption. It is having 6.23 kg/h and 2.65 kg/h capacity and 97% and 94% cutting efficiency for Sandoli and Bibadi, respectively. The cost of the unit is Rs. 5,000/-.

PDKV Turmeric slicer

The turmeric slicer has been developed for slicing of turmeric rhizomes for making powder. It can be operated by 1 hp single phase electric motor. Slice thickness as per requirement can be obtained. It is found techno economically feasible for an entrepreneur/farmer. The capacity of the machine is 350-400 kg/h and the approximate cost of the machine is Rs. 60,000/-.

Technology for better milling of pigeon pea using enzyme pretreatment

Enzyme pretreatment technology of 2:1:1 proportion of xylanase, pectinase and cellulase enzymes at the rate of 45 g/q of dry pigeon pea grain (Variety – PKV Tara) has been developed for better milling of pigeon pea.

PDKV Green pod shelling machine

Green pod shelling machine (capacity 25 kg/h) has been developed for green pigeon pea shelling. By fixing stainless steel corrugated sheet on rubber roller and by changing the sieves, the same machine can be used for green pea shelling (Capacity 36 kg/h). The cost of the machine is approximately Rs. 60,000/-.

5.6. Value Addition and Processing

Rural men and women can get employment and additional income from value added products from rice such as poha, kurmure, papad; preparation of pickle, brined slices, sweet chutney from raw mango and pulp, leather, jam, osmodehydrated slices, powder from ripe mango. Kernels from cashew nuts and products like

squash, syrup, candy, pickle, sweet chutney and wine from cashew apple can add income to the farmers of konkan region. Fisher men can earn more from production of chinglache pickle, jawala chutany, fish batatewada, fish cutlet, fish shev, fish feni, fish khima etc.

Development of value chain products i.e.. absorbent cotton from G. arboreum cotton varieties by the ginning factories may give additional income to the farmers. Production of pallets from cotton stalk may be taken up by establishing pallets making machine in rural areas as most of the farmers are burning the cotton stalk in their open field which is not environmentally economical. In addition, it is possible to cultivate mushroom using cotton stalks. There is scope for scientific processing of cotton seed for premium products and compost can be prepared by using cotton stalks.

Onion bulbs can be processed into dehydrated onion, onion powder, onion vinegar, onion juice beverage, onion chutney, onion pickle, onion oil and onion wine. For preparation of dehydrated onion, bulbs with >90mm diameter can be used while onion bulbs with 20-25 mm are suitable for preparation of onion pickles. Onion bulbs of different sizes can be used for preparation of onion powder, vinegar, juice beverages, rings, oil and wine after removing unwanted portion of onion bulbs such as neck, slit and outer skins. The onion bulbs for processing should be free from diseases and rotting.

All the horticultural crops including flowers need post-harvest management. This can create additional employment opportunities for rural areas. There are ample opportunities to add values to the product through processing. Some of the options for Maharashtra as realized by research institutes have been illustrated in the following section.

Value addition by onion & garlic processing to get flakes, powder, paste, pickles can generate employment for women self-help groups and this can convert 30-50% into product which is generally lost in storage. In addition it saves space for storage, facilitates transportation and price stabilization.

Processed Products from pomegranate includes ready to serve drink seed oil and pomegranate peel powder, minimally processed arils of pomegranate, sparkling wine from pomegranates and organic Mouthwash and Bio-colour. The fruits sorted and segregated for processing are transported to processing unit and then washed and fed to aril extractor. The extracted arils are fed to hydraulic press for juice extraction. The sugar syrup is prepared in separate tank. The sugar syrup, juice, citric acid are added in appropriate proportion so that the RTS will have 15 °Brix TSS and 0.375 % acidity. The pasteurized RTS can be stored at 5°C in cold store before being dispatched for market. The remaining portion of arils after juice extraction is called as marc. This marc is washed and cleaned in a pulping machine for obtaining clean seeds. The cleaned seeds are dried in green house dryer. The dried seeds are used for virgin seed oil extraction at ambient temperature using a cold press (Plate 2) for retention of important fatty acid components (Conjugated linolenic acid). The extracted oil is filtered and packed in amber coloured bottles. The peels remained after extraction of arils is dried in green house dryer. The dried peel is powdered in a pulverizer. The fine powder is packed in laminated film using a form fill and seal machine.

Resins from grape can fetch more value than the table grapes. Preparation of resins and packaging can create employment. In addition the new variety of grape such as Medika has proven to be processing friendly variety which has potential to allow 70% recovery of juice. This has high antioxidant properties & rich color which is quite refreshing as a cold drink. There is no deterioration of the product up to six months and no deterioration in quality in cold storage. Farm gate Sale can be Rs 100/ L of juice and Rs 5 Lakh/ ha income over table grapes.

In crops like citrus there is scope for promotion of agro-waste recycling and bio-fertilizers and there is need for cold transportation facility to minimize post-harvest losses. Hence it is highly essential to establish cold storage facility and provide access to this facility to small farmers. There is a need of thorough assessment of the value chain / value added products and possibilities of cluster approach at village level for establishing processing unit with Govt. support.

Feasibility and expected enhancement of income from the new venture needs to be explored in dry flower industry for export purpose, extraction of essential oils and other natural pigments and colours in addition to exaction pharmaceutical and nutraceutical compounds from flowers. There is also scope for use of flowers in agro based by product industry like soap, cosmetic, poultry feed, making of agarbatti, gulal making, natural colours, etc. There are value added products of flowers like rose water, rose sharbat, flower confectioneries, rose

gulkand, sweets etc. Employment can also be generated through establishment of e-marketing of flowers and through flower arrangements and bouquets making agencies. Off-farm employment/income opportunities / allied activity income for farmers both with and without land including post harvest technologies and value addition.

- On farm cleaning, grading and packaging of flowers
- Development of cold chain and flower collection centres
- Development of cold storages (Zero energy cool chambers, solar cooling chambers) in the area of cultivation to buy more time for marketing
- Use of flowers in agro based by product industry like soap, cosmetic, poultry feed, making of agarbbati, gulal making, natural colours etc.
- Exaction of essential oils, pharmaceutical and nutraceutical compounds from flowers
- Value addition of flowers like rose water, rose sharbat, flower confectioneries, rose gulkand, sweets etc.
- Promotion of dry flower industry for export purpose
- Skill development in making flower arrangements and other value added flower designs
- Achievements under NHM can be replicated for further enhancing the income of farmers through value addition in fruit products

Table 5.7 : Achievements under NHM (2005-06 to 2016-17)

Sr. No.	Components	No.of Units Established	Impact / Capacity Created(MT)
1	Protected Cultivation		Most Impactful Component of NHM
	Green House (No.)	3699	High quality flowers & vegetables production per unit area & thereby increase in net income of farmer.
	Shed net House (No.)	4693	
	Plastic Mulching (Ha.)	9167	
2	Community Tank	21033	Water Storage Capacity Created -115890 Cu. M Life Saving Irrigation Made available for Perennial Fruits Orchards on 113200 Ha.
3	Post Harvest Management Infrastructure (No.)		
	Pack House	4503	180120 MT
	Onion Storage Structure	17323	375875 MT
	Primary Processing Unit	956	23587 MT
	Cold Storage & Integrated Cold Chain	119	250145 MT
	Ripening Chamber	83	24900 MT

5.6.1. Pomegranate

Entrepreneurship Opportunity-I

- Current Status: Huge demand in International Market
- Bottleneck: Shelf life
- Only 2 commercial firms doing this business in India. INI farm- Baramati SAM Agrotech- Hyd. Approximate Investment for commercially feasible unit Rs.100 lakh excluding land and Building costs

Entrepreneurship Opportunity-II

- Thermal processing of juice/ Ready to Serve Pomegranate drink – with no chemical preservative

Entrepreneurship Opportunity-III

- Sparkling wine from Pomegranate

Treated 14 days

Control < 7 days

Approximate cost of Establishing one small scale Unit (100 lph):
Rs.50 lakhs Excluding the cost of Land and building

Sparkling wine: Approximate cost: Rs.50 lakh Excluding land and building

Figure 5.8 : Sparkling wine from Pomegranate

Source : NRCP

Melatonin was observed to be absent in pomegranates juices but it is detected in prominent amounts with respect to other food matrixes (54-550 ng/100mL) in pomegranate wine. The presence of this biogenic amine makes pomegranate wine as bioactive phytochemical as dietary supplement

Entrepreneurship Opportunity-IV: Pomegranate Peel

Organic Mouth wash

Oral health vs Cardiovascular disease (Dumitrescu, 2005).

Mouthwash based on pomegranate extracts effectively reduced the amount of dental plaque microorganisms and gingivitis (Di Silvestro et al. 2009)

Bio-colour

The main coloring agent in the pomegranate peel is the alkaloid N-methyl granatonine. This is water soluble and recovery could go upto 19%

Figure 5.9 : Pomegranate peel organic mouth wash

Source : NRCP

6 Role of Technology

Technology will continue to be a dominant driver of agricultural growth and, therefore, it must be paid due attention. The major issues which need attention for bringing a transformative change in production systems are

- Application of existing stock of knowledge to harness productivity potential
- Access to proprietary technology
- Farm mechanization for higher input use efficiency
- Technology for agro-processing.

The technologies can contribute to doubling the farmers income primarily by enhancing the productivity of the system through enhanced production, reduced cost of cultivation and effective communication about market intelligence. There is also a need to prioritize crops which are likely to experience a technical change similar to that observed in maize (single cross hybrid), cotton (Bt for bollworm resistance) and hybrids in vegetables and flowers and implementation of programs in 'mission mode.' Along with such technological innovations, last mile delivery of technology, skill development and information flow to farmers should be strengthened.

The recent research output from universities and ICAR institutes have clearly revealed the potential of improved crop varieties and natural resource management technologies for enhancing the productivity of crops, livestock and fisheries in addition to allied sectors such as sericulture. In addition, a lot of agro chemicals including the growth promoters are being commercialized in the Indian market. Farmers are in dilemma while using chemical and organic fertilizers; they don't know how to do budget farming. There is poor coordination between agriculture universities and farmers and it is increasingly observed that technologies emerging from research are not reaching farmers who need to be trained in using that technology and it is necessary to increase their capacity to make right choice at right time while making decision on purchase of inputs particularly for high tech agriculture.

Opportunities of using agricultural technologies developed by Universities and ICAR-institutes for different regions of Maharashtra has been given in brief in the following section while comprehensive information can be obtained from respective websites.

6.1. General observations

- Technology is not limiting factor; remuneration is the concern hence action plan is needed including all the sectors, small farmers and land less labours; it is necessary to specify site specific modules for doubling the income of farmers
- All of us know the problem and some solutions already exist but it is not clear who has to reach them to the farmer and hence it is necessary to focus on what is needed for poor farmers and how to achieve in next five years so that it can help to double the farmers income.
- This should focus on comprehensive package which is needed to prioritize action plan: Short term and medium term goals for accomplishing the task; Action plan should include where to grow? What to grow? When to grow?
- Some of the options are risk mitigation with respect to both weather and market: Promotion of water conservation and rain water harvesting for soil moisture security; watershed planning promotion of group farming, promotion of agri. produce export; product branding; training in primary processing;

competitive price and quality of commodity; site specific land use models; remunerative components of IFS including small ruminants for dry areas

- Land use plan and integrated farming system should consider issues such as use of high end science and high resolution data; comprehensive soil health card; global distribution crop and supply and international demand possible technology available; Estimation of harvesting potential; crop plans for mixed cropping
- Soil information of Maharashtra available with ICAR-NBSS & LUP could be used to develop area specific crop productivity enhance intervention in the state. Soil fertility status particularly micro-nutrient states at district level need to be developed to enhance crop productivity
- Soil based crop sustainability maps could be developed for major crops at district level for different agro ecological regions of Maharashtra to enhance crop productivity
- Augmentation and synergies of existing Govt. schemes should consider infrastructure subsidies instead of individual subsidies; employment opportunities; enhanced staff strength to achieve the task; work modules in partnership mode; coordination between SAUS, ICAR institutes and department; assured water and electricity; focus on post-harvest technology

6.2. Production technologies

Several crop production technologies for cereals, pulses, oilseeds, sugarcane and cotton in addition to other crops have been evolved regularly by the State Agriucltural Universities and ICAR institute in the state. They are being periodically published. These technologies encompass integrated management of crops involving the best selection of varieties, crop protection technologies, irrigation schedule and machines for harvest and post harvest technologies. Some of the success stories have been described in the subsequent section in this chapter.

6.3. Strategy and action plan

The empirical evidence shows that if same level of progress in various sources of growth, as experienced in the previous 10-15 years, is maintained, it can achieve 75 percent increase in per farmers income by 2022-23 over base year of 2015-16 with better price realisation. This falls short of doubling the income (100 percent increase) by 25 percent. Thus, to double farmers income by 2022 the progress in various sources of growth has to be accelerated by 33 percent. This change could be across the board or more in some area and less in others with overall acceleration of 33 percent.

Table 6.1 : Sources of growth in farm income : Achievements and required growth rate for doubling farmers income

S. No.	Sources	Recent a Period	achievements Growth rate/change	Required growth Rate for DFI
1	Crop productivity 70% segment	2001-2013	3.1	4.1
2	Livestock value added 30% segment	2005-2014	4.5	6.0
3	Improvement in resource use efficiency	2005-2012	2.26	3.0
4	Crop intensity (70% segment)	2001-2012	1% age	L3
5	Crop diversification towards fruits and vegetables (70% seg)	2003-2014	3.89	5.17
6	Better price realisation: Crops	Karnataka experience Reforms	13% total (in real terms)	17.0
7	Shift to non - farm occupation	2005-2012	1.81	2.4

Crop productivity is required to increase by 4.1 percent and live stock value added by 6.0 percent per year to double farmers income by 2022. TFP growth, which is mainly contributed by agricultural R & D, extension services, new knowledge, efficient practices like precision farming, is required to follow annual increase of 3.0 percent. Indian farmers should raise area under two crops to 53 percent from the present 40 percent recorded in recent years. Area under high value crops is required to follow an increase of 4.4 percent each year. Market reforms are required to enable farmers to get 17 percent higher prices than base level in real terms. This requires 2.26 percent increase in prices received by farmers in real terms. Finally, total number of cultivators is required to come down by 2.4 percent each year (Source PDKV).

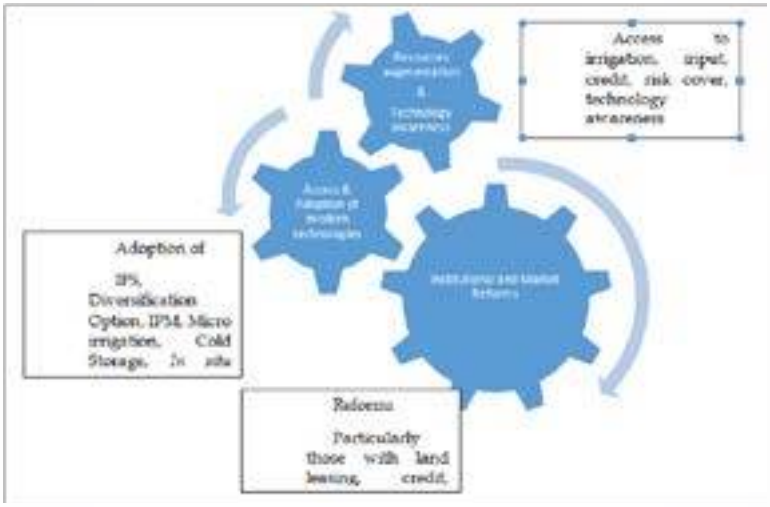


Figure 6.1 : Strategy and action plan

6.3.1. Suggested strategy to achieve the goal

- Promoting Integrated Farming System (IFS)
- Strengthening Crop Diversification
- Promoting in-situ Water Conservation in Rainfed
- Promoting Organic Farming
- Popularizing Concept of IPM
- Expanding Coverage Under Micro-irrigation
- Broad basing Agricultural Extension
- Empowering through Grass root Level Organizations
- Creating Post Harvest Handling Facilities
- Adding Value through Agro-processing
- Sensitizing towards quality Agro-produce
- Encouraging Public-Private Partnership
- Making Agricultural Research More Relevant
- Making Agricultural Education More Useful
- Revitalizing Agricultural - Extension Education
- Increasing Use of IT through Cyber-Extension
- Access to market intelligence
- Bringing in Institutional Reforms particularly those with credit, insurance and marketing

6.3.2. Overall Strategy

- By increasing productivity of crops
- Timely supply of good quality of sufficient seeds prior to season
- Timely availability of good quality of inputs

- Applying short duration high yielding varieties
- Increase SRR of hybrid seeds
- By promoting Farm Mechanization
- Application Integrated Nutrient Management
- Application Integrated Pest Management
- By increasing irrigation facilities
- Adoption of DSR/Zero Tillage/SRI
- By increasing cropping intensity
- According to land situation, irrigation and other facilities farm plan should be prepared for Kharif, Rabi and Gram for 3 years
- Paddy - wheat/pulses/Maize
- Maize – Wheat/Pulses/Maize
- Maize – Wheat/Pulses/Maize - Mung
- Vegetable (cauliflower) - potato - onion – mung
- Maize/Vegetable – Potato-Potato-Onion-Mung
- Paddy (short duration) - vegetable - onion - maize
- Paddy - vegetable - maize
- Short duration hybrid/HYV seeds to be used
- Use of rice fallow land
- Rice- Makhana cropping System
- Diversification of cropping system with high value crops
- Cash crops- Sugarcane, cotton, soybean and Vegetables
- Spices -Turmeric, Ginger, Dhania, Garlic, and Ajwain
- Mushroom Cultivation
- Rearing of honey bee
- By Reducing cost of production
- Subsidy on farm inputs
- Provision of subsidy on HYV/ hybrid in light of market price.
- Subsidy on mechanization in light of market price
- Use of green manuring e.g. Dhaincha, Moong, Cowpea, Sunhemp etc.
- Application of balance dose of fertilizer on the basis of soil testing
- Provision of subsidy on diesel
- Promotion of custom hiring system
- Use of bio fertilizers e.g. Rhizobium, PSB, Azotobactor, Azolla, Blue green Algee, Mycorrhiza
- Subsidy of transport
- Use of Gobar/Bio gas
- Promotion of zero tillage technology
- Promotion of DSR
- Use of Organic fertilizers and Manures
- Promotion of integrated farming system
- Synergise blending of crops/horticulture, dairy, fishery, and poultry to provide regular income.
- Protected cultivation of vegetables and flowers with Micro irrigation

- Constitution of FPO to create market
- Effective procurement strategies to procure on MSP
- Regular region wise weather forecasting
- Provision for practicing kitchen gardening for urban households and poor people
- Facilities of more warehouses and cold chain
- Post harvest management to reduce crop losses
- Required value addition and processing
- Market linkages and reforms
- The sericulture or other allied activities could be the supplementary/additional source of income to the small farmers. Structure of modules to be designed for each district. It is the general opinion that single enterprise alone cannot substantially enhance the income of farmers. However there may be few exceptional cases such as high value horticultural crop. Hence, the modules for enhancing the income of farmers and dependent agriculture and non-agricultural rural mass should involve IFS and forward support for marketing the produce at remunerative cost. Some of the hypothetical modules suggested in the figure needs to be optimised for their income and feasibility in different regions
- Crop diversification: Diversification of crops like fruits, vegetables and other field crops allocated to portion of land in total field so that, farmer can get income year round. Also when one crop fails, the farmer can get income from other crops
- Direct marketing of fruits to big store chains, residential colonies etc. so that intermediaries are avoided and farmer can get income at the rate of retail prices
- Irrigation method to save water: Creation of irrigation, micro-irrigation facilities, water conservation, rain water harvesting approaches would lead to stability and sustainability to citrus cultivation

6.3.3. Resource management to reduce cost

- Soil suitability has been delineated by NBSSLUP- has to be utilized by others for implementing the action plan for doubling the farmers income
- Micro irrigation should cover all sugarcane fields by 2020 (Nala irrigation to drip irrigation a lot of investment)
- Base line 2016-17 for example soil health status; where we want to go and how we can and action mode; Which department will do which job
- Cotton should not be grown on land which is unsuitable for it for example Telangana replaced cotton with red gram
- Desi cotton can reduce 50% of cost of production and hence to be promoted. Seed is major concern; KVK should promote this technology- to be in farmers field
- Geoportal about new technology for decision making to be developed with inputs from all the members of SCC
- The plans for future should include for both land holding and land less farmers with focus on increase in number of man days for land less farmers
- Common property land to be put for proper use considering the need for animal fodder/forage
- Fertilizer dependent agriculture to less fertilizer dependent agriculture to reduce the cost of production for both farmer and environment
- Cost of production in fish can be reduced by addressing fisheries co-management; Feed through local ingredients; Proper marketing of-Seed, fish, and Value addition

6.3.4. Region based strategy

Konkan

- Paddy - Increase area under Hy. Rice, Use of Urea DAP briquettes, Popularising "Chatu-Sutri"-Four point paddy production technology
- Cashew nut - Area expansion, Productivity enhancement, Promotion of organic cashew

- Mango -Area expansion under Alphonso, Post-harvest management including better transportation of mango, Adoption of GAP
- Construction of Konkan Jalkund, Check dams, Diversion Bundhara
- Adoption of specialty flowers like heliconias, ginger lily in intercropping with plantation crops.
- Promotion of suitable crops of region like orchids, anthurium which required high humidity for cultivation
- Promotion of flowers like jasmine, Michelia champaca, rose and other native flower crops.
- Promotion of nursery industry which can cater the need of nearest huge Mumbai market

Western Maharashtra & Khandesh

- Sugarcane - increase productivity & release area for foodgrains and soybean
- Soybean – increase area & productivity
- Grapes & Banana – major stress on export
- Pomegranate -area expansion in DPAP blocks
- Floriculture & high value vegetables-cultivation under controlled conditions
- Promote organic fruits & vegetables
- More emphasis on ICM & IPM for horticultural crops like Pomegranate, Grapes
- Promote floriculture & Cold chain
- Adoption of intercropping of seasonal flowers in major horticultural crops like grapes, pomegranate, mango, etc. where wider spacing is used for cultivation
- Value addition of flower crops: extraction of essential oils, natural pigments and pharmaceutical compounds Development of cold chain and integrated marketing centers.
- Development of flower based by product industries
- Promotion of dry flower industry in the tribal areas of Nandurbar and Dhule
- Flower seed production of various seasonal flower crops

Marathwada

- Cotton - Increase the yield & promote Clean & quality cotton
- Maize -Increase the area for cattle feed & industrial use
- Oilseeds & pulses - Bridge the yield gaps
- Promote the cultivation of sweet oranges,mangoes & banana
- Kharif sorghum - Promote industrial use
- Discourage the cultivation of sugarcane and divert the area under soybean & gram
- Promote protective irrigation through the farm ponds, dug wells and other water harvesting structures
- Promotion of loose flowers like marigold, tuberose, gladiolus, annual chrysanthemum, chrysanthemum, aster, gaillardia, etc.
- Adoption of intercropping of seasonal flowers in major horticultural crops like pomegranate, ber, mandarins etc. where wider spacing is used for cultivation
- Production of natural colours/gulal/holicolours and dry flowers

Vidarbha

- Paddy- SRI method for increasing productivity
- Soybean- increase the area & productivity
- Cotton- promoting Clean & quality cotton through contract farming, reduction in cost of cultivation through INM & IPM
- Organic cotton & mandarin promotion campaign

- Pulses – promoting as intercrop in soybean and cotton
- Mandarin Orange – improving the quality & productivity through improved packages of cultivation and quality planting material
- Promoting PHM of mandarin orange through better packing, transportation & preservation
- Promoting Public Private partnership to develop clusters of pulses, vegetables, flowers & fruits for the ultimate market in the urban areas
- Water harvesting through farm ponds, dug wells, check dams, malgujari tanks & bodies
- Promotion of loose flowers like marigold, tuberose, annual chrysanthemum, chrysanthemum, aster, gaillardia, etc. and cut flowers like gladiolus and tuberose
- Promotion of dry flower industry in the tribal areas of the region
- Promotion of nursery industry in cities like Nagpur, Amravati, Akola, etc.

6.3.5. Dryland Agriculture Strategy

Strategy 1: Productivity enhancement

- Strengthening of soil moisture conservation technologies and storage structures
- In situ soil moisture conservation strategies viz., compartment bunds, ridges & furrows, tied ridges, contour bund before onset of monsoon
- Scooping in between rows to harvest rainfall
- Hoeing at 25 DAS
- Hoeing at 3rd, 5th and 8th week after DAS for rabi sorghum
- Preparation of furrows for moisture conservation after harvest of intercrop
- Opening of alternate dead furrows for water / moisture conservation 30 DAS
- One weeding and one hoeing before 30 DAS
- Ex-situ moisture conservation i.e.. harvesting of excess rainfall in farm pond, cement nalla bund, earthen embankment etc.
- Desilting of water harvesting / storage structures
- Adoption of improved, high yielding, drought resistance varieties
- Sunflower - Phule Bhaskar, LSFH-171
- Pigeonpea -Vipula, BDN-708, Phule Rajeshwari, BDN-711, BSMR-853
- Pearlmillet - Adishakti, Dhanshakti
- Rabi sorghum -Phule Vasudha, Phule Suchitra
- Safflower - Bhima / SSF-708, SSF-733, SSF-748, PBNS-12
- Chickpea - Vijay / Digvijay
- Adoption of improved package of practices
- Reduced tillage
- Hoeing at 25 DAS
- Intercropping of Sunflower (Phule Bhaskar, LSFH 171) + Pigeonpea (Vipula, BDN-708, BDN-711, BSMR-853, Phule Rajeshwari) (2:1)
- Intercropping of Pearlmillet (Adishakti, Dhanshakti) + Pigeonpea (Vipula, BDN-708, BDN-711, BSMR-853) (2:1)
- Intercropping of Soybean (Phule Agrani, Phule Sangam, JS-335) + Pigeonpea (Vipula, BDN-708, BDN-711, BSMR-853) (3:1) (Barshi area)
- Intercropping of Pigeonpea + Black gram (TAU-1, TPU-4) (1:3)
- Strip cropping of Chickpea + Safflower (6:3)

- Strip cropping of Rabi sorghum + Chickpea (6:3)
- Contingent crop planning for delayed onset of monsoon
- Strengthening of disease and pest management technologies
- Use of preventive control measures
- Use of botanical and bioagents
- Need based application of chemical pesticides
- Adoption of farm mechanization
- Use of bullock drawn (Phule Sheti Yantra) and tractor drawn seed-cum ferti drill
- Use of cycle hoe for interculturing
- Use of combine harvester for safflower
- Management of soil health in dryland condition
- Integrated nutrient management approach should be followed
- Fertilizers should be applied at the time of sowing
- Organic cultivation of local grain and millets in different blocks
- Promotion of soil amendments in reclamation of saline and sodic problematic and degraded soil
- Soil and crop stress management
- Use of crop residue management for mulching
- Use of soil amendments
- Use of foliar sprays of antitranspirants
- Use of potash and zinc foliar sprays

Strategy 2 : Livestock: Goatry, Poultry, Fisheries

- Promotion of animal breeds
- Selection of high milk breeds in buffaloes (Pandharpuri) and cattle
- Selection of heat tolerant breeds
- Promotion of goat rearing of Osmanabadi breed
- Establishment of three hatcheries for need of broilor such as Giriraj, Vanraj
- Establishment of milk chilling plant
- Animal nutrition management
- Silage making
- Use of Hydrophonics and Azolla in fodder
- Establishment of Fodder Bank to meet fodder requirement of area
- Promotion of Urea, Molasses, Multinutrient Blocks at Nyaypanchayt level
- Promotion of dryland fodder trees/ crops/ grasses viz., Subabhul, Shevari and Stylo
- Health cover
- Vaccination at proper time
- Use of anthelminitic at regular interval

Strategy 3 : Integrated Farming system

Table 6.2 : Promotion of different Integrated Farming System modules such as Integrated Farming System for dryland agriculture for small farmers (1 ha area)

Area (ha)	% Area allotted	Season		
		Kharif	Rabi	Summer
Crop component (50%)				
0.30	30	Cowpea	Sorghum	Fallow
0.10	10	Maize fodder	Sorghum fodder	Fallow
0.10	10	Fallow	Chickpea	Fallow
Horticulture component (40%)				
0.40	40	Dry land orchard with inter crop of (Pearl millet + Pigeon pea 2:1)		
Animal component (5%)				
0.05	5	Dairy farming: 1 Buffalo (Pandharpuri), Back yard Poultry:30 birds in 5 lot/ year (Giriraj), Goat rearing: 10 female + 1 male (Osmanabadi)		
Farm pond (5%)				
0.05	5	Size 15 X 15 X 3 m		
		Protected cultivation + Composting + Goatry/backyard poultry Fodder production+ Mini dairy + Composting + Protected cultivation		

Strategy 4 : Reducing post harvest losses and value addition

- Establishment of mini Dal mill plant
- Establishment of Food and Processing Units for pickle making
- Promotion of cluster approach for efficient procurement and disposal of surplus fruits and vegetables in areas.
- Promotion of cold storage
- Promotion of Anardana, Custard apple rabadi, sorghum by-products
- Promotion of common resources on custom hire basis viz. farm implements and processing equipments
- Promotion of small scale oil extraction units of Safflower and Sunflower.

Strategy 5 : Waste land development and waste water

- Promotion of plantation of mulberry, dryland fruit plants, fodder trees, and green manuring trees
- Popularization of contour bunds, CCT to save excessive loss of nutrients in wasteland.
- Popularization of trenches for percolation of water to avoid surface runoff.
- Construction of check dam and artificial structure to maximize water percolation rate in marginal and denudated areas.
- Construction of farm ponds for storage of water for lean season.
- Storage of rain water in monsoon season.

Strategy 6 : Reduced cultivation cost by promotion of

- Organic manuring with well decomposed FYM, Vermicompost and Biofertilizers to minimize the use of chemical fertilizers.
- Recommended seed rate, spacing and depth
- Need based application of pesticides and other agricultural inputs
- Hand tools in agricultural and horticultural operations
- Use of Power tillers, Power weeders, Threshers, Maize Sheller, Wheel Hand hoe, Combine harvester, Ferti-seed drills

- Mulching (bio or degradable plastic) to maintain moisture and reduce intercultural operation cost.
- Promotion of pressurized irrigation techniques in horticultural crops
- Tillers and other garden tools for reduction of drudgery

Strategy 7 : Off-farm income

- Promotion of subsidiary occupations like poultry, fish farming and mushroom production.
- Promotion of apiculture for small and landless farmers
- Promotion of sericulture
- Promotion of cultivation and collection of medicinal plants
- Promotion of skill development in women and youth

Strategy 8 : Enabling Policies

- Increasing institutional support by providing subsidises and incentives to small and marginal farmers.
- Labelling of organic inputs and certification mechanism for various crops
- Popularization of Udhyan and Krishak Cards for widespread use of government incentives/subsidies to farmers
- Establishment of seed bank, fodder bank to meet the present and future demand
- Implementation of effective and workable Nursery Act to avoid spurious or unreliable planting material in the state
- Ensure sustainable agriculture through more efficient utilization of land, water and other resources.
- Implementation of Soil Health Card Scheme

Strategy 9 : Marketing and value addition in specific agro-ecological region

- Creation of direct linkages with food processing industries for better prices especially for pomegranate, ber, custard apple, banana, grape, sorghum
- Establishment of strong linkages with various stack holders to furnish information on crop produce and surplus
- Establishment of procurement and collection centre for agricultural surplus with proper labelling.
- Installation of mini grading machines at village level
- Establishment of cold room in different clusters

Strategy 10 : Online Management and Evaluation

- Development of Mobile apps/ software for online management and evaluation at district level
- Development of e-Marketing and kiosk at district level to have information of surplus commodities at block level
- Organization of monthly review meeting at district to solve the problems related with farmers
- Promotion of use of radio, TV talks and use of Whatsapp etc. for effective implementation of program (Source: MPKV)

6.4. Commodity wise strategies

6.4.1. Field crops

Pulses

To meet the demand for pulses greater emphasis is needed in almost all the districts. The task of attaining self sufficient in pulses production looks difficult without area expansion and irrigation. Bringing Additional Area under Pulses diversification of rice system through popularization of early duration varieties of pigeonpea, chickpea, and summer mungbean. Bringing additional area under pulses through promoting urdbean/mungbean and chickpea cultivation in rice fallow in Western Maharashtra Ghat Zone. Promotion of

pulses in intercropping viz., short duration thermo-insensitive varieties of mungbean/urdbean with cotton, sorghum and pigeonpea etc.; rabi chickpea with sugarcane and rabi sorghum; pigeonpea on paddy bunds etc. Development and popularization of urdbean/mungbean for summer planting. Other issues to be addressed are

- Timely availability of quality seed of promising varieties to the farmers as per their requirement
- Selection of variety as per soil types: In pigeonpea mostly midlate group varieties (maturity period of 130 to 160 days) are preferred by the farmers due to its high yield potential and are grown irrespective of soil types
- Limited soil moisture generally coincides with reproductive phase (terminal drought) resulting in substantial reduction in pigeonpea yield
- Poor seed replacement ratio
- Mostly seed treatment is not followed by the farmers
- Use of Bio fertilizers like rhizobium and PSB culture is not much popular among the farmers owing to paucity of reliable source and ready availability of pure culture of biofertilizer in the market. Many times spurious cultures are supplied to the farmers resulting in loss of faith
- Without soil test based fertilizer application
- Timely availability of quality chemical fertilizers
- Pod borer complex caused considerable yield losses in pigeonpea and chickpea despite availability of splendid insecticides due to late in execution. Recently pod fly (Maruca) is emerging as a serious threat to the pigeonpea causing dual losses at field level (approx. 10-25 %) as well as presence of such shriveled grains in the final produce fetc.h less market price (approx. Rs.500-1000/q)
- Wilt and SMD are serious threat to pigeonpea. In mungbean and urdbean Yellow-Mosaic Virus is emerging as serious threat causing significant yield reduction. In addition, heavy damage to pulses grain is caused by pests during storage
- Lack of mechanization : Non availability of suitable genotypes (mungbean, urdbean and pigeonpea) for mechanical harvesting
- Lack of storage facility at field level
- Inadequate processing and un-organized marketing
- Label claim : Due to label claim scientists can not recommend pesticides for various causes from available fungicides, post emergence herbicides, insecticides against white fly for the management of MYMV in mungbean and Gonocephalum (soil dweller pest in saline tracts of Vidharbha) in chickpea etc.
- MSP do not fully support pulse growers
- Development of irrigation facilities such as farm pond/small irrigation projects which can be utilized for use of protective irrigation at critical growth stages

Soybean

Soybean growing areas of Kolhapur, Sangli and Satara have been able to achieve yields up to 2.5 to 3.0 tones per hectare due to assured rainfall and irrigation facilities. Rust disease is also very much specific to these areas. Hence the need for rust resistant varieties as well as varieties with high yield suitable for irrigated conditions as well as with slightly longer duration of maturity. Other areas are fully of rainfed conditions but free from rust. In these areas high water use efficient varieties adapted to less water are needed. Also short duration varieties maturing in 85-90 days but even with slightly lesser yields (up to 2 tones per hectare) have to be urgently incorporated as these will require less water. These need not be resistant to rust as the area is dryer and rust does not occur in these areas.

- Quality Seeds needed : The higher yield potential can be achieved by having optimum plant stand in the field. To achieve this, varieties with better seed germination and resistant to mechanical damage is needed
- Reducing yield loss in the field : This can be done by developing varieties with resistance to pod shattering up to 7-10 days from physiological maturity. Also varieties suitable for mechanical harvesting are to be developed

- Insect pest damage: The damage caused by insect can be minimised by developing suitable insect resistant varieties or through chemical control or through IPM strategies
- Educating farmers: Although technology for better productivity exists the need is for educating the farmers. This needs to be done through training courses at the university/research institute/KVK level. FLD at farmers field has to be conducted with full package of cultivation has to be demonstrated and a realistic budget sanctioned/utilised for the same
- Protecting basic Soybean developing centres: Soybean has been introduced and spread in the country through various research institutes, universities, etc., who have the basic varieties/seed/germplasm, etc. and which are the centres supplying the basic know how and seed for cultivation in the country

These centres face numerous problems, one of which is severe drought and as we all know soybean if not maintained every year losses its viability and fails to germinate after one year.

These centres need to be identified and strengthened by supply of assured irrigation for maintaining the seed/ germplasm, etc. every year.

Protection against upcoming future diseases : As the area under cultivation increases soybean crop is becoming susceptible to various new diseases. Diseases like YMV, bud necrosis, pod blight, etc. are being seen in these areas in a few patches but could increase in the coming years. Research to develop resistant varieties is needed and suitable funding should be provided for the same. One or two varieties are being cultivated over the years and this could lead to severe damage in case of epidemic of diseases. This is to be avoided by supplying seeds of recently released varieties through seed multiplying agencies on a compulsory basis.

Sunflower

In Vidarbha region some part of Buldana and Akola district have saline track in tahasils viz; Jalgaon, Jamod, Sangrampur, Telhara and Akot. High yielding hybrids, improved package of practices, need based plant protection etc. to be followed for enhancing the production.

- For next two-three years honey bee keeping to be promoted in this area to increase the income of farmers.
- Small scale oil extraction unit to be promoted
- In the district Nagpur, Gadchiroli, Bhandara, Chandrapur and Gondia, after kharif paddy, farmers are growing linseed, latharus in rainfed and wheat in irrigated condition. In rainfed condition the yield from linseed and latharus is very low. There is scope for cultivating sunflower crop as a substitute for linseed and latharus
- During 2017-18 to 2020-21, Front Line Demonstrations on Sunflower regarding improved package of practices, high yielding hybrids, INM, need based plant Protection etc. have to be conducted to disseminate the improved knowledge of Sunflower production technology among the farmers of Nagpur, Gadchiroli, Bhandara, Chandrapur and Gondia district
- Along with these activities training programmes, field days have to be organized to give the technical knowhow to the practicing farmers as well as extension functionaries

Groundnut

- In vidarbha region some part of Washim, Buldhana, Akola, Amravati, Wardha, Yavatmal & Nagpur in this area Oilseeds Research Unit, Dr.P.D.K.V, Akola is already conducting FLDs on High Yield Variety, Whole packing practices etc. this help to increased farmers incomes
- Small Scale oil extraction Unit, Salted kernel units at village levels will be promoted addition value of their product ultimate aim to increased income of framers
- In the district Nagpur, Gadchiroli, Bhandara, Chandrpur and Gondia farmers have irrigation facility promote Summer groundnut
- During incoming years Training & FLDs programmes conducted in groundnut crop to disseminate the improved technologies for groundnut productivity increased in Vidarbha region

Cotton

Wherever cotton is a sole crop there is need to promote line sowing and fertiliser application using tractor drawn planters at recommended seed rate, spacing and depth. It is also necessary to promote

- Cotton pickers and strippers for harvesting, cotton stalk chipper shredders for post-harvest field operation, better management practices for cotton picking, cleaning, storage, handling and transportation of seed cotton for maintaining quality and purity of cotton for getting premium prices
- Mushroom cultivation and compost preparation using chipped cotton stalk
- Briquetting and pelleting of cotton stalk as renewable energy source
- Scientific processing of cotton seed for better utilisation of by-products like cotton seed oil, linters, hulls and cake for higher remuneration
- Entrepreneurs at village level for supply chain management of cotton stalk for briquetting and pelleting
- Minimum support price fixing based on true cost of cultivation
- Taxes on sale of cotton stalk briquettes and pellets to be revisited and kept minimum
- Approaches and methodologies to enhance income

Other options

- Shift from low value to high value crops/technologies : Introduction of Bt varieties with short duration can substitute Bt hybrids where the farmers harvest very low yield and receive very low return from light type of soils. The low productive light soils cannot support and supply the plant nutrient to Bt hybrids. Hence Bt varieties or straight varieties with resistance to sucking pest, bollworm are to be supplied to the farmers well in time for cultivation
- New short duration varieties : Long lint Desi (Gossypium arboreum) and Bt varieties: The most crucial factor for high yields in India, these varieties are with five main attributes of short duration (140-160 days), compact architecture, high harvest index, resistance to sap-sucking pests and high ginning% (>40%). Attempts were made over the past 10 years to develop such varieties suited for high density planting in India
- New Break through Desi (Gossypium arboreum) varieties : The Desi cotton species are unique to India. The species is endowed with inherent robustness of high tolerance levels to insects, diseases, salinity and drought. However, Indian Desi varieties were known for their long duration, small boll size and short staple coarse fibre, because of which their cultivation was limited to challenging areas. The ICAR-CICR (Central Institute for Cotton Research) in collaboration with the State Agricultural Universities identified several short duration Desi cotton varieties of high ginning% (>40%), high harvest index, high tolerance to pests, diseases and drought in all categories of fibre (short, medium and long staple) that give high yields with negligible chemical inputs at phenomenally low cost of production. Phule Dhanwantary is an excellent high yielding short staple variety from MPKV Rahuri. PA-255, PA 402 from VNMKV, Parbhani and Roja from ICAR-CICR are medium staple varieties. Two years ago, a break-through was achieved by the Cotton Research Station of Nanded (VNMKV, Parbhani). The breeders developed several long-lint (28-31 mm) Gossypium arboreum (Desi species) short duration varieties. PA-08, PA-528, PA 740 and PA 812 are a few of the outstanding long staple varieties. The long staple Desi varieties were tested extensively by ICAR-CICR in multi-location trials across the country and were found to hold great promise because of their excellent premier fibre qualities, high yields in high density planting at very low production costs with least requirement of chemical inputs. Some of the varieties are likely to be released within the next two years
- Bt-cotton in local varieties: Bt-cotton technology performs best when introduced into locally adapted pure-line varieties. The ICAR-CICR in collaboration with the State Agricultural Universities has been working over the past few years to develop 21 new Bt-cottton varieties. At least 8 Bt-varieties are likely to be available across India for commercial cultivation by the Kharif season of 2018. A few Bt-varieties are endowed with highly desirable traits such as short duration; sympodial architecture; early maturing with synchronous flowering and fruiting; high initial root and shoot vigor; high harvest index with least unproductive branches and leaves; resistance to sap sucking insects such as leaf hoppers, aphids, thrips and whiteflies; resistance to 'bacterial leaf blight' and tolerance to 'cotton leaf curl virus' and other diseases; desirable fibre qualities with high ginning% of 37-40% and amenable to machine picking
- High density planting systems (HDPS) & 'Short-dense-early' pattern: High density is defined by a spacing of 10 cm between plants in a row, with variable row spacing at 38 to 100 cm. The ICAR-CICR spearheaded the HDPS programme in India to demonstrate high yields with low input costs with short duration varieties. All the countries that have yields higher than 1000 kg/ha are known to have been following the high density approach. Plant density is kept at more than 110,000 plants per hectare. Interception of light is an important factor for high yields. Therefore compact varieties are more suited for high density planting. The new varieties (Bt& Desi non-Bt) were tested by ICAR-CICR under high

density planting systems in all the major cotton growing locations under Indian conditions. Field experiments showed that the Bt-varieties and Desi varieties under high density planting consistently out-yielded the reference Bt-hybrids at recommended spacing at all locations. The varieties if cultivated with conservation tillage, plastic mulching, canopy management and precision input management are likely to give outstanding results

- Sub-soiling to break hard-pans : Though not taken seriously, hard-pan is a major problem in many regions in the country that results in poor root penetration and low yields. Land preparation must be done by sub-soiling at a depth of 40-45 cm to break the hard-pan and sub-soil layer to improve water and root penetration. Avoid compaction due to tillage machinery to retain porosity and soil structure for internal drainage which is a limiting factor in heavy clay soil
- Precision planting, north-south oriented row direction & nursery raised plants : Under many conditions, early sowing helps the crop to establish vigorously and escape several insect pests. Seeds must be planted at uniform spacing of 10-12 cm between plants with precision in drilled or hill drop pattern at a depth of 4-6 cm with precision planters. Row spacing may be kept at 45 cm or 60 cm or 75 cm or 90 cm depending on type of variety, soil, water source and weather. This will optimize emergence, save seed and ensure uniform germination. Planting on ridges or raised beds using BBF (broad-bed furrow) planters improves drainage, warms soil and provides less favourable conditions for seedling pathogens

  North-south oriented row direction would ensure effective penetration of solar radiation to plants in a row especially during squaring, flowering and boll formation. Seedlings can be raised in nurseries a month before the onset of monsoon using soil blocks (8 cm x 4 cm) containing 10% organic manure. Wherever nursery-raised plants are used, crow-bar method may be used for planting. Machines for nursery planting have been developed in China. These ensure precision planting at proper spacing of 10 cm between plants within a row. Cotton seedlings transplanted immediately after the onset of monsoon develop into vigorous and robust plants to give high yields. Use systemic pesticides for seed treatment to protect the seed and seedlings from insects, nematodes and pathogens. Scouting for early season pests / symptoms of pest damage improves pest management decision making
- Plastic mulching, drip irrigation under plastic mulch & water management : The use of plastic mulches is negligible in India. In China, plastic mulches are used extensively to cover almost all cotton fields across the country in 30 to 40 lakh hectares especially in the arid and semi-arid regions of northern China and coastal saline-alkali areas. Machines are used in China to cover inter-row space with plastic film 30 days before sowing (early mulching) to improve plant stand establishment, biomass, lint yield and earliness. Drip irrigation in mechanized plastic mulching and training plant architecture in high density planting played a major role in enhancing yields in majority of the areas in China and in some parts of India
- Water management : Cotton is extremely sensitive to excess moisture and water stagnation could reduce yields in heavy textured soils. Drainage of excessive water is crucial for a good crop. Ridges and furrows enable effective drainage and moisture conservation especially in rain-dependent regions. Wherever irrigation is available, drip irrigation or furrow irrigation may be followed. Ideally adequate amount of water and nutrients should be made available in a precise manner based on the crop requirements during flowering and fruiting period to obtain high yields. Avoid water stress from squaring, flowering and early boll window. Adequate soil moisture during this critical phase helps plants establish the desired structure and helps in the retention of fruiting forms. Do not provide heavy irrigation after the first open boll. Moist soil at first open boll is sufficient to provide adequate moisture required to mature the crop. Excess moisture delays harvest and complicates pest management
- Stale weed-seed bed system: Weed management in the early stages of seedling growth is very crucial for high yields. Application of pre plant, contact herbicides, three weeks prior to planting enables the preparation of a stale-seed-bed while ensuring that no green vegetation is left on the field. Application of post-emergence herbicides on weed-seedlings and or application of pre-emergence herbicides such as pendimethalin 1.0 kg a.i./ha just before sowing helps cotton seedlings to retain their initial vigour in the absence of weed competition. Fields must be kept free of weeds through subsequent inter-culture and weeding at least for the first 2-3 months of the crop to prevent weed competition
- Conservation tillage, cover crops, crop residue recycling or mulching : Wherever possible, zero-tillage and strip tillage should be practices to facilitate timely planting rather than waiting for optimum soil conditions for conventional tillage. In zero-till or strip till systems, winter cover crops protect the emerging cotton seedlings. Plant legume crops such as soy bean, cowpea, groundnut, sesbania and sunhemp or melon and pumpkin are sown in alternate rows of cotton as cover crops. The inter-crops, more especially the green manure cover crops sesbania or sunhemp may be sown 15-20 days after

sowing cotton crop to avoid competition. These crops may be mowed and tilled into the soil after they attain 30-40 days age to act as effective green manure and mulch. Sesbania and sunhemp are also called "green manure" and "live mulches." because they fix atmospheric nitrogen, provide other nutrients to the soil apart from preventing soil erosion and evaporation of soil moisture. In addition, intercropping with legume crops such as red-gram, black-gram, green-gram, cow-pea etc., encourages establishment of predators and parasitoids of insect pests

- Post harvest shredding and incorporation of crop residues and cotton stalks into soils plays an important role in pest management and nutrient management. Shredding of stalks prevents over wintering of pink bollworm. It also ensures a mandatory 90 days host free period for pink bollworm. Cotton stalks from one hectare when incorporated back into the soil, provide 20-25 kg nitrogen and 70-80 kg phosphorus per hectare. Currently, crop residues are burnt in India resulting in loss of biomass and environmental pollution
- Square and boll retention with plant growth regulating chemicals : Regular crop health monitoring should be done especially for canopy-shading and nutrient deficiencies that cause square-shedding, boll shedding etc. to ensure timely interventions of natural light, water, fertilizer and application of plant growth regulators such as 'alpha-napthyl acetic acid' as and when necessary. The crop should be examined periodically for moisture stress, water-logging, diseases and insect pests to initiate timely interventions. At squaring stage, data on plant height, number of nodes, node of first fruiting branch and fruit retention at first position helps to detect fertilizer or moisture stress/excess. At flowering stage, data on plant height, number of nodes, number of nodes above upper most position white flower (NAWF), retention of first position square (below white flower) helps to detect deficiencies or excess in fertilizer application or stress due to deficit or excess moisture. The need for application of plant growth regulators can be decided based on excessive vegetative growth if any
- Canopy management: Plant training practices such as removal of vegetative branches, old leaves, empty branches, early fruiting branches, apical points of vegetative and fruiting branches and removal of growth-tip (topping), are done for canopy management mainly to facilitate nutrients to be redirected to fruiting parts. Plant growth regulators (PGRs) are used for canopy management to prevent excessive vegetative growth and allow adequate transfer of nutrients to bolls. Low rate multiple applications of PGRs are less risky. Under Indian conditions it may be appropriate to resort to topping at 90-100 days and use a PGR such as mepiquat chloride to prevent a bushy lateral growth of fruiting branches. It helps to maintain an open canopy, limits vegetative carbon sink and stimulates the development of bolls on lower branches, instead of inefficient boll set on the upper branches which gets most affected due to moisture stress in the late stages of the crop. However the effects of PGR application are dependent on soil moisture levels, nutrition and crop management
- Restricting plant height: Aeration and ventilation in the high density crop is ensured by controlling the plant height to 65-70 cm by using PGRs, water and nutrients
- Topping: Removal of growth tips on the main stem (topping) is carried out when the number of fruit branches is 10 to 20 per plant depending on the density of plants per hectare. Plant topping is conducted in 100% of cotton fields in China for regulating plant growth and increasing yield
- Removal of vegetative branches: Vegetative branches are removed manually after appearance of the first fruiting branch in 50-70% of the farms in China. This practice was found to increase seed cotton yield significantly
- Removal of unproductive plant parts: Empty fruiting branches, old and yellow diseased leaves are removed after full flowering for remarkable improvement in ventilation, light penetration, reduction in soil humidity and boll rotting.
- Removal of apical points: Apical points of vegetative branches are removed after peak flowering and those of fruiting branches are removed at peak boll-setting.
- Removal of early fruiting branches: Early fruiting branches, generally the lower most 2-3 fruiting branches of the main stem are removed at peak squaring stage.
- Precision chemical input management: Nutrient management based on soil fertility status: Cotton crop needs 85% of nitrogen during the critical stage of flowering and early boll formation. Soil nutrient status is determined by plant analysis and soil testing to diagnose nutrient deficiency and provide corrective measures. Synchronizing nutrient availability with plant nutrient demand at critical stages, saves fertilizers, improves nutrient use efficiency and results in high yields. Application of fertilizers in three splits at planting, squaring or flowering stage and after topping helps in providing nutrients when the plant needs them most. Band placement of fertilizers, especially neem-coated urea ensures

controlled release with minimum nutrient loss. Drip-fertigation can be used for precision nutrient delivery. Application of Farm Yard Manure @ 5 to 10 t/ha or compost after the first rain. Seed treatment with Azotobacter and PSB (phosphate solubilizing bateria) @ 25 g each / kg seed helps in nutrient uptake. Nitrogen should be applied in splits, with full dose of phosphorus and potash at planting or early vegetative phase. Nitrogenous fertilizers should be applied judiciously to the minimum to prevent the proliferation of sap-sucking pests. Excessive application of nitrogen makes the crop susceptible to insects and diseases, induces rank vegetative growth, results in boll shedding, delays fruiting and crop maturity and reduces lint yield and profit. Limited usage of nitrogenous fertilizers plus full application of P+K before flowering helps in reduction of sucking-pest infestation. Solubilization of soil bound phosphorus can be improved by making conditions favorable for mycorrhizal association with cotton roots. Use foliar potassium application only to supplement soil application and not as a substitute. Peak demand for potassium is during boll filling stage. Low potash in soils and less active root system limits soil K uptake and hence foliar supplementation of K is beneficial. Secondary nutrients such as Ca and Mg needs as best assessed through soil tests. Normally amendments are used to regulate soil pH that takes care of Ca and Mg requirement. Micronutrient bio-availability is also governed by soil pH. Therefore correction of soil pH is important. Sandy soils with low organic matter are more prone to micronutrient deficiencies. Appropriate application of micronutrients during the flowering and fruiting phase facilitates good crop health management. It is important to determine soil pH and amount of residual nutrients to make amendments for less mobile nutrients such as P, K, Ca and Mg. Cotton grows best at soil pH of 5.8 to 8.0. Use amendments like gypsum and lime to correct soil pH. Boron is a key element for cotton and a separate soil test for Boron is helpful to decide on an efficient micronutrient supplementation program.

- Pest and disease management : The best pest management is through host plant resistance that can be supplemented by naturally occurring biological control. Varieties that are resistant to sap sucking pests provide robust foundation for integrated pest management. Coupled with appropriate seed treatment these varieties can tolerate sap-sucking pests and diseases so that there would not be any need for pesticide applications early in the season at least for 2-3 months after sowing. In the absence of early season application of eco-disruptive pesticides, naturally occurring biological control gets strengthened and plays a significant role in sustainable pest control. Early planting of short season varieties enables the crop to escape several species of insect pests. Avoidance of excessive nitrogen is crucial for crop health. Other technologies such as IPM compatible inter-crops, trap crops, botanical pesticides, augmented biological control, pheromones (monitoring and trapping) and cultural control practices can assist in effective control of insect pests and pathogens in an eco-friendly and sustainable manner without the need for chemical pesticides. Chemical pesticides must be considered only as a last resort. Pesticide and insecticide mixtures must be strictly avoided. Chemical pesticides belonging to WHO Class I (extremely or highly hazardous) must be strictly avoided. As far as possible prefer WHO Class III or safer insecticides. Choice of insecticides must be based on principles of IRM (insect resistance management) to minimize resistance risk and IOBC (International organization for biological control) rating for selectivity to beneficial and bio-control insects.

Table 6.3 : Crop rotation

Season	1st Year	2nd Year	3rd Year
Summer	Sugarcane	Sugarcane Ratoon	Cotton-Wheat / Gram
Kharif	Cotton-Wheat	Groundnut / Sesamum – Sorghum / Safflower	-

6.4.2. Forage crops

- Cultivation of perennial forage legume (e.g. lucerne var. Rl-88, Anand-3) and cereal (e.g. hybrid napier var. Phule Gunwant, Phule Jaywant)/ Marvel (Phule Govardhan) in equal proportion will be beneficial under irrigated condition to dairy farmers for reducing cost of cultivation and supply of balance nutritious green fodder
- Green fodder of maize/sorghum/bajara produced during Kharif season converted in to silage will be use during summer season
- Use high yielding varieties of forage and grasses
- Seeds or sets should be treated with appropriate bio-fertilizers
- Use micro sprinklers/drip irrigation system for efficient use of water

- Use eco friendly bio-control measures to control insect pests
- Use handheld grass cutter for harvesting forage/grasses
- Use of chaf cutter
- Dairy farmers can produced green fodder of maize by hydroponic techniques during severe drought condition
- To reduce the cost of concentrate feed dairy farmers could produce and use Azolla as protein supplement fodder
- Some farmers can take up nursery activity for production and sell of planting material of perennial grasses such as Hybrid napier, Irrigated Marvel, rainfed grasses such as Madras anjan and Marvel grass for additional income
- Some farmers can take up seed production activity in forage crops viz., maize var. African Tall, Lucerne var. RL-88, berseem var. Wardan for additional income

Source : PDKV, Akola

6.4.3. Horticulture crops

Onion

In past 20 years, production of onion in India has increased more than four times and that of garlic more than two times. ICAR-DOGR has played an important role in this increase. ICAR-DOGR has developed onion and garlic production technology, which farmers can use to enhance productivity and get higher returns. The doubling of farmers income will be possible with collective efforts of various agencies through demonstrations, trainings, literature and input distribution.

- Superior varieties : ICAR-DOGR red onion varieties viz., Bhima Dark Red (Kharif), Bhima Raj (Kharif and Late kahrif), Bhima Super (Kharif and Late kharif), Bhima Shakti (Late kahrif and Rabi), Bhima Kiran (Rabi) and Bhima Red (Kharif, Late kharif and Rabi) are suitable for the districts viz., Nashik, Dhule, Jalgaon, Nandurbar, Pune, Ahmednagar, Solapur, Satara, Sangli, Aurangabad, Jalna, Beed, Latur, Osmanabad, Nanded, Parbhani and Hingoli. ICAR-DOGR white onion varieties viz., Bhima Safed (Kharif), Bhima Shubhra (Kharif and Late kahrif), Bhima Shweta (Kharif and Rabi) are suitable for the districts viz., Amravati, Buldhana, Washim, Akola and Wardha. Onion seed of these varieties is available with ICAR-DOGR, Rajgurunagar, Pune
- Reduction in Inputs : Reduction in inputs is possible if farmers use following technologies.
- Drip irrigation and Fertigation : The research outcome indicated that the drip irrigation at 100% Pan Evaporation (PE) significantly improves the marketable bulb yield (15-25%) with higher percent 'A' grade bulbs, water saving of about 35-40% and labour saving of 25-30% as compared to flood irrigation. Fertigation is an effective and efficient method of applying fertilizers through drip irrigation which is used as the carrier and distributor of irrigation water and crop nutrients. Application of 40 kg nitrogen as basal dose at the time of transplanting to 60 DAT through drip irrigation is recommended for achieving higher marketable bulb yield and profit. Fertigation reduces nitrogen losses by leaching into ground water as fertilizer nutrients are applied in root zone only.
- Soil test based input recommendations: The results of the experiment carried out at ICAR-DOGR showed that onion crop removes about 90-95 kg of N, 30-35 kg of P_2O_5 and 50-55 kg of K_2O to produce 40 t onion bulbs/ha. It is necessary to apply plant nutrients in a balanced manner externally for sustainable onion production and soil health. Therefore, soil test should be done before applying fertilizers. The recommended dose of fertilizers for kharif is 75:40:40 kg NPK. It is 110:40:40 kg for late kharif and rabi. In addition to NPK, sulphur is also an essential plant nutrient important for onion crop for improving yield and pungency of onion bulbs. Application of 30 kg S/ha is sufficient for growing onion crop in soils having sulphur level above 15 kg/ha while 45 kg S/ha is needed for soils having sulphur level below 15 kg/ha for optimum production of onion. If the soil test shows a deficiency of any micronutrients, besides NPKS, the deficient micronutrient should also be applied to correct the deficiency.
- IPM technology : Among the diseases, anthracnose, purple blotch and Sclerotial rot frequently occur in kharif season. Stemphylium blight mostly occurs in rabi season. Among the pests, thrips are the major pest affecting growth and yield of onion. Cost effective management is possible with integration of various IPM components like seed treatment with thiram + carbendazim (2:1) @ 3g/kg or Trichoderma @ 4-6 g/kg seed; multiply 2 kg of Trichoderma in 1 q of FYM and apply in 1 ha; dip seedlings in 0.025%

carbosulphan + 0.1% carbendazim solution for 2 hours before transplanting; foliar spray of mancozeb (0.25%) + methomyl (0.8 g/L) at 30 days after transplanting and hexaconazole (0.1%) + profenophos (1 ml/L) at 60 days after transplanting; and plant two rows of maize crop on border of onion field. The spreader @ 0.5-1.0% should be always added to spray solution.

Pomegranate

The pomegranate farming is resource intensive enterprise. The inputs required for pomegranate farming involves planting material, organic and inorganic fertilizers, pesticides, labours, drip irrigation setup etc. The technical knowhow for diagnosis of pest and diseases, the spray schedule etc. also require specific skill sets. The pomegranate post harvest management which includes cleaning, grading, washing, waxing, packaging, storage and marketing is also very much important and requires heavy capital investment in terms of establishment of pack house and cold chain etc. In this context the formulation of farmers producer company for group farming and value chain management is required in terms of the reduction of input cost required for various inputs essential in pomegranate production. The farmer producer company may get price incentive as the inputs will be taken in bulk reducing total cost of production for farmers. The farmer group can also carry out the common spray schedule recommended by NRCP also follow uniform bahar treatment etc. This will increase the quality of produce. The export oriented production can also be possible in such kind of group farming. The pack houses for primary processing and processing units are also feasible when group farming or FPO is involved as the bulk produce will be available for packaging or value addition. The availability of sufficient raw material for processing and value addition will make this enterprise financially viable.

- Pomegranate cultivars Bhagwa, Ganesh, Ruby, G-137, Arakta, Mridula, having yield above 20kg/tree are commercially grown in Maharashtra, however Cv. Bhagwa occupies major area. Recently ICAR-NRCP along with ICAR-IIHR released new biofortified variety Solapur Lal having 30% higher yield than Bhagwa. Presently Bhagwa has the highest demand in both national and international market. Presently for processing only table purpose varieties are being used in addition varieties like 'Amlidana' and 'Solapur Anardana' having yields 20-24/ha) can be grown specifically for processing. Mechanization procedures in pomegranate are required for pomegranate plantation (Pit digging/trench formation using JCB machine, post hole diggers attached with tractors}, timely fertilizer and pesticide application (using tractor mounted sprayers), periodical weeding (using brush cutters/tractors) . These services may be made available to the farmers in a locality on genuine hiring costs. Other actions to be included for the benefit of pomegranate farmer include
- Collection of information from different villages in most suitable pomegranate areas to get information on farmers in debt or having hand to mouth existence. The information may be collected from State Horticulture department, Commissionerate of Agriculture, Pune, KVK and ATMA organizations in this region.
- Imparting training to interested/selected farmers in selected regions
- Demonstration of model pomegranate cultivation /developing disease free pomegranate nursery/ processing of products where already pomegranate cultivation is there in selected clusters in collaboration with KVKs/ATMA/SAUs.
- Landless labour can be trained for various poultry/dairy/farm and horticultural operations for specific clusters, which will become source of earning for them in local areas through sale of manure and milk/ eggs.
- Village woman can be trained on small scale production of various processed products from unmarketable produce
- Integrated Disease and Insect Pest Management Schedule (IDIPM) for Pomegranate.
- Tissue culture protocol with bio-hardening
- Sub surface drip irrigation system for pomegranate
- Protected Cultivation
- Mechanization of horticultural operations
- Breeding for improved varieties having better nutrient use efficiency
- Breeding for export oriented varieties
- Mulching of pomegranate orchards

- Integrated nutrient management including use of biofertilizers
- Development of pomegranate juice and RTS beverage
- Minimal processing of pomegranate arils
- Process of extraction of virgin pomegranate seed oil
- Improvement in Total Factor Productivity

Grapes

Maharasthra is ahead of many other states in making grape industry more remunerative for farmers. However, to further strengthen the export opportunities it is necessary to facilitate cultivation of grape cultivators in great demand in western markets. In addition, area under grape cultivation can be extended to potential areas where the income for farmers from other crops is marginal.

Mango

- Success stories of mango growers from Konkan region e.g. Shri. Sandip Ramkrishna Barve, from Gavhe, Tal- Dapoli, Dist - Ratnagiri, Shri. Umesh Lanjekar, Tal- Ratnagiri, Dist- Ratnagiri, Dr. Vivek Bhide, At/ Po - Malgund, Tal-Ratnagiri, Dist - Ratnagiri, Shri. Bhushan Nabar, Tal - Vengurle, Dist - Sindhudurg, Shri. Shekhar Tendulkar, Roha, Tal- Roha, Dist - Raigad, Dr. Sandesh Patil, Tal-Alibaug, Dist- Raigad. This success stories will be the good example for enhancing the income of Mango growers in Konkan region.
- Integrated farming system modules recommendation have given by the university in Mango e.g. Banana, Papaya as an intercrop will give additional income to the mango growers.
- Income from other non farm activities that is Agro-tourism module in mango block has been establish at Regional Fruit Research Station, Vengurle by the university
- Developed new hybrids like Ratna, Sindhu, Konkan Ruchi, Suvarna, Konkan Raja, Konkan Samrat as regular bearing and high yielding varieties in Mango. Planning of infrastructures like Mango ripening chamber, Mango processing units, Cool chambers in South Konkan and North Konkan.
- Training to the farmers involving progressive Mango growers through SAU & KVK's
- Women empowerment by forming SHG's

Cashew

- Success stories of Cashew growers from Konkan region e.g. Shri. Balkrishna Ganesh Gadgil, At & Post Vetore. Tal. Vengurla, Dist. Sindhudurg, Shri. Suresh Ankush Nerulkar, At/Po- Poip, Tal-Malvan, Dist- Sindhudurg. This success stories will be the good example for enhancing the income of Mango growers in Konkan region
- Intercropping modules recommendation has given by the university in Cashew e.g. tuber crops as an intercrop will give additional income to the Cashew growers
- Developed new hybrids like V-4, V-7, V-8, V-9 high yielding varieties in Cashew. Planning of infrastructures like Cashew processing units in South Konkan
- Training to the farmers involving progressive Cashew growers through SAU & KVK's
- Women empowerment by forming SHG's

Coconut

- Success stories of Coconut growers from Konkan region e.g. Shri. Anil Joshi, At & Post Narvan, Tal. Guhagar, Dist. Ratnagiri, Dr. Vinita Salvi, At/Post- Malgund, Tal-Ratnagiri, Dist- Ratnagiri
- Intercropping modules like lakhi baugh recommendation have given by the university
- Developed new varieties like Pratap, TXD, DXT high yielding varieties in Coconut. Planning of infrastructures like Cashew processing units in South Konkan
- Training to the farmers involving progressive Coconut growers through SAU & KVK's
- Women empowerment by forming SHG's

Other fruit crops

Other fruit crops such as custard apple, fig, ber and dragon fruit can be promoted and with value added products these crops may contribute to much needed diversification and also can improve remunerations for farmers

Flower crops

Action plan for enhancing production, cost reduction, quality improvement, generating additional income from flowers

Table 6.4 : Suitable technologies for different agro-ecologies of Maharashtra with alternate options

Region	Loose flowers	Cut flowers	Nursery Plants	Cut Foliage and Fillers
Konkan	Jasmine, Marigold, chrysanthemum	Lilium, Orchids, Anthurium	Monstera, Pilea, Dieffenbachia, Acalypha, philodendron, croton, Anthurium foliage, spathyphyllum, orchids, etc.	Zamioculcas, Ferns, gypsophila asparagus, golden rod, different foliage palms
Western Maharashtra	Rose, marigold, tuberose, aster, jasmine, gaillardia chrysanthemum, annual chrysanthemum	Rose, gerbera, gladiolus, carnation, chrysanthemum, lilium, orchids, anthurium	Seasonal flowers seedlings, English Ivy, golden pothos, Boston fern, dracaena, bamboo palm, spathyphyllum, agave, sansevieria, chlorophytum, Schefflera, etc.	Palm leaves Candyturf gypsophila asparagus, golden rod
Khandesh (North Maharashtra)	Marigold, chrysanthemum, rose, aster	Rose, chrysanthemum, gerbera tropical orchids	Ficus species, Schefflera, syngonium dracaena chlorophytum, aglaonema etc.	Palm leaves Candyturf gypsophila asparagus, golden rod
Vidarbha	Marigold, Gaillardia,	Gladiolus, rose	Maranta, aglaonema, sedum, cactus, sansevieria, furcaria dracaena, croton, philodendron, syngonium etc.	Palm leaves asparagus, golden rod etc.
Marathwada	Marigold, rose, tuberose	Rose gladiolus, tuberose	Maranta, aglaonema, sedum, cactus, sansevieria, furcaria dracaena, croton, philodendron, syngonium etc.	Palm leaves asparagus, golden rod etc.

Source : DFR

Potential of flower crops in income generation

Cultivation of flower crops has huge potential of income generation which is several times higher than other crops (cereals, pulses, oil seeds or any other horticultural crop). The details of income (based on various published reports and research articles) from flower crops (as sole crops) are furnished in Table. 6.5.

Table 6.5 : Potential of Sole Cropping

Name of Flower	Condition	Area (ha)	Gross Income (Rs) in Lakh
Rose	Open Field	1.00	3.80-4.00
Rose	Protected	1.00	30.00-40.00

Name of Flower	Condition	Area (ha)	Gross Income (Rs) in Lakh
Jasmine	Open Field	1.00	2.50-3.50
Chrysanthemum	Open field	1.00	2.00-4.00
Aster	Open field	1.00	1.50-2.50
Marigold	Open field	1.00	2.00-4.00
Tuberose	Open field	1.00	3.00-5.00
Gerbera	Protected	1.00	20.00-30.00
Gladiolus	Open field	1.00	3.00-4.00

Source : DFR

Improved varieties developed in different flower crops, the adoption of which can substantially increase the productivity are as follows (Table.6.6).

Table 6.6 : List of improved varieties of flower crops suitable for growing in Maharashtra.

Crop	Varieties
Tuberose	Arka Nirantara, Phule Rajani, Prajwal, Vaibhav, Suhasini
Aster	Phule Ganesh White, Phule Ganesh Violet, Phule Ganesh Pink, Phule Ganesh Purple
Gladiolus	Phule Ganesh, Phule Prerna, Phule Tejas, Phule Neelrekha
Rose	Gladiator (open) First Red, Grand Gala, Avalanche, Noblesse Gold Strike, Poison, etc. (protected cultivation)
Marigold	Arka Bangara, Arka Agni, Pusa Narangi Gainda, Pusa Basanti Gainda

Source : DFR

6.5. Livestock

- For hot and dry climatic region having less and uncertain rainfall, goat farming, backyard poultry farming should be promoted with technical and financial inputs.
- Combination of livestock, fish and agriculture enterprise needs to be adopted in the places where water is available.
- Farmers should conserve the elite indigenous breeds. Such breeds must be Genetically characterized and marketed as a breedable stock
- It can be achieved through improving productivity in a huge population of low producing animals-cross breeding, upgrading and selective breeding are the most effective way for improving productivity.
- Distribution of improved bulls can be practiced in remote areas where AI facility is not available. Systematic conservation and genetic improvement and sustainable utilization of indigenous livestock breeds.
- Fodder and feed development program along with fodder bank should be designed in every district especially rain shadow areas of the region.
- Wider and effective immunization and compulsory deworming program.
- Production costs in animal husbandry can be minimized through efficient feeding management. Application of Good Animal Husbandry Practices would be crucial.
- Manipulation of feed ingredients
- Use of synthetic amino acids
- Enzyme supplement
- Disease control
- Supply of area specific mineral mixture at subsidized rates.

6.6. Fisheries

Opportunities for technology intervention and change in components of IFS if exist and if not - viable IFS for the specified area:

- Increase in fresh water fish production by adapting prawn species like Litopenaeus vannamei commonly known as white legged shrimp
- Crab fattening in the coastal areas
- Fish processing units and small scale industrial development through trainings Development of value chain along with the market linkage
- Creating awareness in food-safety and certification necessary for fish export and other local markets
- Marketing information system through mobile phones and web access
- The supply chain for fish and fishery products can involve a large number of stakeholders between the fisherman/fish farmer and the final consumer – easing of the direct open market for the fish farmers – linking between the large fish processing units and the farmers etc.
- Establishment of hatchery and brood bank for catla (Catla catla) and rohu (Labeo rohita)
- Raising the fry and fingerlings in nurseries and rearing ponds; and thereafter releasing them in the rivers, besides practicing pen culture at suitable sites
- Capacity building through creating awareness for tribal fishers
- Training on fish product development and guidance for developing cottage industry
- Establishment of Litopeneaus vannami cultivation in salt affected areas/Crab fattening units in coastal villages
- Coastal areas near mangrove forests provide conducive environment for crab fattening ponds – that will fetch good revenue for the farmers nearby metro and mega cities
- Product development processing units will cut short the post-harvest losses and thus benefit the farmers
- Enhancing the market linkages

6.7. Integrated farming system

In addition to routine IFS described in other sections, it is necessary to explore other options as described below.

- **Floriculture intervention :** Farmers who are currently relying on cereal or vegetable crop can shift partially to high value crops like pomegranate, banana and grapes intercropped with marigold, sweet corn, drum stick, depending on land availability. This will ensure him round the year income and also production of cereals and vegetables for his family, excess of which can be sold.
- **Pomegranate – Dairy farming system :** Small farmers with 1-2 acres of pomegranate orchard can keep dairy animals (3-4 cows). The grasses along bund can be used for grazing by animals. The FYM from dairy unit will help to manure the pomegranate orchard. Sale of milk will give additional income as well as nutrition to farmer family.
- **Pomegranate – poultry farming system :** Small farmers with 1-2 acres of pomegranate orchard can keep 50-100 poultry birds. The rind of pomegranate as rind powder may be used as ingredient /component of poultry feed. The poultry manure could be used for manuring the orchard. Sale of eggs will be additional income to the farmer in addition to providing high protein nutrition to the farmer family.
- **Pomegranate-Marigold/drumstick/Sweet corn intercrop :** Pomegranate can be intercropped with marigold/drumstick/sweet corn between the space between two pomegranate trees. These crops specifically Marigold varieties of African marigold (Tagetes erecta) group varieties Pusa Basanti Gainda and Pusa Narangi Gainda provide nematode control in Pomegranate. The flowers are in great demand in market for decorations and festive seasons with rates ranging from Rs 50-100/Kg in retail market during different seasons. Drumstick and sweet corn have been found to have no adverse effect in pomegranate intercrop and their produce is in high demand due to their high nutritional benefits.
- Since the income enhancement with sole crop alone cannot help in doubling the farmers income it is necessary to integrate different enterprises. The benefit for farmers can enhance with this approach as shown in the hypothetical modules shown below.

Figure 6.2 : Intergrated farming system

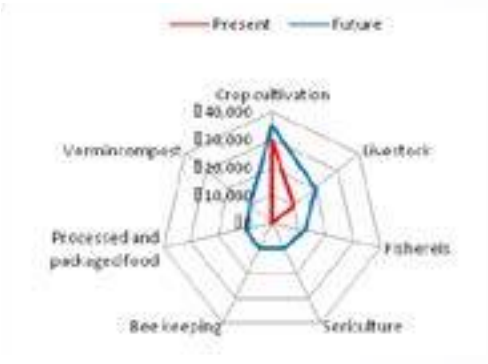
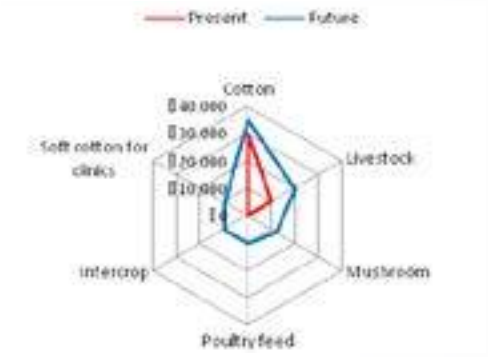
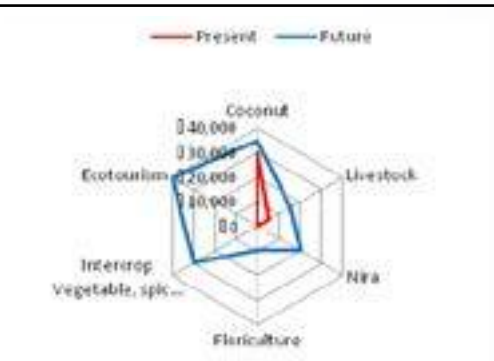
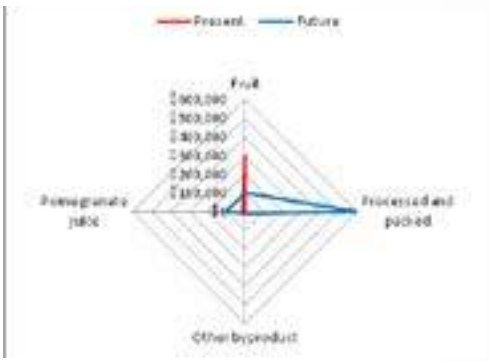
Present status	Hypothetical modules for enhancing income
For present field crop based agriculture and where the possibility of other allied activities such as bee keeping and sericulture possible	
Cotton based agriculture where cotton is grown.	
Coconut plantation	
Pomegranate	

Figure 6.3 : Schematic modules for enhancing income

Source : CCRI

6.8. Organic Farming

In Indian farming system, now-a-days mostly inorganic chemicals are being applied as the major inputs to enhance the production and to manage the diseases and pests of crops. Rethinking is necessary in this regards considering health issues, environmental pollution and biodiversity point of view. As for as entomological

pest management is concerned, in nature many predators, parasitoids and pathogens play an important role to regulate the insect pests population. Much more research have been come out in this aspect; biological control is to be applied as a major component of IPM. For instance mass multiplication and release of predators and parasitiods in the field /horticultural crops ultimately reduces the use of pesticides. Bio-pesticides; an eco-friendly pesticides, should be promoted. Its licensing system for mass production and selling by the SAU's should be liberal and cheaper so as to produce and sale it directly to the farmers on cheaper price so that farmers will get more net profit and ultimately helps to doubling the income.

- Area under Organic cultivation — 6.50 Lakh Ha.
- Area Registered for Certification — 1.14 Lakh Ha.
- Certified — 0.42 lakh Ha.
- Under conversion — 0.72 lakh Ha.
- Total Vermicompost units — 1.26 lakh
- Total Biodynamic compost depot — 2.02 lakh
- Identified Service Provider — 91 N.G.O.
- Developed Model Organic Farm — 37 farms
- Major Crops — Cotton, Cereals, Fruits & Vegetables etc.

Source : PDKV

6.8.1. Value addition for additional income

- **Pomegranate :** In general 70% of pomegranate production is suitable for domestic or international market. The remaining 30 % produce generally fetc.hes very low price in market and can be utilized for processing into high value products which can generate many fold additional income as well as employment. In addition in periods when the crop is damaged due to hail storms, bacterial blight, fruit suckng moth or abiotic cracking the fruits cannot be sold as have no shelf life, such produce can be used for processing as arils are in good condition. One small processing unit for a cluster of 20 ha pomegranate area can be set up. The products to be processed will be pomegranate ready to serve beverage, pomegranate seed oil, and pomegranate peel powder. This will ensure total utilization of pomegranate for value addition. The potential pomegranate catchment areas suitable for setting up pomegranate processing units in Maharashtra are Solapur, Nashik, Sangli, Ahemadnagar and some selected talukas near Pune. The project cost economics suggest that project will be technically and financially viable with internal rate of return over 50 %. The benefit cost ratio for the project will be 1.94. The payback period for the project will be 1.78 years.
- Biomass obtained from the harvesting of crops such as pomegranate can be utilized for making enriched compost. Though 100% organic production is difficult due to availability of organic products and time consuming methods for preparing home made spray and soil application materials.
- **Cotton by products :** Value addition to cotton stalk biomass for additional remuneration by briquetting, pelleting, particle boards, mushroom cultivation, compost making; Diversified use of cotton for technical textiles like absorbent cotton for medical uses; Scientific processing of cotton seed for oil extraction and by-products utilization

6.9. Diversification

Diversification towards high value crops (HVCs) offers a great scope to improve farmers income. The staple crops (cereals, pulses, oilseeds) occupy 77 percent of the total or gross cropped area (GCA) but contribute only 41 percent of total output of the crop sector. Interestingly, almost same value of output was contributed by HVCs (fruits, vegetables, fibre, condiments & spices and sugarcane), which just occupy 19 percent of gross cropped are a during 2013-14. Average productivity of HVCs after adjusting for cropping intensity variations was estimated as Rs. 1,41,777 per hect are as compared to Rs. 41,169 per hectare for the staple crops. With this differential in productivity, shifting one hectare area from staple crops to commercial HVC has the potential to increase gross returns up to Rs. 1,01,608 per hectare. Between 2004-05 and 2013-14, area under HVCs in the country increased by 9.16 million hectare (Mha) at an annual growth rate of 3.31 percent. Due to the large difference in area under HVC and staples, a1 percent increase in area under the former is equal to 0.25 percent decrease in area under staples. Thus, a1 percent increase in area under HVC results in 0.319 percent increase

in output of crop sector, after netting out the decline in output due to area shift from staples to HVC. Based on these calculations it is estimated that if past trend in diversification continues in future, it has the potential to raise output of crop sector by close to 1 percent each year. This can translate into 5 percent increase in farmers income by 2022-23. Scope also exists to raise farmers income by diversifying towards other allied enterprises like forestry rather than depending primarily on crop cultivation. India meets 40 percent of its non-fuel timber requirement from the import of wood and wood products. India imports wood and wood products worth more than Rs. 33 thousand crore, whereas, thousands of hectare of private land remain barren. Various legal restrictions on felling of trees and setting up of timber industry and transit permit for marketing of timber are the major deterrents to raise trees on private lands.

Table 6.7 : Per ha value of out put of major crops/groups in year 2013-14

S. No.	Crop	Value (Rs. crore)	Area (Mha)	Productivity (Rs/ha)	Adjusted Productivity* (Rs/ha)	Share (96}	
						In total Output	In total area
1	Pulses	62135	23.23	26748	26748	4.14	11.95
2	Oilseeds	116181	98.28	44707	44707	7.74	14.68
3	Cereals	439383	28.53	40722	40722	29.26	50.56
A	Staple crops	617699	150.04	41169	41169	41.14	77.18
4	Fibre crops	95993	12.54	76549	76549	6.39	6.45
5	Sugarcane	76295	5.01	152285	109558	5.08	2.58
6	Condiments & Spices	54163	3.24	167376	120415	3.61	1.66
7	Fruits	155547	7.19	216458	155725	10.36	3.70
8	Vegetables	234219	9.57	244820	244820	15.60	4.92
B	High value crops	616217	37.54	164154	142777	41.04	19.31
C	All crops	1501464	194.4	77236	61503	100	100

6.10. Off-farm employment/income opportunities/allied activity income

In Maharashtra, cotton farmers can also get benefit of diversification into other crops with backup support. Introduction of dairy farming, goat farming, backyard poultry, and fishery wherever possible can enhance income of farmers. Establishment of fruits and vegetable processing unit in rural area may be useful to avoid distress sale of vegetable, fruits in major market where the farmers dispose their farm produce at very low price.

Employment can be generated by commercial onion nursery. Within a short span of 45-50 days after sowing and limited area farmers can get income up to Rs 1 lakh/acre. Further, seed production by Self Help Groups and proper grading and packaging can enhance market value by 20-30%.

In floriculture, there is scope for intensification of cultivation of crossandra, spider lily, gaillardia, nerium, hibiscus, Jasminium humile (yellow jasmine at higher altitudes) in non-traditional areas. Further, it is possible to intensify of cultivation of bird of paradise, heliconia, ornamental ginger, ornamental pineapple, ornamental banana, lisianthus, limonium, rose hip stems, alstroemeria, annual flowers like calendula, stock, rice flower, corn flower etc., can diversify the basket of cut flowers. With increased demand for greenery in most of cities of Maharashtra the nursery industry with quality plants is going to be a good source of income generation. Already nursery industry has emerged in sub-urban areas of Pune and Mumbai which fetches good returns. Another avenue in floriculture is intensification of cultivation of indoor ornamental plants like English Ivy, golden pothos, Boston Fern, dracaena, bamboo palm, spathyphyllum, agave, sansevieria, chlorophytum, as a green walls/vertical gardens is smart cities like Pune, Solapur, Aurangabad etc. that are proven to mitigate the indoor pollution, has greater potential. Demand for flowers is increasing every day due to present day

customs of 'saying it with flowers'. Flower arrangements and bouquets are value added options to generate more income and for that the cut foliage and fillers are required. Intensification of cultivation of foliage ornamental including dracaena, anthurium, spathyphyllum, areca palm, monster, sansiveria, golden bamboo, callistemon, alpinia etc. has greater potential.

Floriculture industry has scope to provide employment opportunity in activities like on farm cleaning, grading and packaging of flowers, development of cold chain and flower collection centres, development of cold storages (Zero energy cool chambers, solar cooling chambers) in the area of cultivation to buy more time for marketing.

Animal husbandry, back yard poultry, goatery can help to give supplementary income. In rural areas skills based training for activities related to agriculture like maintenance of agro machinery, maintenance of micro irrigation sets etc. can help to add some additional income. The price for product is the key for adopting advanced technologies and adoption of dairy and animal husbandry as reliable options of livelihood. Hence it is very important to ensure remunerative prices for animal-poultry farm produce with at least 15-20 % profit margin which is unfortunately not happening at present. Technologies are available to convert milk, meat and eggs in to value added processed, further processed, ready to cook or ready to eat products. It is possible to incorporate specific nutrients in them to make them functional foods. Development of fodder/feed units, use of silage production technology, Hydroponics and Azolla cultivation can add to diversification.

Formation of farmers producing companies, farmers to consumer marketing channel, marketing at farmers gate, agro tourism and agro industries for farm machinery/custom hiring can all enhance income for the farmers and their family.

In Western Maharashtra districts the productivity of salt affected sugarcane ranges from 0 to 25 ton/acre with an income ranging from Rs. 10,000- Rs 15,000 per acre which is substantially less than that earned by sugarcane farmers from areas with non-problematic soil. The income for farmers can be enhanced by IFS modules with integrated technology for reclamation of salt affected sugarcane fields through agriculture and sub-surface drainage (SSD) system, enhancement of fisheries in reservoir and fish seed production in poly lined farm ponds particularly in Vidarbha & Maratwada Region. In Vidarbha region, salt affected soils can be utilized for aquaculture of marine fish & freshwater fish shrimp i.e.. white leg shrimp Litopenacus Vannamei. In addition it is possible to promote cage & pen culture in open waters like reservoirs, creeks in coastal districts. In addition, there is scope for value added fish products.

In Konkan region, there is a scope for additional income for farmers from coconut by product such as coir, nira, coconut sugar etc. In addition, there is a lot of scope for agro ecotourism modules. Such modules have also been demonstrated by KVK located at Baramati. There is a scope for bee keeping and mushroom cultivation to enhance the income of landless agricultural labourers.

Enhancement of value chain management with forward and backward linkage can enhance remuneration for farmers in general and particularly for horticultural crops. There is a need to conduct studies on value chain in the horticulture and crop based clusters to be focused. Such studies should focus on assessing the infrastructural gap of planting material, tissue culture labs, input delivery, production and post-production practices, forward linkages (cold supply chain, market linkage, linkages to processing and export hubs etc.). Further, analysis to be carried out in the institutional mechanisms of organizing production and marketing. All these activities have great potential to create employment opportunities for rural youth.

Fisheries provides off-farm opportunities for farmers both with and without land including post harvest technologies and value addition. They can get involved in construction of pen and hatchery installations and cottage industry for fish preservation and product development.

Skill development in farm implement operation, construction and maintenance of polyhouses, accessories for agricultural operations can create additional employment and hence can reduce the cost and time for getting the structures repaired leading to reduction in cost of production and enhanced income of farmers and also of non-agricultural workers in the villages.

6.11. Marketing Related strategies

- District Agricultural Marketing Structure (DAMS): can strengthen agriculture marketing system, for creating storage & processing infrastructural facilities and for better market price to farmers; This should get support from various schemes of Central & State Govt. such as RKVY, NHM, DMI, APEDA, NHB, NABARD, NCDC, MOFP to support activities such as
- Pledge Loan Scheme
  - Fruit Festival Scheme
  - Rural Godown Scheme
  - Onion storage structure scheme
  - Onion transport /Ship transport freight subsidy scheme for exports
  - Setting up of Cold Storage and other related infrastructural projects
  - MARKNET / market information Project Farmers Market
- Need for integrated and value chain approach
- e-NAM would prove to be game changer
- Market linkages and reforms essential
- Price uncertainty needs to be given due priority
- Estimation of regional, national and international demand to avoid the glut situations preventing the situation of price crash
- Need for stable commodity trade policies
- Abrupt policy changes do not allow harnessing the lucrative market situation

6.12. Non-farm and other Concerns

- Creating suitable infrastructure
- In case of irrigation, requirement of capital is huge
- All schemes under AIBP not sanctioned, only 99 schemes are eligible
- Need for attracting private investment
- Agro-tourism can be a lucrative off-farm activity
- Can bring substantial income in NE and NWH to go for diversification of fruits and vegetables mainly because of the price risk and uneconomic lot for marketing
- Need for separate plans for small farmers in terms of bargaining power in various transactions in the input and output market
- FPOs have shown very impressive benefits to small farmers, women, tribal farmers, even in remote and disadvantaged areas

6.13. Validated / successfully demonstrated Technologies

The technologies can contribute to doubling the farmers income primarily by enhancing the productivity of the system through enhanced production, reduced cost of cultivation and effective communication about market intelligence. The recent research output from universities and ICAR institutes have clearly revealed the potential of improved crop varieties and natural resource management technologies for enhancing the productivity of crops, livestock and fisheries in addition to allied sectors such as sericulture.

In addition, a lot of agro chemicals including the growth promoters are being commercialized in the Indian market. Farmers are in dilemma while using chemical and organic fertilizers; they don't know how to do budget farming. There is poor coordination between agriculture universities and farmers and it is increasingly observed that technologies emerging from research are not reaching farmers who need to be trained in using that technology and it is necessary to increase their capacity to make right choice at right time while making decision on purchase of inputs particularly for high tech agriculture.

Opportunities of using agricultural technologies developed by Universities and ICAR-institutes for different regions of Maharashtra has been given in brief in the following section while comprehensive information can be obtained from respective websites.

6.13.1. PDKV -01T-01: Improved rice varieties

- ***Early duration*** **-** SYE-1, SKL-6, MTU-1010, IR-64, IR-36, Karjat-3
- ***Midlate duration*** **-** PKV HMT, SYE-2001, SYE-75, JGL-1798, JGL-384, MTU-1001, PKV- Ganesh, PDKV-Kisan
- ***Late duration*** **-** Swarna, SYE-5, SKL-8,BPT-5204
- ***Aromatic – PKV*** **-** Khamang, PKV- Makarand
- ***Rice Hybrids*** **-** Sahyadri,Sahyadri-2, Sahyadri-3, Sahyadry-4, PA-6444, PA -6201
- ***Submergence tolerance varieties*** **-** Swarna Sub1, Sambha Sub1, SYE5 needs to be cultivated in flood prone area in Pauni, Lakhandur, Tumsar taluka

6.13.2. PDKV -01T-02: Rice production using system of Rice Intensification (SRI)

- There are six important management practices to be followed in SRI method of paddy cultivation.
- Use of young seedling for transplanting: 8-12 day old seedling (two leaf stage) need to be planted. (10-15 days also) This ensures more tillers and more root growth.
- Careful transplanting: Seedlings are removed from the nursery 'carefully' with seed, soil and roots intact and planted them in the main field shallow without plunging too deep into the soil. The plants establish immediately, grow fast and tiller profusely.
- Planting at wider spacing: Planting has to be done in a square pattern at 25 x 25 cm for mid late & late and 20 x 20 cm spacing for and early rice varieties respectively. In fertile soils, even wider spacing can be adopted for planting.
- Weed control: Water is not allowed to stagnate in the field, weed intensity is high. The cono weeder, power weeder is operated initially at 10-12 days after planting and thereafter thrice at ten day intervals which churns the soil and incorporates the weeds into the soil. The use of rotary weeder increases supply of oxygen to roots. This help in multiplication of microbial population which in turn mobilise nutrient supply to the plants. cono weeder use more than twice, results in increased yields. (can also use preemergence weedicides)
- Water Management : Careful water management needs to be followed. The field is kept moist and water should not be allowed to stagnate. Furrows are made at every 2 meter intervals to facilitate drainage.
- Organic manures (10 t/ha): Apply glyricida / Garadi leaves / Urea DAP briqueets @ 170 kg/ha

Nursery Management for SRI

Nursery management should be carefully made as only 8-12 day old seedlings are transplanted in SRI method. Paddy seed is germinated by soaking for 12 hrs. in water and incubated for 24 hrs. The seed is covered with layer of FYM and then mulch with paddy straw. After two days paddy straw is removed. Watering is done carefully. Paddy seedlings will be ready by 8 days. Remove seedlings from nursery with seed, soil and roots intact an transplant single seedlings in a square pattern at 25 x 25 cm or 20 x 20 cm spacing as per varieties

Where and how to adopt SRI ?

- Where irrigation facilities are available particularly wells, bore wells by identifying the farmers in the villages and get aware.
- In leveled paddy bundhies
- Hybrid, HYV can be used
- In gallmidge prone area viz,. Sakoli, Lakhandur Taluka (Bhandara District), if to adopt SRI then try to use two seedlings per hill to avoid gallmidge effect to some extent.

6.13.3. PDKV -01T-03: Four Point techniques of paddy cultivation

- Use of paddy straw @ 20 qt/ha (30-40Kg K_2 O and 120-140Kg silicon) and apply partially burned rice hull ash to seed bed @ 0.5 to 1Kg/m2
- Use of Glyricidia / Garadi leaves @ 1.5-2(12-15Kg N) ton/ha
- Control transplanting 25 x 15 cm
- Application of Urea DAP briquettes @ 170 kg/ha(56 Kg N and 30 Kg P_2O_5 after transplanting within 2 days at 7-10 cm deep in soil
- Increase in yield (upto 20%) and saving in chemical fertilizer (40 %)

6.13.4. PDKV -01T-04: Management of major pest of paddy

For the ecofriendly management of insect pest of rice viz. stem borer, leaf folder, army worm, green plant hopper, brown plant hopper and white backed plant hopper and for getting higher B:C ratio, follow the ecofriendly IPM module as given below.

- Seed treatment – 3 % salt treatment
- Paddy seedling roots dip in Chloropyriphos 20 EC solution @10 ml in 10 liters of water upto 12 hrs before transplanting for management of Gall midge and Stem borer
- Application of Garadi leaves @ 1.5 ton/ha at the time of puddling for management of Gall midge, Stem borer and Hopper
- Soil application of carbofuron 3 G @ 25 kg/ha for management of Gall midge
- Collect eggs masses of Stem borer and put it in bamboo basket for parasitoids emergence
- Destruction of wild rice plants adjacent to field
- Rope drag over the crop if case worm, leaf folder& army worm infestation is seen
- Collection and destruction of Stem borer infested Dead heart, White Ear head and Gall midge infested silver shoots
- Withdrawn of water for 3-4 days if case worm and hopper infestation is seen
- Filling up of water if Army worm infestation is seen
- Four Release Trichogramma japonicum @ 50,000 eggs /ha at weekly interval for stem borer management.
- Use of Metarrhizium anisopliae @ 2.5 kg/ha at the initiation of Brown plant hopper, after withdrawn of water from paddy bundhies
- For effective management of leaf folder, green plant hopper, brown plant hopper and white backed plant hopper and for higher economic return, after attaining ETL of any aforesaid pest, spraying of Triazophos 40 % EC (@ 20 ml/ 10 litre of water or Thiamethoxam 25 WG @ 2 g/10 litres of water and second spraying at 15 days interval should be followed
- For management of Brown Plant Hopper in rice and for getting higher ICBR spraying of imidacloprid 17.8 SL @ 2.2 ml or Fipronil 5 SC @ 20 ml or Thiamethoxam 25 WG @ 2 g in 10 litres of water should be followed

6.13.5. Dr. BSKKV-01T-01 : Rice Production Technology for Konkan Region

- Adoption of four point and SRI method of rice cultivation along with green manures
- Use of High yielding improved Fine varieties (Karjat 7 and Ratnagiri 5) and coarse varieties Karjat -3 and Karjat - 5
- Use of Pre emergence herbicides and use of Drum seeder, Reaper and Paddy thresher.
- Transplanting with proper spacing with use of Cono Weeder

6.13.6. ATARI-Hyd-01T-02: Broad adoption of Broad Bed Furrow (BBF) technology for Soybean

- With use of BBF planter only 0.55 qt seed requires for sowing of 1 ha land resulting in the 20 kg seed saving as compared to traditional sowing method. Overall 32 Qt seed is saved costing rupees 1.8 lacks for 160 ha of land sowing

- It is found that installation of sprinkler irrigation system is easy while providing protective irrigation during dry spell
- Number of spraying reduced due to less incidences of insect and pest
- Productivity was increased by 26% by using BBF planting method as compared to traditional method
- Out of 3 treatments, sowing of soybean in 4 lines with row spacing of 37.5 cm is more economical

Table 6.8 : Comparison between BBF sowing and traditional sowing methods

Observation	BBF Planter	Traditional sowing
Seed Required (qt/ha)	0.55	0.75
Field capacity (ha/hr)	0.40	0.16
labour required (man hr /ha)	2.5	12
Operating cost (Rs/ha)	1500	1600
Productivity (qt/ha)	25.2	20

Farmers Feedback :

- The increased economic benefit year after year has established soybean as major crop replacing cotton. Soybean- Bengalgram cropping pattern is being wildly accepted by farmers.
- Enhancement of organic carbon through leaf biomass resulted into improvement of soil health
- Use of BBF planter helps in adopting farm mechanization.

BBF planter **Intercropping with Redgram**

Figure 6.4 : BBF planter along with intercropping with redgram

6.13.7. VNMKV-01T-03 : Conservation furrow in cotton and soybean sole and inter-cropping

- An additional cotton equivalent yield of 450 kg/ha. can be obtained with net monetary benefit of Rs. 19350/- per ha
- This practice conserve 30 per cent more moisture and reduced runoff and soil loss by 30 per cent

Figure 6.5 : Conservation furrow in cotton

6.13.8. CIFE-01T-04: Reclamation of Salt Affected Sugarcane Fields through Aquaculture and Sub-surface Drainage (SSD) System in Western Maharashtra

- The sub-surface drainage system is installed in selected plots of 2.0-4.0 ha area at a depth of 1.0 to 1.20 m depth maintaining 0.2 m slope. The sub-surface drainage (SSD) system consists of 80 mm diameter corrugated PVC pipe with 1 mm width slits and covered with 80-120 micron non-woven geo-synthetic polyester fiber cloth to prevent chocking of slits of pipes due to soil particles and achieve free flow of water. These pipes were arranged at parallel to each other at 20 m distance. These parallel lines were connected to a 160 mm diameter PVC pipe horizontally. These horizontal pipes from different locations are connected to 1.5 m deep and 0.75 m diameter dug well to collect drain water. The well is connected to a 0.20 ha aquaculture pond having 2.5-3.0 m depth with a cement pipe of 300 mm diameter to collect the drain water from SSD. An over flow pipe of 60 cm diameter was provided to the pond at opposite side to SSD pipe at a height of 150 cm from pond bottom to facilitate excess water from the pond to drain out and to avoid the re-enter of the excess drain water into SSD pipes. In this system, the salts leached very fast (< 1 year), because the salt water is drained at faster rate into the collection chamber i.e.., aquaculture pond which is close to the system and is an integral part within the experimental field.
- Fish ponds are fertilized with organic and inorganic fertilizers to enhance the natural productivity, but in the case of sub-surface drain water collection pond no fertilizers need to be applied because the desired nutrients are getting through drain water from fertilizers applied to the agriculture crops. The novelty of the innovation is that the salt affected soil reclaimed during the first carp period itself and increased the sugarcane production 3-4 folds. The system can be adopted by small SHGs with less investment as compared to existing high investment system which can't be implemented by SHGs.
- Economics: The present income; which was:-
- Base line income: Rs. 10,000/- to Rs. 15,000/- per acre. Some farmers getting loss to a tune of up to Rs.12,000/- per acre
- After intervention by CIFE in demonstration area: Rs. 91,475/- per acre

Table 6.9 : Economic analysis of innovative integrated technology for reclamation of salt affected sugarcane fields through aquaculture and subsurface drainage system (SSD).

Sl. No.	Name of Self Help Group	Area (acres)	No. of Farmers	Base line production (Tons)	Ave. production with SSD (Tons)	Input (Rs.)	Gross income (Rs.)	Net income (Rs.)
1	**Shree Hanuman Farmers SHG, Malkhed, Tal. Karad, Dist. Satara. (Maharashtra)	10.25	6	0-15	53.25 Sale price@ Rs. 2,750 per ton	62,000	1,46,438	84,438
2	**Shree Kedarling Farmers SHG, Malkhed, Tal. Karad, Dist. Satara. (Maharashtra)	10.25	11	0-15	53.75	62,000	1,47,813	85,813
3	Shree Bhagwan Somnath Farmers SHG,Tambave, Walwa,Dist. Sangli, (Maharashtra)	10.00	7	20-25	63.00	66,000	1,73,250	1,07,250
4	Mauli Farmers SHG Urun, Walwa, Dist. Sangli (Maharashtra)	4.40	5	30-35	74.00	78,000	2,03,500	1,25,500

Sl. No.	Name of Self Help Group	Area (acres)	No. of Farmers	Base line production (Tons)	Ave. production with SSD (Tons)	Input (Rs.)	Gross income (Rs.)	Net income (Rs.)
5	Jayant Farmers SHG, Gothkhindi (Phata) Walwa Dist. Sangli (Maharashtra)	4.40	6	20-25	54.00	62,000	1,48,500	86,500
6	Mangalmurti Farmers SHG Chinchwad, Shirol, Dist. Kolhapur, (Maharashtra)	4.40	4	0	42.00	56,000	1,54,000	98,000
7	Padmavati Farmers SHG, Arjunwad, Shirol, Dist. Kolhapur, (Maharashtra)	4.40	5	20-25	49.00	60,000	1,34,750	74,750
8	Soneshwar Farmers SHG, Songaon, Baramati, Dist. Pune, (Maharashtra)	4.40	5	0	41.00	55,000	1,51,250	96,250
9	Khadkeshwar Farmers SHG, Group, Vadagoan, Daund, Dist. Pune, (Maharashtra)	4.40	4	10-15	45.00	59,000	1,23,750	64,750
	Total	56.90	53					
	Average			0-35	52.78	62.22	1,53,695	91,514

6.13.9. MPKV-01T-05: Enhancing production of Cotton (HYVs, Production technology, access to water)

- Selection of varieties according to soil type
- Moisture conservation practices (BBF or furrow opening)
- Supplementary irrigation
- Integrated Pest Management, Integrated Disease Management
- Crop rotation

Table 6.10 : Crop rotation and intercropping for sugarcane, cotton-wheat

Season	1st Year	2nd Year	3rd Year
Summer	Sugarcane	Sugarcane Ratoon	Cotton-Wheat / Gram
Kharif	Cotton-Wheat	Groundnut / Sesamum – Sorghum / Safflower	-

- Intercropping with groundnut, pigeonpea, greengram.
- High Density Planting System (HDPS) for G. arboreum cultivars.
- Wider spacing with drip irrigation for intra hirsutum hybrids.

6.13.10. MPKV-02T-06 : Organic farming for Cotton production

- Use of bioagent viz. Trichoderma viride, Pseudomonas fluorescens, B. subtilis etc. for seed treatment/ soil application and foliar application for management of foliar diseases of cotton

- Adequate incorporation of decomposed cow dung with farm manure in the field before sowing (every year)
- Use of local improved varieties instead of Bt hybrids/varieties to decreased the cost of cultivation.
- Spray of bio-pesticides (Neem ark, PPFM)
- Pheromone traps and Trichocards should be used
- Use of Green Manure crops
- Intercropping with black gram and crop residue application after pod plucking
- After harvesting use of all biomass for compost preparation

6.13.11. MPKV-03T-07: Tolerant cultivars of Cotton for rainfed and irrigated condition

Table 6.11 : List of tolerant varieties for rainfed and irrigated cotton production

Sr. No.	Name of Varieties/Hybrids	Characteristics
Rainfed Cotton		
Improved G. arboreum varieties suitable for HDPS (45 x 22.5) for Jalgaon, Dhule, Nandurbar		
1	Phule Dhanwantary	Surgical purpose, High yielding, Tolerant to sucking pest and bollworm, Resistant to ALB & BLB.
2	Phule Anmol	Long staple cotton, Tolerant to sucking pest and bollworm, Resistant to ALB & BLB.
3	JLA-794	High yielding, Tolerant to sucking pest and bollworm,
4	JLA-505	High yielding, Tolerant to sucking pest and bollworm
Irrigated Cotton		
Improved G. hirsutum varieties suitable for Solapur, Nashik and Ahmednagar District		
1	Phule -688 (RHC-0688)	High yielding, Medium long staple cotton, Sucking pest and bollworm tolerant, Resistant to ALB & BLB.
2	Phule Yamuna (RHC-0717)	High yielding, Sucking pest and bollworm tolerant, Resistant to ALB & BLB.
Intra hirsutum hybrid suitable for Solapur, Nashik and Ahmednagar District		
1	Phule Asmita (RHH-0917)	High yielding, Long staple cotton, Moderately resistant to sucking pest and bollworm, Resistant to ALB & BLB.
2	Phule Shwetambari (RHH-0622)	Early Maturing hybrid, High yielding, Medium staple cotton, Tolerant to sucking pest and bollworm, Moderately resistant to ALB & BLB.
3	Phule Suman (RHH-1007)	High yielding, Long staple cotton, Resistant to sucking pest, Tolerant to bollworm, Resistant to ALB & BLB.
Inter specific hybrid suitable for Sangli, Satara and Solapur District		
1	Phule Dhara (RHB-711)	High yielding, Extra long staple cotton, Tolerant to sucking pest and bollworm, Resistant to ALB & BLB.
2	Phule Prabha (RHB-812)	High yielding, Extra long staple cotton, Tolerant to sucking pest and bollworm, Resistant to ALB & BLB.

6.13.12. MPKV-04T-08:Integrated Pest Management Technology for Non Bt cotton Production

- Seed treatment with thiamethoxam 30% FS @ 10 ml/kg seed
- Planting one row of maize and cowpea alternate at one meter distance around the field as border crop and at every 9th row of cotton alternate line of maize, cowpea and setaria

- Application of 5% NSE at 30 and 45 DAS
- Use of pheromone traps @ 5 /ha for each for monitoring of E. vittella and H. armigera at 45 DAS
- Release of Trichogramma chilonis @ 2 lacs/ha (10 cards/ha) at 60 DAS
- Application of 10 ml HaNPV in10 l water (500 LE/ha) at 75 DAS
- Installation of ' T ' shaped bird perches @ 25/ha at 80 DAS
- Installation of pheromone traps @ 5 /ha for monitoring of Pectinophora gossypiella at 85 DAS
- Spraying of profenophos 50% EC @ 20 ml/10 l water at 90 DAS
- Use of yellow sticky traps @ 10 /ha for whitefly monitoring at 100 DAS
- Spraying of triazophos 40 % EC @ 20 ml/10 l water at 105 DAS for control of whiteflies and pink boll worm
- Spraying of lambda cyhalothrin 5% EC @ 10 ml/10 l water at 120 DASfor control of pink boll worm

6.14. Bt cotton production

- Clean cultivation and summer deep ploughing in March –April
- Planting of trap crops like maize, cowpea, marigold and castor around the cotton field
- Spraying of 5% NSKE after 105 DAS
- Release of parasitoid Trichogrammatoidea bactrae or Trichogramma chilonis @ 1.5 lakh eggs/ha after 115 DAS
- Use of yellow sticky traps @ 10-12 traps/ha after 125 DAS
- Spraying of Thiodicarb 75% @ 1kg/ha after 140 DAS
- Collection and destruction of larvae and damaged parts
- Spraying of recommended insecticides at ETL level

6.14.1. PDKV-01T-09: Integrated farming system

- Integrated farming system / cropping system (rotational with legume crop as well as inter cropping with legume) with low input requirement crops may also improve farmers income at a greater depth. For e.g. If American cotton + pigeon pea (6:2) and local cotton + pigeon pea (12:2) are cultivated then farmer can get more income.
- The income generated by the farmers from cotton cultivation varies depending on the growth environment and agro climatic features. For example with conventional method farmers earn up to Rs 25, 740 under rainfed condition while this may increase with an access to irrigation. Various technologies have been demonstrated to enhance the income from cotton cultivation which has been listed in the Table.

Table 6.12 : Farming system module for cotton based farming system in Nagpur district

Sr. No.	Farming system modules for cotton	Gross income (Rs)	Cost of cultivation (Rs)	Net Return (Rs)
1	Income generated by the farmer under farming system module for rainfed cotton based cropping system *Land holding :* 4 acres (rainfed)	45840	10300	35540
2	Income generated by the farmer under farming system module for rainfed cotton based cropping system *Land holding :* 2.5 Acre (protective irrigation) Village: Mangli	50900	12700	38200
3	Income generated by the farmer under farming system module for irrigated cotton based cropping system *Land holding:* 8 Acre (Irrigated) Village: Mangli	158100	39700	118400

Sr. No.	Farming system modules for cotton	Gross income (Rs)	Cost of cultivation (Rs)	Net Return (Rs)
4	Income generated by the farmer under farming system module for irrigated cotton based cropping system *Land holding:* 2 Acre (Irrigated): Village: Mangli	60650	18700	41950
5	Income generated by the farmer under farming system module for irrigated cotton based cropping system *Land holding:* 10 Acre (Irrigated) + 9 Acre Rain fed; Village: Ranmagali	274000	95500	178500

6.14.2. MPKV-05T-10 : Forages and Grasses Production Technology for Irrigated condition:

Table 6.13 : Improved varieties for different forage crops and grasses

Crop	variety	Remark
Hybrid napier	Phule Gunvant/ Phule Jaywant	Perennial cereal
Marvel grass	Phule Govardhan	Perennial cereal
Lucerne:	RL-88	Perennial legume
Season: Kharif		
Maize	African Tall	Annual cereal
Sorghum	Phule Godhan and Phule Amruta	Annual cereal
Bajara	Giant bajara	Annual cereal
Cowpea	Sweta and UPC 5286	Annual legume
Season: Rabi		
Maize	African Tall	Annual cereal
Oat	Phule Harita, Phule Surabhi and Kent	Annual cereal
Lucerne	Anand-2	Annual legume
Berseem	Wardan	Annual legume
Season: Summer		
Maize	African Tall	Annual cereal
Bajara	Giant bajara	Annual cereal
Sorghum	Phule Amruta, Ruchira	Annual cereal
Cowpea	Sweta and UPC 5286	Annual legume

- Cultivation of perennial forage legume (e.g. lucerne var. Rl-88, Anand-3) and cereal (e.g. hybrid napier var. Phule Gunwant, Phule Jaywant)/ Marvel (Phule Govardhan) in equal proportion will be beneficial under irrigated condition to dairy farmers for reducing cost of cultivation and supply of balance nutritious green fodder.
- Green fodder of maize/sorghum/bajara produced during Kharif season converted in to silage will be use during summer season.
- Use high yielding varieties of forage and grasses
- Seeds or sets should be treated with appropriate bio-fertilizers
- Use micro sprinklers/drip irrigation system for efficient use of water
- Use ecofriendly bio-control measures to control insect pests

- Use handheld grass cutter for harvesting forage/grasses
- Use of chaf cutter
- Dairy farmers can produced green fodder of maize by hydroponic techniques during severe drought condition
- To reduce the cost of concentrate feed dairy farmers could produce and use Azolla as protein supplement fodder
- Some farmers can take up nursery activity for production and sell of planting material of perennial grasses such as Hybrid napier, Irrigated Marvel, rainfed grasses such as Madras anjan and Marvel grass for additional income
- Some farmers can take up seed production activity in forage crops viz., maize var. African Tall, Lucerne var. RL-88, berseem var. Wardan for additional income

Rainfed condition:

Table 6.14 : Improved varieties for different forage crops and grasses

Crop	variety	Remark
Season: Kharif		
Cereal forages:		
Maize	African Tall	Annual cereal
Sorghum	Phule Godhan, Ruchira and Phule Amruta	Annual cereal
Bajara	Giant bajara	Annual cereal
Legume		
Cowpea	Sweta and UPC 5286	Annual legume
Cereal grasses		
Marvel grass	Phule Marvel-06-40, Phule Marvel-1	Perennial cereal grass
Madras Anjan	CAZARI-75, Phule Madras Anjan-1	Perennial cereal grass
Legume		
Stylo	Phule Kranti	Perennial legume grass
Dasharath	Veli masal/local	Perennial legume grass
Raifed condition with protective irrigation facility		
Season : Rabi		
Cereal		
Sorghum	Ruchira and Maldandi	Annual cereal
Legume		
Dasharath	Velimasal/local	Perennial legume grass

- Cultivation of perennial cereal grass (e.g. Marvel var. Marvel 06-40, Phule marvel-1/Madra anjan Var. CAZARI-75, Phule Madras anjan-1) and legumes(e.g. Stylo var. Phule Kranti/Dasharath grass var. Velimasal, local)in equal proportion will be beneficial under low rain fall areas to dairy farmers for reducing cost of cultivation and supply of balance nutritious green fodder.
- Excess green fodder of maize, sorghum and bajara produced in Kharif should be converted in to silage for utilization during summer season
- Use high yielding varieties of forage and grasses
- Seeds should be treated with appropriate bio-fertilizers
- Use micro sprinklers/drip irrigation system for efficient use of water

- Use ecofriendly bio-control measures to control insect pests
- Use handheld grass cutter for harvesting forage/grasses
- Use of chaf cutter
- Dairy farmers can produced green fodder of maize by hydroponic techniques during severe drought condition
- To reduce the cost of concentrate feed dairy farmers could produce and use Azolla as protein supplement fodder
- Some farmers can take up nursery activity for production and sell of planting material of perennial grasses such as Hybrid napier, Irrigated Marvel, rainfed grasses such as Madras anjan and Marvel grass for additional income
- Some farmers can take up seed production activity in forage crops viz., maize var. African Tall, Lucerne var. RL-88, Berseem var. Wardan for additional income

6.14.3. NRCG-01T-11: Use of protected cultivation for offseason cropping/ protection against extreme weather events

Climate change has affected the realization of the net profit to the growers due to unseasonal rains, hails/ hailstorm during the onset of summer conditions i.e.. from 15th Feb. onwards and low temperature during berry development stage. Hailstorm followed by cyclone in 2008-09 and 2009-10, untimely rains in 2011 followed by hailstorm again in 2014 has done immense damage to the grape crop. The grape-growers started using plastic covers to protect their vineyards from extreme weather events during fruiting season. The change in microclimate under plastic cover in comparison to open conditions affects the grapevine physiology. In many cases low fruitfulness/ productivity has been observed. ICAR-NRC Grapes have studied the effect of plastic cover on improving vineyard performance for two consecutive fruit pruning seasons

6.14.4. NRCP-01T-12: Pomegranate production technology

Table 6.15 : ICAR-NRCP technology and impact for Pomegranate

ICAR-NRCP Technology	Impact
Use of healthy, bio-hardened, disease free planting material	Saving on sprays of bactericides and antibiotics of ~ Rs. 24000/- per ha. Per year in non-traditional areas.
Use of technology of in-situ hard wood cutting in already existing healthy pomegranate orchards for further extension.	Approximate total benefit Rs. 42,000/- per ha
Use of ICAR-NRCP IDIPM Schedule	Yield increase up to 79.5% with management of economically important diseases.
Use of Penicillium pinophilum based bio-fertilizers for 70% substitution of K fertilizer	Approximate saving Rs 40,000/ ha
Use of gypsum @ 25 % along with 15 kg/plant well decomposed sugarcane press mud in non-calcareous soil with high pH.	120-130% increase in yield
In acidic soil with low soil pH should be reclaimed with lime @ 25% of the lime requirement analyzed using Soil Health Card along with 40-60 kg biochar.	Potential increase in yield from 25-70%
Protected cultivation with 35 % shade net on top and insect proof on side	70% more yield
Subsurface drip irrigation having double laterals with 4 drippers	11.9% increase in Yield; Upto 70 % water saving
Mulching using pervious mulch	Water saving > 40 %, Increase in yield by 8.9 %

6.14.5. Dr. BSKKV-02T-13: Mango production technology

- Integrated canopy management
- Use of standardized dose of paclobutrazole for early and regular flowering
- Integrated control of fruit drop and fruit quality enhancement
- Rejuvenation of old and senile mango orchards. 50 per cent subsidy be given for rejuvenation
- Motivation of mango orchard owners for planting of 15 % grafts of other mango orchards
- Orchard specific, need based integrated nutrient management (June)
- Scrupulously following plant protection schedule (Oct to Feb)
- Need based foliar sprays of nutrients, growth regulators and 5-6 irrigations at fruit development stage.
- Post harvest canopy management, adopting recommended tree specific pruning (April-may)
- Intercropping of vegetables in rainy season
- High density planting (5 × 5 m)

6.14.6. Dr. BSKKV-03T-14: Cashew Production Technology

- Planting bold nutsize cashew varieties like Vengurla 4,7,8
- Provision of protective irrigation
- Integrated nutrient, disease and pest management
- Promotion of fertigation
- Conversion of old orchards planted through seedling by coppice grafting
- Providing irrigation 200 litre/tree from December to March at fortnightly interval
- Nutrient and growth regulator spraying at appropriate state i.e.. vegetative flush, flowering and fruit set (2% urea, dry fish extract @ 50g/10lit. and 10 ppm ethrel)

6.14.7. Dr. BSKKV-04T-15: Coconut Production Technology

- Balanced use of fertilizers
- Drip irrigation
- Adoption of multi storied cropping model consisting of tree spices (Nutmeg, Cinanamon, black pepper) and annual fruit crops (Banana and pineapple) having potential to earn profit more than 1.0 lakh per acre popularized 'Lakhi Baug'
- Productivity – 100 nuts/Palm/yr.

6.14.8. CCRI-01T-16: Rejuvenation of declining Nagpur mandarin orchards (A success story)

A complete protocol was developed at CCRI, Nagpur for rejuvenating the declining Nagpur mandarin orchards by identifying the causes of decline and ameliorating the causal factors. Stepwise implementation of rejuvenation technology is as under :

- Remove all the dry woods and shoots with the immediate foliar spray of Carbendazim @ 1gm/lit of water
- Regular irrigation, nutrient and manure application as recommended
- Two Bordeaux paste applications on the tree trunk before and after monsoon. Cotton swabbing of Bark eating caterpillar (BECP) larval tunnels with Dichlorvas 0.1% or injecting 5 ml of it with the help of disposable syringe. Insect pest control measures as per situation must be resorted
- Weed control with Glyphosate @ 4 lit/ha or 3-4 kg a.i. Diuron/ha, twice with 40 days interval during Mrig bahar
- Irrigation water should not be allowed to stagnate in basin and touch the tree trunk
- Crop should not be taken at least for 2 seasons and intercrops should be avoided till the orchard is rejuvenated

- First 2 seasons crop load should be monitored and strictly regulated
- Cost :Capital Investment : Rs 60,000/ha

Performance Results

- Regular monitoring followed by timely rectifying the problems can yield favourable results
- Before taking up the orchard for rejuvenation the yield was 5.5 tons/ha (In 2011-12)
- After rejuvenation (2013-2014), the per ha yield of 16.38 tonnes obtained at demonstration sites is a testimony of the performance of technology
- Considering 7000 fruits in a tonne and price @ Rs. 2.50 per fruit (Yr:2016-17), the income would be Rs. 2,86,650/- per hectare
- After deducting the cost of rejuvenation, (Rs. 60,000/- ha) the total profit comes to Rs. 2,26,650/ha

6.14.9. DOGR-01T-17: Onion and Garlic Production Technology

- Quality seed adopting seed village concept by the farmers
- Use of micro irrigation will increase yield by 25%, with labour saving even under shortage of electricity & fertigation will help to increase fertilizer use efficiency
- Raised bed cultivation during kharif can save crop even upto 90% loss due to drainage
- Raising of healthy & uniform seedlings in onion and using uniform cloves in garlic will result in production of uniform and quality bulbs
- Popularization of technology for storage with suitable storage structures
- Value addition through grading and process products
- Encouraging SHG to solve labour, mechanization and marketing issues

6.14.10. DOGR-02T-18: Some Success Stories of ICAR-DOGR's Onion Production Technology

- By following onionproduction technology developed by ICAR-DOGR, farmers of Vidarbha region are successfully growing kharif onion. On advice of ICAR-DOGR, Shri Namdeorao Adhau, a progressive farmer of Deulgaon village of Vidarbha planned for 4 acres and used variety Bhima Super and raised nursery on raised beds with sprinkler irrigation and transplanted seedlings on broad bed furrows with sprinkler irrigation in the first week of August. He followed fertilizer doses and plant protection recommendations as per the ICAR-DOGR guidelines, and earned a net profit of Rs. 2.60 lakh per acre. Paradoxically, in kharif, in Maharashtra, there were yield losses to the tune of 30-60%. Yield level was 2-4 t/acre when planted on flat beds while raised bed planted crop recorded higher yield of 10t/acre.
- A white onion variety – Bhima Shubhra has been found suitable for Vidarbha region of Maharashtra, where white onion is preferred over red. This variety is popular in Vidarbha because of its high yield and market demand. Impressed by the performance of this variety, a group of about 300 farmers from twelve villages was formed. Most of the members are often earning a net profit of more than Rs. 1.0 lakh/acre.
- Onion is important commercial crop, which can improve livelihood of farmers. The tribal belt of Nandurbar in Maharashtra has congenial climatic conditions for production of onion and garlic at the commercial level. But cultivation of these crops was limited to the kitchen garden before the initiation of Tribal Sub-Plan (TSP). The scheme was initiated in this area in April 2013. About 350 farmers were selected from 35 farmers groups. Each group undertook demonstrations on onion and garlic cultivation in one acre of land in Navapur, Akkalkua and Dhadgaon talukas of Nandurbar district. In total, 73 demonstrations on newly improved varieties of onion and garlic and production technology were undertaken. Demonstrations on kharif onion production were carried out in Navapur taluka of Nandurbar district. More than one thousand tribal farmers were trained. Fifteen villages have been benefitted with the commercial cultivation of onion and garlic. Farmers earned a net income of Rs. 80,000-1, 00,000 per acre by production of about 120 q bulbs of onion variety Bhima Shakti during rabi and almost same income by production of about 80 q bulbs of Bhima Super in kharif. Nandurbar also has favourable climate for onion-seed production. Farmers earned a net income of Rs. 1, 00,000-1, 20,000 per acre through production of 250 kg seeds per acre of variety Bhima Kiran.

6.14.11. ATARI-Hyd-02T-19: Commercial cultivation of Brinjal under polythene mulch

Application of soil mulch along with drip irrigation system is a promising technology to avoid moisture loss by evaporation and at the same time to supply just enough water for irrigating the crop. Growth of weeds is controlled to a large extent through the use of plastic mulch.

To propagate this technology among vegetable growing farmers, FLD was arranged by KVK under Tribal Sub Plan at village Narali, Tal.-Roha, Dist.-Raigad. Total 5 farmers from tribal population were selected for the purpose with area of 0.2 ha per farmer. Plastic mulch paper (25 µm thickness, 4' wide, colour: silver-black) was supplied to farmers as an input in FLD. Hybrid variety of brinjal named 'Krishna' was sown in the demo plots. Group discussion of the participating farmer was arranged before commencement so as to acquaint them with the benefits of mulching and drip irrigation system. The farmers agreed to purchase drip system on their own. A 2 days training programme on improved package of practices for cultivation of vegetables was also organized for the tribal farmers.

Table 6.16 : Comparison of farmers practice and improved technology of Brinjal

	No. of Weeding	Yield (kg/ha)	Gross Income (Rs./ha)	Cost of Cultivation (Rs./ha)	B:C Ratio
Farmers practice					
(Ridge & Furrow plantation)	4	25,570	3,06,840	2,32,450	1.32:1
Improved technology (Use of plastic mulch with drip irrigation)	-	28,274	4,52,384	2,48,500	1.82:1

Output : Use of plastic mulch in brinjal cultivation resulted in many fold benefits to farmers. Firstly the traditional irrigation systems which they were practising previously suffered drawback of heavy loss of water through evaporation and deep percolation. Substantial quantity of water was saved through the use of plastic mulch coupled with drip irrigation system. Weed growth was checked because of plastic mulch as evident from the reduction in number of weeding. About 40 % reduction in water requirement compared to traditional methods of cultivation, and also due to reduction in labour required for weeding and intercultural operation the farmers who were struggling with these resources are inclined to adopt this method in the next summer season.

Figure 6.6 : Brinjal crop stand under polythene mulch

6.14.12. : DFR-01T-20 Floriculture

Table 6.17 : List of production technologies of flower crops suitable for growing in Maharashtra.

Sr. No.	Crop	Technology
1	Tuberose	Optimum time & size of bulbs. Optimum dosage of chemical fertilizers. Weed management Diseases management Vase life and packaging
2	Aster	Optimum planting time and varieties Optimum dosage of chemical fertilizers

Sr. No.	Crop	Technology
3	Gladiolus	Optimum plant density and planting methods Diseases and pests management strategies Integrated nutrient management Storage and postharvest management strategies
4	Chrysanthemum	Packaging and cold storage Diseases management
	Carnation	Standardization of propagation techniques Standardization production technology
5	Gerbera	Optimum plant density Nutrient and diseases management Vase life and postharvest management
6	Rose	Optimum dosage of chemicals fertilizers and plant spacing Diseases and pests management strategies Standardized techniques for keeping quality of rose Integrated nutrient and diseases management under protected conditions

Table 6.18 : Viable IFS with floriculture components for the specified regions

Regions	Viable IFS
Konkan	Adoption of specialty flowers like heliconias, ginger lily in inter cropping with plantation crops. Promotion of suitable crops of region like orchids, Anthurium, tabernaemontana (TMC), Jasmine, etc.
Western Maharashtra	Adoption of foliage and cut greens plants along with main crops on borders and in fallow lands Adoption of intercropping of seasonal flowers like marigold, china aster, gaillardia, etc. in major horticultural crops like grapes, pomegranate, mango, etc. where wider spacing is used for cultivation. Promotion of hibiscus, nerium, michelia, plumeria species, jasmine species, etc.
Khandesh (North Maharashtra)	Adoption of intercropping of seasonal flowers like marigold, china aster, gaillardia, etc. in major horticultural crops like grapes, pomegranate, banana, etc. where wider spacing is used for cultivation Promotion of dry flower industry in the tribal areas of Nandurbar and Dhule Promotion of acroclimum, helichrysum, hibiscus, nerium, plumeria species, jasmine species, etc.
Vidarbha	Promotion of loose flowers like marigold, tuberose, gladiolus, annual chrysanthemum, chrysanthemum, aster, gaillardia, etc. Promotion of dry flower industry in the tribal areas of the region (Gondia, gadchiroli, etc.) Promotion of acroclimum, helichrysum, hibiscus, nerium, plumeria species, jasmine species, etc. Promotion of lotus and water lilies in wet districts like Bhandara and parts of gondia where paddy is a major crop.
Marathwada	Promotion of loose flowers like marigold, tuberose, gladiolus, annual chrysanthemum, chrysanthemum, aster, gaillardia, etc. Adoption of intercropping of seasonal flowers marigold, aster, gaillardia, etc. in major horticultural crops like pomegranate, ber, mandarins etc. where wider spacing is used for cultivation

6.14.13. MPKV-06T-21 Mushroom Production Technology

- For chemical pasteurization of oyster mushroom substrate, the treatment of Carbendenzim (50 WP) 7.5 g + Formaldehyde (38-45 LR) 125 ml per 100 lit. of water for 18 hrs. is recommended
- For spawning in oyster mushroom 2% spawn on wet weight basis of substrate is recommended for layer method of spawning
- For spawning in button mushroom 0.75% spawn on wet weight basis of compost is recommended for layer method of spawning
- For spawning in Milky mushroom 4% spawn on wet weight basis of substrate is recommended for layer method of spawning
- For higher yield of button mushroom the use of coir pith + FYM (1:1) as casing material is recommended
- The application of Veradix-2 spray @ 0.15% at pinning stage in button is recommended for higher yield.
- Pleurotus sajor- caju followed by P. florida are the most suitable species for cultivation in Maharashtra during monsoon and winter season
- Amongst different strains of Agaricus bisporus P-1, NCS-12 and 310 were observed to be high yielding in Maharashtra
- A. bitorquis strain NCB-6 could be grown successfully at natural temperature (22 to 26oC) during monsoon under Pune conditions

6.14.14. NRCG-02T22: Manjri Medika Technology for Grape processing

Manjri Medika is a hybrid grape variety developed by from the cross between Pusa Navrang X Flame Seedless at ICAR- NRC for Grapes, Pune. It is found suitable for processing. Being a juicy variety having very dark colour in juice with high antioxidant values, it has potential to utilize in preparing High quality juice, blending with juices of other varieties also. Same time, the developed diversified technologies based on this variety will offer enriched.

6.14.15. NRCG-02T22b: "Zero waste" processing model proposed by ICAR-NRC Grapes, Pune

Cookies prepared by using pomace powder. The leftover from juice industry i.e.. seeds have potential to utilize for extraction of high quality grape seed oil. A "zero waste" processing model has been proposed by this centre for this variety. Utilization of waste material will be additional income to grape growers Adoption of this variety by group of grape growers will certainly create job opportunities and high return in comparison to table grapes and raisin production.

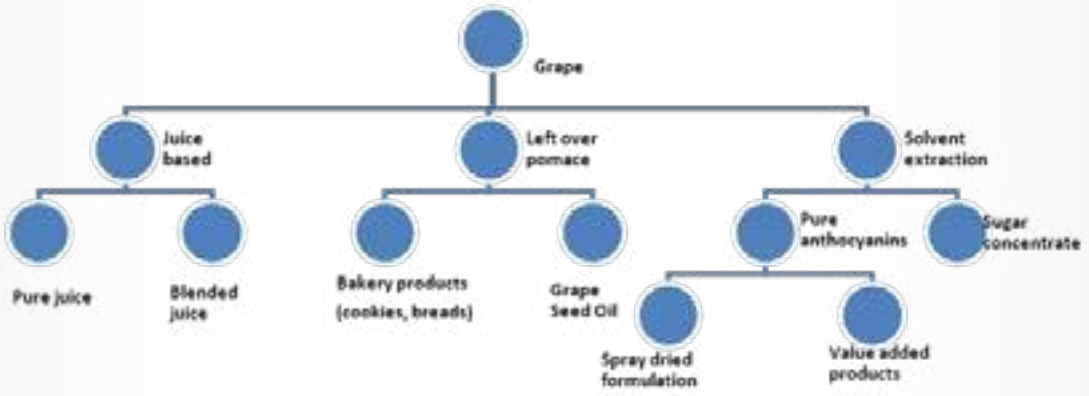


Figure 6.7 : "Zero waste" processing model proposed by ICAR-NRC Grapes, Pune

6.14.16 : ATARI-Hyd-02T-23: Goat Rearing Technology

Generally, goat is considered as more efficient digester of feed as compared to other ruminants. Flushing is conditioning of does for breeding. Does two weeks prior to breeding are provided with good pasture, balanced feed and additional concentrate supplementation. This will result in more uniform kids, increasing kidding rate and incidence of multiple births in flocks.

Plan, Implement and Support :For upgradation of goat and semi stallfed goat rearing, KVK conducted PRA in different villages where goat is the major enterprise and identified gaps in technologies adoption. For PRA, help of Famers Clubs also taken. Based on these gaps identified, interventions were planned. For training beneficiaries selected with the help of Farmers Clubs, SHGs. News also given in daily new paper and in Community Radio Center. Technological and skill imparting training organized at KVK as well as in villages. Need based demonstrations; OFTs were also conducted on farmers field in order to show the performance of the goat. Exposure visits were arranged in different goat unit. Similarly different inputs also made available to the farmer in order to increase adoption and diffusion.

For promotion of goat rearing KVK conducted short duration training for farmer farm women and rural youth considering the importance of goat rearing and its future for meat and milk. Likewise group meetings and seminar also conducted in which more than 250 farmer farm women and rural youth participated. KVK focused on two aspects i.e.. up-gradation of local breed and introduction of semi stall fed goat rearing as commercial venture of goat farming. For up-gradation of local goat, KVK introduced Osmanabadi for milk and meat purpose. Osmanabadi breed is more suitable in both backyard as well as semi-stall fed goat rearing. Initially KVK reared the goat at KVK farm and made available the goats as well as breedable bucks to the beneficiarie. Self Help Groups (SHGs) were involved for promotion of the goat farming. Various activities were conducted to the SHG members besides demonstration of new breeds, preparation of home made concentrate feed and introduction of some fodder crops. KVK introduced the up-gradation of goat concept in more than 40 villages with more than 26 Osmanabadi goats unit having capacity 10 +1 started among the rural youth. Similarly village Chinchpur was adopted for complete replacement of the existing breed with Osmanabadi with the help of SHG members. Under NICRA project Osmanabadi bucks are provided among the farmer for increasing weight gain and twining percentage in rainfed area.

Outcome : Due to up-gradation of goat programme, more than 3500 goats were up-graded during last 5 to 6 years period. Due to this up-gradation, average weight gain has been increased by two to three kg. per goat besides increasing the twinning by 65 percent. Due to KVKs intervention more 118 stall fed goat-rearing farm units started with average 10 to 25 goats/units. Every family is getting additional income of Rs. 20 to 30 thousand per annum With this intervention, gain of 20000 to 25,000 kg. meat and 1300 kids per annum to the farmers resulted in more than 70 to 75 lakh additional income to more than 14000 goats. On an average increase of Rs. 1400 to 1500 per family due to up-gradation of goat and semi stall fed goat rearing.

Impact : One hundred and eighteen rural youths and women are self-employed in last year due to semi stall-fed goat rearing. These units are providing the good quality breed able bucks and goats to other farmers for starting goat units and upgradation local non-descript goats.

6.14.17. Dr. BSKKV-05T-24: Fishery Technology

- Intensive aquaculture and shrimp culture
- Crab fattening and Crab rare ring
- Ornamental fish culture
- Cage culture
- Value added fish product

6.14.18. CIFE-02T-25: Innovative technology in Litopeneaus vannami cultivation in salt affected areas

Pacific white shrimp *(Litopeneaus vannami)* is recently introduced species in Indian coastal aquaculture – commercially since the year 2009. The farming became popular due to its faster growth rate, high stocking density tolerance and lower dietary protein requiremnent. This candidate species is ideal since it is adaptive and tolerant to wide range of salinity and temperature

Technology intervention: Major challenge of inland saline waters is ionic imbalance with low potassium and high calcium levels along with variable Mg levels. Fortification of ponds with potash and organic slurry, post larval stocking carried out. For initial 40 days, feeding was based on the hapa survival. At certain cases, soil and water probiotics were also used for the maintenance of the desired water quality and upkeep of pond bottom health

A total production of 13.4 tons/ha/120 days was obtained. This proved that Inland Saline Waters can be profitably used for L. vannamei culture by execution of cpst effective ionic amendments.

Technology benefits: Interception of ground saline water and utilization in aquaculture ponds will lower the ground table, help in soil improvement and reduction of secondary salinization. Since inland saline water is drawn from bore wells at different depths, it is free from pathogens and biosecure, unlike coastal areas. As the vast stretc.h of agriculture land became saline and unfit for any agricultural activity, the farmers can undertake *L. vannamei* culture for 100-120 days like any other agriculture crop and reap an enormous profit. Target geographical areas Around 8.62 million hectares of agricultural land has been badly affected with the problem of soil salinity and 1.93 million sq. km. area is under laden with ground saline water in India. Of the total inland saline area about 40% is contributed by Haryana, Uttar Pradesh, Punjab and Rajasthan and at the same time 41-84% of ground water is un-potable in these states. The L. vannamei culture technology has enormous scope to implement in these areas.

6.14.19. CIFE-03T-26: Culture based Capture Fishery Technology

- The man-made reservoir resources cover around 3.15 million ha water spread area and are mostly distributed in varied climatic environment congenial for fish growth. In India, the reservoirs are categorized into small (area >10 to 1000 ha), medium (area 1000 to 5000 ha)) and large (area >5000 ha). There are 19370 reservoirs in the country covering an area of 3.15 million ha. The small reservoirs are 19134 nos (14, 85,557 ha), medium 180 nos (5, 27,541 ha) and large 56 nos (1,140,268 ha). The average fish production from Indian reservoirs is about 15 kg/ha; which can be increased up to 100 kg/ha by stocking fingerlings above 100 mm size. Cage culture offers in situ rearing of fry to fingerlings before releasing them into reservoirs.
- Hatchery and nursery developments near the reservoirs: Raising the fry and fingerlings of catla (Catla catla) and rohu (Labio rohita) in nurseries
- Constructions of pen and hatchery installation
- HDPE cages of 3x3x3 m are ideal for open water bodies
- Stocking of fish by stocking the fry of 35 mm size with density of 50 -200 fry/m and raising for 60 days
- Cleaning cages from biofouling organisms like algae and sponges helps the faster growth of fry to fingerlings
- Feeding of fish in cages using formulated feed (rice bran 10%, GOC 40%, maxie 7%, soybean and acetes – 20% each, vitamin mix 2% and mineral mix 1%) to be given at 3-5% of body weight at least twice a day
- 100 to 120 mm size fingerlings can be harvested at the end of 60 days
- Technology benefits:The production of fingerlings through cage aquaculture will improve country`s production in two ways

1. By regularly stocking open water bodies like lakes and reservoirs with desired varieties of fingerlings and thereby improving fish catch from these water bodies
2. Fish farmers, fishers, cooperative societies, community depending on the reservoir fishery or other open water bodies will be benefited through generation of income and livelihood by the application of this technology.MPKV-07T-27: Production of Vermicompost from sugarcane trash

Table 6.19 : Vermicompost production from sugarcane trash

Sr. No.	Sugarcane trash production /ha	Vermicompost Production	Present farmer income	Total income Rs.	Doubling farmers Income
1	6.00	4.2 tonne/ha	0.0 (Due to burning of sugarcane trash)	0.00	42,000
2	6.00	4.2 tonne/ha	Incorporation of sugarcane trash in field	42,000	-

- Area under sugarcane in Maharashtra : 7.20 lakh/ha
- Total Vermicompost Production /year : 5.04 lakh tonne /year

6.14.20. PDKV-07 T-27: Problematic soil conservation technology

For improving soil health, productivity and monetary returns in cotton- soybean rotation, it is recommended to apply 25 per cent recommended N through Dhaincha loppings (2 t ha^{-1}) or Neem cake (3 q ha^{-1}) with remaining recommended dose of NPK of cotton (45: 28: 17 kg NPK ha^{-1}) along with RDF of Soybean through chemical fertilizers or Application of 100 % recommended N of cotton and soybean through FYM (11 t ha^{-1} to cotton and 5 t ha^{-1} to soybean)and remaining dose of P & K through phospho-compost to cotton (80 kg ha^{-1}) and soybean (3.8 t ha^{-1}).

- Salt affected soils of Purna Valley

  In salt affected soils of Purna valley in Vidarbha region, growing of dhaincha as a green manuring crop between two rows of cotton (1:1) and in situ burring after 40 DAS is recommended as an alternative to gypsum for improving soil health, soil carbon stock, higher productivity and monetary returns of cotton rotated with green gram – chickpea.

- Conservation Tillage

  It is recommended to adopt conservation tillage (one harrowing and two weeding) and 50 % N through glyricidia green leaf manure (3.5 t ha^{-1}) and compensation of RDF through chemical fertilizers (30:27:8 kg NPK ha^{-1}) as a alternative to FYM (50 % N) for sustaining productivity of cotton, monetary returns and improvement in soil health of Vertisols under rain fed situations.

- Nutrient Management in soils

  In medium deep black soils having sulphur and zinc deficiency application of sulphur @ 30 kg ha^{-1} + zinc @ 2.5 kg ha^{-1} along with recommended dose nitrogen (30 kg) and P_2O_5 (75 kg /ha) is recommended for higher yield, nutrient uptake, nutrient use efficiency, grain quality of soybean as well as improving soil fertility status.

  In zinc deficient medium deep black soils for obtaining higher productivity of soybean, monetary return, uptake of nutrients, improved quality of grain and use efficiency of N and P, the foliar application of zinc through zinc sulphate @ 5 g lit^{-1} or zinc-EDTA @ 2.5 g lit^{-1} at 30, 45 and 60 DAE is recommended.

  In zinc and boron deficient medium deep black soils for obtaining higher productivity of maize, uptake of nutrient and improved grain quality, nutrient use efficiency and nutrient recovery as well as monetary returns the soil application of zinc @ 10 kg ha^{-1} and boron @ 1 kg ha^{-1} along with recommended dose (100: 50: 50 kg ha^{-1} Nitrogen, Phosphorus and Potassium) is recommended.

  For soybean crop, the critical levels of zinc is recommended as 0.65 mg kg^{-1} in soil and 24 mg kg^{-1} in plant at grand growth stage, useful for zinc management in medium deep black swell-shrink soils.

  In zinc and iron deficient soils of Maharashtra, for obtaining higher yield of sweet orange and improvement in fruit quality, soil application of Zn-EDTA @ 50 g /tree and Fe-EDTA @ 100 g /tree or one foliar spray of Zn-EDTA @ 0.5 % and Fe-EDTA @ 1.0 % one month after fruit set along with recommended dose is recommended.

  In sulphur deficient soil, for obtaining higher onion bulb yield and monetary returns and nutrient use efficiency, besides improving soil fertility, soil application of sulphur @ 45 kg /ha through gypsum or sulphur @ 30 kg/ha through bentonite-S along with recommended dose (10 t FYM + 100 : 50 : 50 kg / ha N, P_2O_5 and K_2O) is recommended.

  In sulphur deficient soils, application of 30 kg Sulphur ha-1 through gypsum (250 kg) or bentonite-sulphur (35 kg) along with RDF (60 : 30 : 30 kg NPK ha-1) is recommended to increase the productivity and oil content of Bt cotton under rainfed situation.

  In zinc deficient medium deep black soil, for obtaining higher grain yield of chickpea, nutrient uptake, quality of grain and higher monetary returns besides improving soil fertility, soil application of zinc sulphate @ 20 kg ha^{-1} or two foliar sprays of zinc sulphate @ 0.50 % during flowering and grain filling stage along with recommended dose of fertilizer (20:50:30 kg ha^{-1} N, P_2O_5& K_2O) is recommended.

  For chickpea crop, the levels of zinc 0.64 mg kg^{-1} in soil and 23.03 mg kg^{-1} in plant at grand growth stage are recommended as critical levels useful for zinc management in swell shrink soils.(Source PDKV)

6.14.21. MPKV-08T-28: Technology for management problematic soils

Management of saline soils

- Scraping of soluble salts from surface soil
- Leaching of soluble salts by irrigation with good quality of water
- Provision of open or subsurface drainage for removal of soluble salts
- Ploughing with mole plough at every 4.0 meter interval along the slow
- Green manuring of dhainch or sunhemp in corporation in soil once in a three year
- Use of mulching for different crops
- Growing of salt tolerant crops like wheat, Sugarcane, Cotton, rice, Lucern
- Growing of tree (eucalyptus) on border of land as a biological drainage system
- Management of Sodic Soils
- Provision of subsurface drainage by using perforated pipes for removal of soluble salts
- Mole ploughing at every 4.0 meter interval along the slow for drain out of sodium salt
- Application of gypsum as per gypsum requirement with FYM
- Irrigate soil with good quality of water
- Application of Nitrogen 25% more of the recommended dose with split application
- Irrigate soil frequently with light irrigation
- Use of acid forming fertilizer to crops like Ammonium sulphate, ssp, phosphoric acied etc.
- Green manuring of dhaicha or sunhemp in corporation in soil once in a three year
- Growing of salt tolerant crops like sugarbeet, wheat, Sugarcane, Cotton, rice, Lucern

Validated and Demonstrated Success Stories:

PDKV-SD-01: Success Story of Rabi sorghum growing farmer

Shri. Shashikantji Chaware is a farmer of karanja (Lad) of Washim District, Maharashtra. He owns 130 acre land and having 73 farm animals on his farm.

In seasonal crops in rabi season previously before 3 years he was growing 5 acre wheat and 6 acre gram. But due to more irrigation requirement and less fodder yield of both the crop he decided to grow rabi sorghum after discussion with the scientist of Sorghum Research Unit, Dr. PDKV., Akola. He acquired the information on improved cultivation practices on rabi sorghum and decided to grow rabi sorghum variety PKV-Kranti on 25 acre area. Now he has been growing rabi sorghum since last four years. By changing his cropping pattern from wheat and gram to rabi sorghum he can not only doubled the cropping area with same limited irrigation facility but also get more yield with additional benefit of fodder for his animals in just one irrigation. In addition to this can also increase his milk production because of the good quality fodder he got from rabi sorghum. He fetc.hes more price about Rs. 2800 to 3000 per quintal and produces about 30 to 32 quintal per hectare grain and require cost of cultivation is about 10500 to 11000 Rs/ha. Thus he is getting about Rs 75000 to 85000 net profit from grain sorghum with sufficient fodder to fulfill requirement of his farm animals and thereby increase in milk production.

Figure 6.8 : Rabi Sorghum

Thus though the Karanja region in Vidharbha was not a traditional rabi sorghum growing region Shri Chaware changes the cropping pattern successfully and put an example before the farmers of the region. Many farmers have been visiting to his farm regularly and have been inspired to change their cropping pattern. Now, surrounding rainfed rabi growing farmers in Karanja region are shifting towards rabi Sorghum cultivation

where partial irrigation is available and PKV Kranti rabi sorghum variety has been getting increasingly popular in the region because of the efforts of Shree Shashikantji Chaware.

PDKV-SD-02: Success story of parching sorghum growing farmer

Shri. Ramprasad Ramkrushna Chaware is a farmer of of Vairagadh in Buldhana District, Maharashtra. He owns 25 acre land. In seasonal crops in kharif season previously from last 6-7 years he was growing soybean. But due to more production cost and decreasing yield of soybean similarly to get working capital during the growing season he decided to grow Kharif parching sorghum variety PKV Ashwini. He acquired the information on improved cultivation practices on parching sorghum variety PKV Ashwini from Sorghum Research Unit, Dr. PDKV., Akola. Now by decreasing the area under soybean he is growing parching sorghum variety PKV Ashwini from last 2-3 years. He fetc.hes price about Rs. 80 to 100 per kg for dough stage sorghum in the nearby market at Khamgaon. He produces about 15 to 20 quintal per hectare dough stage grain and getting about Rs 50000 to 60000 net profit from grain sorghum in addition to sufficient fodder to fulfill requirement of his farm animals.

He is an active farmer in village and always using improved cultivation practices and newly developed technologies released by the University. Many farmers have been visiting to his farm regularly and have been inspired to take parching sorghum on some part of their farm. Thus he put an example of an entrepreneurship development for getting working capital before the farmers of Buldhana region.

PDKV-SD-03: Success Story of Pulses Research Unit, Dr. PDKV., Akola under cluster demonstration in Akola district

Pulses research unit has conducted the demonstration on mungbean, urdbean, pigeonpea and chickpea crop with recommended package of practices. As per the results of cluster demonstration (2016-17) the productivity of mungbean is increased by 109% and urdbean 88%, pigeonpea 49% and that of chickpea 116% over average productivity of Vidarbha.

However, the improved package of practices is needed to be adopted over larger farm area in order to double the farmer income.

Table 6.20 : Crop wise impact of cluster demonstrations in Vidarbha region

Sr. No.	Crop	Genetic potential (kg/ha)	Area (acre)	No. of demon-stration	Avg. productivity of Vidarbha (kg/ha)	Productivity under FLD (kg/ha)	% increase over avg. productivity of Vidarbha
1	Mungbean	15-20	1.0	25	547	1148	109.87
2	Urdbean	15-20	1.0	25	577	1089	88.73
3	Pigeonpea	25-30	1.0	50	777	1159	49.16
4	Chikpea	30-35	1.0	37	810	1750	116.05

PDKV-SD-04: Success Story of urdbean variety PDKV Blackgold

Name of the Farmer	:	Shri Narendra Uttamrao Gavhale
Address	:	At-Post Sonala Tq. Akola Dist. Akola (M.S.)
Crop	:	Urdbean
Variety	:	PDKV Blackgold
Area	:	3 Acre intercropped with pigeonpea in rainfed condition
Cost of cultivation	:	Rs. 6900/- per acre
Yield	:	5 q/acre
Market Price(Avg)	:	Rs. 6600/- per q
Total return	:	Rs. 33000/- from one acre
Net Return	:	Rs. 33000-Rs. 6900 = Rs. 26100 per acre
	:	Rs. 65250/- per ha

PDKV –SD-05: Success Story of pigeonpea variety PKV TARA

Name of the Farmer	:	Shri Sudhakar Ramchandra Banait
Address	:	At-Post Madhapuri Tq. Murtiapur Dist. Akola (M.S.)
Crop	:	Pigeonpea (Sole)
Variety	:	PKV TARA
Spacing	:	150 cm x 25-30cm
Area	:	2 Acre under drip irrigation
Cost of cultivation	:	Rs. 20000/- per acre
Yield	:	12 q/acre
Market Price (Avg.)	:	Rs. 5000/- per q
Total return	:	Rs. 60000/- from one acre
Net Return	:	Rs. 60000-Rs. 20000 = Rs. 40000
per acre	:	Rs. 1, 00,000/- per ha

PDKV-SD-04 : Increased Pigeonpea productivity through protective drip irrigation system on contour farming with limited use of chemicals

Name of Farmer	:	Shri. Sudhakar Ramchandra Banait, Age-45
Village	:	Madhopuri
Tq.	:	Murtizapur
Dist	:	Akola
Business	:	Only farming

This farmer has done contours on his field for conservation of every drop of water and well drained condition on farm.

After field preparation, laid down the drip on 5 ft. distance and dripper to dripper 50cm. and drip irrigation was given for 6-8 hrs from 3 to 7th June and dibbled pigeonpea 4 seed per hill on laterals at 30cm distance . Variety were used PKV Tara, BSMR-736 and Ankur prabha and used biocultures (Rhizobium + PSB +Trichoderna) for seed treatment. Then one hour watering was given per day up to arrival of monsoon

Manure and fertilizer management was also done by drip irrigation. He was prepared a mixture of 6 quintal vermicompost + 1 kg trichoderma + 2 kg. rhizobium culture + 2 kg.PSB in one tank and applied through drip irrigation for pigeonpea. Also fertilized 25kg DAP/acre four times through drip at 30 days interval. Intercultivation operations i.e.. thinning, weeding and hoeing was done. Detopping of Tur was done at 40-45 days after sowing.

For pest management - Prepared the mixture of 35 lit cow urine + 12kg neem leaves + 6kg Rui + 6kg sitaphal leaves + 6kg Subabul leaves + 2 kg S-9 culture + 5 kg deshi cow dung + 500g urea in 140 lit water. Kept for 25 days and every day stirred the mixture. Then 4-5 Sprayed 2 lit of Leaf extact mixture in 20 lit water on pigeonpea crop from bud development stage to pod development stage. HNPV 100LE/acre for bollworm larvae management. Lastly used insecticide.

Average yield obtained was 12q/acre since 16 years and cost of cultivation was Rs. 20000/acre and Gross returns was Rs. 60000/- (Av 5000/q market rate) and B:C ratio was 3.00.

PDKV –SD-05: Success Story of Value addition in Groundnut (var. AK 303)

1.	**Name of Farmer**	**:**	**Shri. Prafull Bhaskarrao Fale**
		:	Post- Masa (Dongargaon)
		:	Tq. Dist- Akola
2.	Total land holding	:	9 acre (Father-4 acre and Mother-5 acre)
3.	No. of members in family	:	6
4.	Education	:	Shri. P. B. Fale (M.A. Social Science)

			Sister (D.Ed. B.A.)
		:	Brother (BE Civil)
5.	Previous cropping pattern	:	Soybean-Tur
		:	Cotton
		:	Udid-Tur
		:	Moong-Tur
6.	Changed cropping pattern	:	By addition Kharif Groundnut in 2013-14 2013-14: 9 Q/acre (TAG 24) 2014-15: 10 Q/acre (TAG 24) 2015-16:9 Q/acre (AK 303) 2016-17: 14 Q/acre (AK 303) 2017-18: 10 Q/acre (AK 303) estimated
7.	Initiation of Value addition	:	Total Groundnut production 2016-17 : 88 Q Out of this production he use 60 Q Groundnut production as value addition, 20 Q sell as a seed and 9 Q use as a seed for himself.
8.	Previous Family Income 2013-14	:	15000/- per acre
9.	After value addition	:	Previous Total Income 135000/- @ Rs. 15000/- per acre
10.	Increased Family income Production after Value addition		After value addition now Total Income 40000/- (Income increases by 300 %)
11.	Technology and Techniques	:	Oilseeds Research Unit Dr. PDKV Akola
12.	Processing and Marketing	:	ATMA Akola
13.	Collaborating Agencies for DFI		1.Oilseeds Research Unit Dr. PDKV Akola 2. ATMA, Akola 3. SAO Office, Akola 4. KVK Akola

MPKV-SD-05 : Success story on intercropping of Pigeonpea and Soybean (1:3)

Figure 6.9 : Intercropping of Pigeonpea + Soybean (1:3)

1	**Name of the farmer**	**:**	**Shri. Shailesh Umbare**
2	Address		
	i) Village	:	Narotewadi
	ii) Post	:	Narotewadi
	iii) Tehasil	:	North Solapur

	iv) District	:	Solapur		
	v) State	:	Maharashtra		
3	Contact Details	:			
4	Details of the farm (size, location, water availability, etc.)	:	Size = 9.0 ha, Location: Narotewadi Source of irrigation = Well & bore		
5	Membership in Self Help Group, producers co-operative/company, co-operative society, etc.	:	Member of co-operative society- Narotewadi Member of Custom Hiring Center- Narotewadi Member of Shivratna Farmers Club- Narotewadi		
6	Names of the central sector / state scheme utilized by the farmer and period	:	State Department of Agriculture, NICRA- DLA Project from 2012-13		
7	Technologies / good agricultural practices / facilities / benefits obtained with details	:	Intercropping of Pigeonpea + Soybean (1:2). Use of improved cultivar – Pigeonpea-Vipula, Soybean- Phule Agrani Fertilizer ($N:P_2O_5:K_2O$ kg/ha) – 50:25:25 kg/ha Protective irrigation facilities Seed treatment : Rhizobium 25g + PSB, trichoderma. Increase in yield by 35 % over farmers practice.		
8	Details of results obtained due to adoption of technologies	:	Improved / present production technologies Pigeonpea Soybean		Traditional / past production technologies Sole Pigeonpea
i)	Productivity Grain (q ha-1) –	:	9.51	13.18	10.35
	Straw (q ha-1)		27.10	17.69	30.96
ii)	Cost of production (Rs. ha-1)	:	43000	40000	
iii)	Net income (Rs. ha-1)	:	51565	21555	
iv)	Price realized (Rs. q-1) - Grain -	:	5050	3000	5050
	- Fodder		5307	1770	9288
v)	Natural resources saved / conserved like soil, water, etc.	:	30 per cent more moisture conserved due to ridges and furrows Mitigate the drought Monetary returns increased by 58.19 per cent		
vi)	Product quality improvement	:	--		--
9	Marketing strategy – Access to market	:	Private market		
10	Factors contributing to success	:	In-situ moisture conservation (Ridges and furrows) during kharif season, Sowing on ridges and Furrows One weeding and two hoeing in kharif crops Use of improved cultivar and recommended fertilizer dose. Farm machinery Usage Ridger planter Tractor Drawn M.B. plough Cycle hoe		
11	Any other relevant information	:	Encouraged other farmers to take this activity		

PDKV-SD-06: High density planting of Straight variety of Dr PDKV AKH081 cotton with intercropping under tribal area of Akot tahsil of Akola district

Bt cotton grower shifted to organic farming with Straight variety of cotton due to severe sucking pests attack. A farmer Shekhadsingh Aabassinh Chavan of Borva, tribal village of Akola dist grown Dr PDKV Hirsutum variety AKH081 which is Short duration matured in 140 days. Added 1 ton FYM and also used 1 ton biodynamic compost/acre (S-9 culture) before sowing and Used high density population about 1.66 lakh/ha (60x10cm) with 15 kg seed rate /ha and after 8 row of cotton two row of Pigeonpea PKV Tara 2 kg seed rate/ha was grown as intercrop. . Biocultures were used for seed treatment. Furrow opening was done on 40 days after sowing for better conservation of moisture under rainfed. IPM was used for bollworm management. (NSKE 5%, taral khat, cow urine was used). The HDPS seed cotton yield was 1875 kg/ha and 500 kg Pigeonpea grain yield with straw for animals. And farmers practice with Bt cotton Ajeet hybrid was 20.75 q/ha Intercrop yield was bonus and it was profit over farmers practice. SCY and net profit was higher due to Short duration variety AKH081 variety and PKV tara for pigeonpea, which is drought tolerant , moisture conservation practice also adopted and addition of FYM improved moisture status which helped for boll development and seed development under rainfed. Improved yield of FLDs on intercropping and performed better under climate change because this year monsoon was started right time but after sowing there was dryspell of 25-30 days in the region

Net returns of HDPS cotton with pigeonpea intercrop was Rs 67938/haand B: C was 2.44 and B: C of farmers practice was 1.94 So better remuneration with intercropping system with cotton under rainfed area..

Intercropping with pigeonpea in (8:2) with cotton increased more additional profit and moisture conservation practices also improved moisture status which helped for boll development.

Table 6.21 : HDPS in cotton demonstration Year 2015-16

Name of Farmer		SCY Kg/ ha	GMR(Rs)			COC(Rs)		NMR(Rs)		BC	
	IT	Intercrop	FP (Bt cotton)	IT	FP	IT	FP	IT	FP	IT	FP
Shekhadsingh Aabassinh Chavan Borgao Tq-Akot District -Akola	18.75	5	20.75	115000	84038	47063	43313	67938	40725	2.44	1.94

Market price of cotton Rs 4000/q and Pigeonpea Rs 8000/q (2015)

Figure 6.10 : Cotton (AKH081) + Pigeonpea (8:2) at Shri Chavan field tribal village

PDKV-SD-07: High density planting of arboreum cotton under organic farming

A famers started organic farming in 2010 cropping system and earlier cropping was Hybrid jowar, soybean and Bt cotton .A women farmer Sau Ambika Pandurang Gunjkar of Takarkhed Helga village, Tq- Chikli and dist Buladana grown Dr PDKV Arboreum deshi variety AKA-7 which is Short duration matured in 140days. Biocultures were used for seed treatment. Added 6 ton FYM before sowing and Used high density population about 1.66lakh/ha with 15 kg seed rate /ha. Furrow opening was done (MCT) on 45 days after sowing for

better conservation of moisture under rainfed. IPM was used for bollworm management. (NSKE5%, cow urine was used). The seed cotton yield was 650kg/acre which was 21% more over farmers practice. SCY and net returns were higher due to deshi variety is drought tolerant,moisture conservation practice, addition of FYM improved moisture status, which helped for boll development under rainfed. This year monsoon was delayed by one month and withdrawal in first fortnight of Sept 2014. The dry spell during flowering and boll development of cotton. HDPS demonstration on MCT (opening of furrow in every row of cotton 40 after days sowing) was performed better under climate change .

Table 6.22 : HDPS in cotton demonstration Year 2014-15

Name of Farmer	SCY Kg/ha			GMR(Rs)		COC(Rs)		NMR(Rs)		B;C	
	IT	Inter-crop	FP (Bt cotton)	IT	FP	IT	FP	IT	FP	IT	FP
Sau. Ambika Pandurang Gunjarkar Village –Undri Chikali Tq Dist Buldana	1625	-	1275	65812	51637	28000	25000	37812	26637	2.35	2.06
Market price of cotton Rs 4000/q											
IT- Improved practice HDPS cotton and FP - Farmers practice Bt cotton											

Net returns of HDPS cotton with moisture conservation practices was Rs 37812/haand B: C was 2.35 and B: C of farmers practice was 2.06. Organic cotton with HDPS cotton by using moisture conservation practice improved the seed cotton yield of arboreum under rainfed ecosystem.

PDKV-SD-08: Success story of High density planting of cotton with intercropping of Pigeonpea under climate change.

A farmer Shekhadsingh Aabassinh Chavan of Borva, tribal village of Akola dist grown Dr PDKV Hirsutum variety AKH081 which is Short duration matured in 140 days. Added FYM and also used biodynamic compost before sowing and Used high density population about 1.66 lakh/ha (60x10cm). Furrow opening was done on40 days after sowing for better conservation of moisture under rainfed. The seed cotton yield was 1875 kg/ ha and 500 kg Pigeonpea grain yield with straw for animals. Intercrop yield was bonus and it was profit over farmers practice. SCY and net profit was higher due to Short duration variety AKH081 variety and PKV tara for pigeonpea, which is drought tolerant, moisture conservation practice also adopted and addition of FYM improved moisture status which helped for boll development and seed development under rainfed. Improved yield of FLDs on intercropping and performed better under climate change because this year monsoon was started right time but after sowing there was dryspell of 25-30 days in the region

The net profit due to ICM was Rs 15495/ha and with intercropping was Rs 40992/ha. Additional profit due to FLD on moisture conservation practices in cotton was Rs 3041/ha,. Whereas FLDs on intercropping with cotton was Rs 26732/ha and Average BC ratio was 1.70.Market. Price of Pigeonpea (>Rs 8000/q) and remuneration was highest in intercropping system with cotton.

Intercropping with pulses (pigeonpea) with cotton increased more additional profit and moisture conservation practices also improved moisture status which helped for boll development. Both type of FLDs performed better under climate change was observed.

PDKV-SD-9: Success Story of Arboreum cotton under High density planting with organic farming under climate change

A women farmer Sau Ambika Pandurang Gunjkar of Takarkhed Helga village and dist Buladana grown Dr PDKV Arboreum deshi variety AKA-7 which is Short duration matured in 140 days. Added FYM before sowing and Used high density population about 1.66 lakh/ha. Furrow opening was done on 45 days after sowing for better conservation of moisture under rainfed. The seed cotton yield was 650 kg/acre which was 21% more over farmers practice. SCY and net profit was higher due to deshi variety is drought tolerant,moisture conservation practice and addition of FYM improved moisture status which helped for boll development

under rainfed. This year monsoon was delayed by one month and withdrawal in first fortnight of Sept 2014. The dry spell during flowering and boll development of cotton. FLDs on MCT was performed better under climate change . This year monsoon was delayed by one month and withdrawal in first fortnight of Sept 2014. The dry spell during flowering and pod development of pulses and boll development of cotton resulted into low yield of cotton and intercrops. The net profit due to ICM was Rs 14035/ha and with intercropping was Rs 13673/ha. Additional profit due to FLD on moisture conservation practices in cotton was Rs 4805/ha.

This year monsoon was delayed by one month and withdrawal in first fortnight of Sept 2014. The dry spell during flowering and pod development of pulses and boll development of cotton resulted into low yield of cotton and intercrops. The net profit due to ICM was Rs 14035/ha and with intercropping was Rs 13673/ha. Additional profit due to FLD on moisture conservation practices in cotton was Rs 4805/ha.

NRCP-SD-10 Successful pomegranate production in Osmanabad district

Farmer Mr. Subash Kisanrao Patil, an ordinary farmer from Pimpalgaon (Dhola), Taluka Kalam, District Osmanabad (Kalam- Dhoki Road), Maharashtra (Contact 09423341427; 09763474868) having 10 acres of land for cultivation. Till 2001 he was growing only sugarcane, banana and cotton and says was always in debt. Then he started replacing these crops with pomegranate and confesses pomegranate gave him a lot as he earned Rs. 25-50 lakhs/year in different years from sale of pomegranate produce from 4 acres and pomegranate air layered planting material from 4 acres . His present well-furnished marbled house in 2500-3000 sq.ft., farm facilities like tractor, power tiller, blower, assured irrigation facilities and personal vehicle of reputed brands like Inova, Bolero speak the success of a pomegranate farmer and the role of pomegranate cultivation in enhancing farmers income.

NRCP-SD-11 Pomegranate production transformed labourer into Krishi Bhushan Farmer in Solapur district

Shri Vishwasrao Kachare once an ordinary farm labourer in Telangwadi village of Mohol in Solapur in 1970 is now an owner of 320 acres of land with 1,10,000 pomegranate trees along with other horticultural and agricultural crops, with a real estate business in Mumbai and is now planning for establishing processing industry. Annually Produces 4000 tonnes of pomegranate for national market and export. His efforts were awarded and he is a proud recipient of Krishi Bhushan in 1996 a by the Govt. of Maharashtra, Shri Jagjivan Ram Award in 2006 by ICAR, N. Delhi and Krishi Samrat Puraskar in 2007 by Zhuari Industries Pvt. Ltd. Goa.

NRCP-SD-12 Successful pomegranate production in drought prone areas of Sangli and Solapur districts

Atpadi taluk in Sangli district of Maharashtra is a drought-prone area where the villagers earned their livelihoods only by migrating to cities. About 25 years back started growing pomegranate. Today a large number are millionaires.

Aran village in Solapur district of Maharashtra has no irrigation facilities and meager rainfall. Most of the villagers worked as labours in the adjoining villages, about 15-20 years ago. Today with 1,000 acres under pomegranate, the village is now short of labour to get the operations completed in time.

DBSKKV-SD-13: Success stories in Konkan region on fruit processing

1) **Shri. Dhananjay Yadav**
   At/Post. Walne Post- Jalgaon
   Tal-Dapoli Dist. Ratnagiri
   Unit – Cashew processing
   Capacity- 100 t/year

2) **Dr. Vivek Yashvant Bhide**
   At/Post – Malgund,
   Tal & Dist – Ratnagiri
   Unit – Mango Processing
   Capacity : 2 Lakh t/year

Technology and Extension Measures for DFI

- Processing 20-25% produce per year
- Selling rate of Mango farm produce Rs. 30-40 /kg.
- Cashew nut Rs. 100-120 / kg.
- Need to utilize atleast 40% of the mango produce, all kokum produce, cashew nut, cashew apple, jackfruit and karonda

- Need to run the processing units for at least 6-8 months in a year
- Need to use the self-help group for mass scale production of post-harvest products
- Need to develop linkages between farmers, processors, retailers and consumers
- Processed productions give double the price

DBSKKV-SD-14: Success story on Kokam fruit production in Konkan region

1) **Shri. Shivram Arolkar**
   At/Post. Goveri, Tal-Kudal,
   Dist. Sindhudurg
   Area - 3.00 ha
   Production - 8 t/ha
   Income - Rs. 4 to 5 lakh.

2) **Shri. Balkrushna Ganesh Gadgil**
   At.Post Vetore, Tal. Vengurla
   Dist. Sindhudurg
   Area -1 ha. (Border plantation in cashew orchard)
   Production - 8 to 10 t/ha.
   Income - Rs. 2,00,000/ha.

Technology and Extension Measures for DFI

- Productivity : 8-10 t/ha.
- Income – 1,60,000/- per year
- Planting of Konkan Amruta and Konkan Hatis varieties with new plantation
- Integrated nutrient management and adoption of improved technologies
- Professional management
- Application of recommended dose of fertilizers 50 kg FYM, 1 Kg N, 0.5 Kg P_2O_5, 0.5 kg K_2O per plant per year. Application of 3% KNO_3 twice at the interval of 15 days after fruit set gives 20-25 days early maturity. (100% harvest)
- Utilization of harvested fruits for preparation of post-harvest products like kokum syrup, Kokum agal, Kokum soal and Kokum butter

MPKV-SD-15: Success story on Low HP tractor operated onion seed BBF planter

Generally, the onion seeds are sown in nursery and transplanted with row to row spacing of 15 cm and plant to plant spacing of 7.5 cm to get optimum yield. During onion cultivation, transplanting of seedlings, weeding and harvesting are the most labour intensive operations that are presently done manually in India. The labour requirement in manual transplanting of onion seedlings is as high as 100 – 120 man- days/ha as 8.9 lakh seedlings per hectare are to be transplanted. Because of high requirement and shortage of labour, the area under onion cultivation is low and can be increased by mechanization of this crop. Work on semiautomatic transplanters have been done in India for sowing of wide row and widely spaced vegetable crops, whereas very little work has been done regarding transplanting of onion. A progressive farmer of Maharashtra has developed tractor drawn onion transplanter but the plant population achieved by the machine was only 40% as compared to the recommended plant population.

Onion can also be grown by direct seeding method which is labour saving. The direct seeding of onion seeds is evolving technology where new techniques of soil preparation, irrigation, fertilizer and pesticide application, seed production and seed processing continue to interact to increase the probability that a well synchronized population of the desired plant density is established. The seed of onion is of very small size, having low density and irregular shape which poses problem in precision planting. To overcome these difficulties 'Seed Pelleting Technique' is being used in the developed countries. In this seed is enclosed in to small quantity of inert material just large enough to produce a globular unit of standard size to facilitate precision planting. In India very little effort has been done for seed pelleting and development of precision planter/drill for sowing the small size, light weight and irregular shaped seeds.

Nashirabad is about 20km from Jalgaon city. The farmers grown cotton, soybean, gram etc. but recently the area of pomegranate and onion increased. The Jain irrigation system limited started contract farming of onion by using bullock operated seeddrill. In this method, Bed making is done by tractor and after by using bullock operated seed drill the sowing of onion,but pelleted seed is required. Shri Chandan Rane studied this machine and developed tractor operated onion seed bbf planter. In which bed making and sowing has been done

simultaneously and did not required pelleted seeds.Keeping in view, the aforementioned aspects, a study was planned to develop a onion seed bbf planter for direct sowing of onion seed. Initially the disc which lift the seed made from acrylic sheet and taken several trail. We show that there were only one or two seed lifted and there is no requirement of pelleted seed or making the seed roung for easy lift.

Benefits of direct sowing

- Reduced transplanting cost
- Required only one labour (Driver only)
- Simultaneously bed making and sowing possible
- DO not required to raise nursery so reduced the cost and time
- Required less time (about 20-25 days early than transplanted) for harvesting after sowing as compared to transplanted
- Also, Sown sesamum and mustard by using this planter

Figure 6.11 : Low HP tractor operated onion seed BBF planter

Table 6.23 : Features and specifications of onion seed BBF planter

Sr. No	Features	Specification
1	Weight, kg	90
2	Seed box material	Non corrosive 1.5 mm zinchodine
3	Seed box capacity, kg	4
4	Crop to be sown	Onion, sesamum
5	Number of rows	9
6	Distance between two rows	11.56 cm
7	Distance between two plants	5-10 cm
8	Required power, hp	15-25
9	Bed length, cm	104
10	Furrow depth, cm	30-40
11	Distance between two furrows	138.78
12	Seed requires per acre, kg	1.5-3 (as per adjustment)
13	Labour required	1 (driver)
14	Notches on sowing disc	10
15	Time required to sown/acre	45 minutes
16	Diesel required to sown one acre	1.5 litre (15 hp tractor)
17	Time for harvesting after sowing	About 5 months

Figure 6.12 : Sowing plot by using onion seed BBF planter

DOGR-SD-16: Success Story of Tribal Sub-Plan on Onion and Garlic

Onion and garlic are important commercial crops which can improve livelihood of farmers. The tribal belt of Nandurbar in Maharashtra has congenial climatic conditions for production of onion and garlic at commercial level. But cultivation of these crops was limited to the kitchen garden only before the initiation of Tribal Sub-Plan (TSP) in this area by ICAR-DOGR. The scheme was initiated in this area in April, 2013. About 350 tribal farmers were selected from 35 farmers groups. Each group undertook demonstrations on onion and garlic cultivation in one acre of land in Navapur, Akalkua and Dhadgoan Talukas of Nandurbar. In total, 49 demonstrations on newly improved varieties of onion and garlic and improved production technology were undertaken. Kharif onion production was also demonstrated in Navapur Taluka of Nandurbar. Fifteen tribal villages have been benefited by commercial cultivation of onion and garlic. More than one thousand tribal farmers have been trained by organizing 9 field days and 4 trainings by ICAR-DOGR.

Most of the farmers of selected areas now cultivate onion and garlic on commercial scale. Onion and garlic are giving more profit than traditionally grown crops in these areas. Farmers have earned a net income of Rs. 80,000-1,00,000 per acre by production of about 120 q bulbs of onion variety Bhima Shakti during rabi season and earned same net income by production of about 80 q bulbs of Bhima Super in kharif season. Cultivation of garlic at commercial level has also been introduced in this belt. By garlic cultivation Rs. 80,000-90,000 per acre is earned by production of about 30 q bulbs per acre of Bhima Purple.

Nandurbar areas also has favorable climatic conditions for onion seed production. Vast availability of honey bees which are main pollinator of onion further enhance the potential of seed production in this area. Production of onion seed was also demonstrated under TSP in this area. Farmers have earned 1,00,000-1,20,000 per acre net income by production of about 250 kg seeds per acre of Bhima Kiran. ICAR-DOGR intends to carry this scheme further to new areas.

Figure 6.13 : Tribal Sub-Plan on Onion and Garlic

DOGR-SD-17: Success Story of Kharif Onion Production In Vidarbha region

Kharif onion production is not a tradition in Vidarbha region of Maharashtra. The farmers of Vidarbha generally cultivate Rabi onion. But due to the factors like shortage of water, irregular electric supply, high temperature rabi onion production is also becoming less profitable. Keeping these constraints in view, Shri. Namdeorao Adhau, a progressive farmer of Patur, Akola of Vidarbha region (Maharashtra), decided to cultivate Kharif onion in his field. He was advised on Kharif onion production technology developed by DOGR for growing onion crop on Broad Bed Furrows (BBF) with micro irrigation and provided with technical

bulletins and CDs published by DOGR. First he planned for 4 acre and used variety Bhima Super developed by DOGR and raised his nursery on raised beds with sprinkler irrigation and transplanted seedlings on BBF with sprinkler irrigation in the first week of August. He has followed fertilizer doses and plant protection recommendations as per DOGR guidelines. He harvested onion after 95 days and got 10 ton marketable onion per acre and sold right at the field @ Rs.30 per kg which gave him total income of Rs. 3 lakh per acre. His cost of cultivation for onion was Rs. 40,000 per acre.

Paradoxically in the Kharif season in Maharashtra, there were yield losses to the tune of 30-60%. Yield level was 2-4 t/acre planted in flat beds while raised bed planted recorded yield of 10t/acre. DOGR has popularized "Kharif Onion Production Technology". Kharif onion plays an important role in supply chain management from October to January all over the country.

DOGR-SD-18: Success story of high yielding Garlic variety "Bhima Purple"

Bhima Purple a high yielding garlic variety developed by the ICAR-Directorate of Onion and Garlic Research (DOGR), Rajgurunagar has become a success story in Maharashtra and adjoining states. This variety had been recommended at national level in 2nd Annual Group Meeting of AINPORG held at Ooty (TNAU, Coimbatore) during 29-30 April, 2011 for cultivation in Andhra Pradesh, Bihar, Delhi, Haryana, Karnataka, Maharashtra, Punjab and Uttar Pradesh. It matures in 135-140 days after planting and has light purple bulbs with good storability. It is also field tolerant to thrips and foliar diseases.

Mr. Vishnu Ramchandra Jare, a farmer from Bahirwadi, Ahmednagar (Maharashtra) had purchased 1 kg mother bulbs of Bhima Purple from DOGR in 2007 and raised garlic crop as per DOGR recommended technology. He conducted trial with different garlic varieties and found Bhima Purple to be the best yielder. After multiplication he has raised commercial crop in last six years and obtained a record net yield of 40 q/acre of uniform bulb shape and colour. He earned a net profit of Rs 2.0 lakh/acre by selling garlic bulbs @ Rs. 80-100/kg as seed to other farmers. He is continuously multiplying Bhima Purple along with another farmer Mrs. Lata Arjun Konthivire from Jeur, Ahmednagar. In 2014-15, both the farmers planted Bhima Purple in about 40 acres and harvested bulbs were sold as seed directly to different farmers from Maharashtra, Karnataka, Gujarat and Madhya Pradesh. This variety is now grown over 600 acres in different states. Most of the farmers are often earning a net profit of more than Rs. 1.0 lakh/acre by cultivating Bhima Purple. Mr. Jare who is the recipient of Late Vasantrao Naik Krushi Bhushan Award (2012) and Mahindra Samriddhi India Agri Award (2013) for his realistic achievements in cultivation of garlic gives due credit to DOGR for his achievements.

DOGR-SD-19: Success story of white onion variety "Bhima Shubhra" in Vidarbha region

White Onion is preferred over red onion in the Vidarbha region of Maharashtra. Directorate of Onion and Garlic Research (DOGR) developed a high yielding white onion variety 'Bhima Shubhra'. This variety was recommended in the workshop of All India Network Research Project on Onion and Garlic at Bidhan Chandra Krishi Vishwa Vidyalaya, Kalyani during 18-19th April 2013 for cultivation in kharif and late kharif seasons. This variety matures in about 110-115 days after transplanting during kharif and 120-130 days after transplanting in late kharif.

Shri Namdeorao Adhau, from Patur, Akola (Maharashtra), purchased 5 kg seed of 'Bhima Shubhra' from DOGR and sowed onion crop on 1.25 acre area on raised bed as per recommended technology of DOGR. He obtained a record marketable yield of 21 tonnes/acre of good quality bulbs with uniform size and without doubles and bolters.

He earned a net profit of Rs. 2.5 lakhs by marketing the produce of 'Bhima Shubhra'. Impressed by the performance of this variety, he decided to disseminate the technology to the farmers in his vicinity. Shri Adhau formed a group of about 300 farmers from twelve villages of the region. Now this group is promoting the cultivation of 'Bhima Shubhra' in an area of more than 750 acres in these villages. Most of the members of this group are often earning a net profit of more than Rs. 1.0 lakh/acre.

Shri Adhau displayed the bulbs of 'Bhima Shubhra' in various agriculture exhibitions including at 'KRISHI VASANT' - a National Agriculture Exhibition held at Central Institute for Cotton Research (CICR), Nagpur during 9-13th February, 2014. Shri Pranab Mukherjee, Hon'ble President of India was very much impressed by the quality of bulbs of onion variety 'Bhima Shubhra' being displayed by Shri Adhau. Shri Mukherjee remarked 'Bhima Shubhra' as the King of Onion.

Figure 6.14 : White onion variety "bhima Shubhra"

DOGR-SD-20: Success story of Mera Gaon Mera Gaurav adopted villages in Pune district

Under 'Mera Gaon Mera Gaurav' scheme, DOGR scientists guided farmers of the adopted villages. Shri Ravindra Namdeo Gorde, farmer of Gosasi village, District Pune was one of them. He has narrated that he got tremendous increase in onion bulb yield after applying ICAR-DOGR technologies. According to him previously he was cultivating onion crop by using traditional practices. He was spraying pesticides and insecticides after seeing incidences of diseases and insects. Now he takes precautions before diseases and insects occurs. He does treats onion seed with thirum before sowing in nursery. He transplants onion seedlings after dipping roots in carbendazim and carbosulfan solution for two hours. Afterwards, he sprays insecticides and pesticides time to time as per DOGR advice. Last year on 22 July 2015, Shri Gorde had sown seed of Bhima Shakti in nursery. He transplanted seedlings on 5 September 2015. He harvested onion crop on 25 December 2015 and sold onion in market on 5 January 2016. Shri Gorde was previously getting only 60 bags (1 bag = 65 kg) /acre of onion bulbs. But last year after using advance technology of onion cultivation, he got 150 bags of good quality onion bulbs in one acre. As his onion bulbs were of good quality, he received market rate of Rs. 21 per kg. Previously, he was getting only Rs. 10 per kg.

Figure 6.15 : Mera Gaon Mera Gaurav

In this way, Shri Gorde has been benefitted due to advice of scientists of ICAR-DOGR under 'Mera Gaon Mera Gaurav' scheme.

MPKV-SD-21: Success Story of "Siddharth Mushrooms" in Ahemednagar district

Mr. Pawar Kiran Sadashiv borned on 12th June, 1974, in village Loni (Bk.), Pravaranagar of Ahmednagar district of Maharashtra in poor family. He completed his Diploma in Chemical Engineering in the year 1996-97. Initially he was interested in service, but he could not get a good job. Meanwhile, he joined marketing company where he had to travel more door to door for selling domestic appliances. He was not satisfied with this job, but it opened so alternatives before him. He continued this job for 1½ years. During this period, he saw farming in various villages and it developed interest in his mind about farming and allied opportunities. One day he had seen advertisement "Mushroom Pikawa Aani lakh kamava" published in self-employment generation unit of a private agency in Daily Sakal newspaper and contacted the organization for training. But he did not get proper technical guidance and contacted the AICRP on Mushroom, College of Agriculture, Pune for detailed knowhow about the oyster mushroom cultivation and spawn production. Further he attended different trainings, seminars and workshops organized by DMR, Solan(HP) to get sufficient technical knowledge about mushroom technology.

He started his own mushroom cultivation unit at his residence in Loni (Bk), District-Ahemadnagar, State-Maharashtra in 1998 with 20 kg/day production. But marketing was the main constraint for him. Those agencies who advertised for marketing of mushroom after contacting denied buying of mushroom. So, he decided for marketing of his fresh and dry mushroom. With his past marketing experience, he got success in marketing of fresh and dry Oyster mushroom mainly to hotels, Big Bazaars, supermarkets and directly to the consumers. It built his confidence and increased the production capacity as per market demand and also started marketing of fresh and dry oyster mushroom of other mushroom growers. During marketing, he learnt that there is vast scope for good quality mushroom spawn production. To get more detailed technical knowledge of spawn production he completed spawn production training at AICRP on Mushroom, College

of Agriculture, Pune in 2001 and started small spawn production unit with 500 kg/month capacity with the cultures provided by AICRP on Mushroom, Pune Centre. As the demand grows, he developed well equipped spawn laboratory and as on today producing more than 5 MT spawn/month.

Figure 6.16 : "Siddharth Mushrooms" in Ahemednagar district

He visited different states for marketing of mushroom, spawn supply and consultancy. With the help of different NGO's engaged in tribal development in Gujrat and Madhya Pradesh, he is guiding more than 125 units of oyster mushroom cultivation. He is being invited for lectures on oyster mushroom to different colleges, KVKs, Forest departments etc. Now he decided his mission for initiating the entrepreneurs for hygienic and clean mushroom production for export marketing and processing of mushroom.

MPKV-SD-22: Success Story of "Quality Oyster Mushroom Farm", in Satara district

Mr. Sandeep Nathuram Kumbhar borned on 10th October, 1984, in village Vadgaon (Umbraj) of Satara district of Maharashtra in poor family. He completed his education up to B.Sc. (Electronics) D.C.M. and could not complete his higher education. As his background is from farmers family during these days he came across one article published by Mycologist, All India Coordinated Mushroom Improvement Project, Pune Centre. Then he approached to the mushroom project for training on oyster mushroom cultivation. Initially he started on small scale production in his hut, but he faced lot of problems in marketing of the produce.

He rushed to Pune, Mumbai and Satara cities which are adjoining to Vadgaon (Umbraj). There also he could not to get good response from consumers. But his enthusiasm power does not permit him to become nervous. He took lot of efforts to develop market and finally with help of his family he established his own market by trade name "Quality Mushroom" and developed a good position for mushroom in Pune, Kolhapur, Bhopal and Mumbai market.

Since the initiation of his mushroom cultivation, he maintained his touch with scientists of Solan and Pune. For large production of mushroom basic infrastructure facilities were established by him with financial assistance from IDBI, Bank amounting Rs. 11.25 lakh and refunded large amount in last three years. Now the infrastructural facilities are well developed. He had expanded the mushroom cultivation capacity up to 100 kg per day with total of 36 tonnes of mushroom per annum.

He decided to produce value added products from oyster mushrooms, for this he took Rs. 10 Lakh sanctioned by Dhanvantari Co. Credit Society and established basic infrastructure for drying and value addition in mushroom. He is marketing the fresh mushroom @ Rs. 140/- per Kg and dry mushroom @ Rs. 750/- per Kg with 50% net profit from it. In his mushroom farm he has engaged 10 labours. He developed four new oyster mushroom farms in adjoining areas and provide them technical expertise. From the point of expansion he is motivating and providing guidance to new mushroom growers.

MPKV-SD-23: Success stories of AICRP on Goat (Sangamneri field Unit)

Sangamneri field unit under MPKV, Rahuri is taking the efforts for improvement of Sangamneri and alike Sangamneri goats (a threatened breed) in 29 villages in three districts viz., Ahmednagar, Pune and Nashik by providing elite breeding bucks and technical guidance to goat keepers and succeeded in Conservation,improvement in Sangamneri goat as well as economic upliftment of goat keepers.

Major Achievements:

- Population of Sangamneri goats increased by 53.23 per cent over the last year in registered clusters, however the population in breeding tract increased by 352.85 per cent i.e.. 3759 during 2006-07 to 17023 during 2015-16
- The body weights at 1, 3, 6, 9 and 12 months of age were improved by 2.04, 5.70, 12.57, 10.43 and 13.14 per cent, respectively over the baseline performance
- The improvement in milk yield over the baseline population was 51.79 per cent
- Instrumented in establishment of 2 goat association and one production company
  - ✓ Ahilyadevi Holkar Goat Association, Sangamner
  - ✓ Savitribai Phule Goat Production Company Ltd., Dodi, Tal- Sinnar, Dist-Nashik
  - ✓ Nalawane Pashupalan Sanghani Jaiva Vividhata Sangh, Dist-Pune

MPKV-SD-24: Successes Story on Sangamneri goat in Ahemednagar district

Shri. Sharad Mahadev Pawse,

A/P-Hivergaon Pawsa, Tal- Sangamner, Dist- Ahmednagar

Age : 35 yrs.

Details of Management: He is small farmer with land holding of 1.25 acres. He rears the goats since his childhood, at present maintaining the flock 50-60 heads. The goats are totally maintained under extensive system i.e.. 6-7 hours grazing. The concentrate provided only if available. The house for goat is Kaccha type with *murrum* floor. Vaccination and deworming is followed as intervention of AICRP.

Technology adopted :

- Using the elite Sangamneri buck for breeding
- Replacing the buck by every year
- Timely Vaccination and Deworming
- Selling the animal on body weight basis

Impact of Technology:

The flock of mixed population is now upgraded to Sangamneri as a result of consistence use of elite Sangamneri buck since last 13 yrs. The body weights are improved from 12-15 kg to 22-25 kg at saleable age. Twining is also enhanced up to 60-70 per cent. Awareness is developed towards timely vaccination, deworming and feeding of mineral mixture.

Economics :

The rearing cost of goat is very less as the flock is under extensive system managed by himself. Selling 60 kids at the age of 4-6 months after achieving the body weights of 18-20 Kg. since last 3 yrs. He is selling the adult animal for rearing and breeding to other goat keepers. The animals are sold on live weight basis at the rate of Rs. 270 per kg live weight. He earns 1.5 to 2.0 lakhs per annum.

With help of small goatery he brought his land under irrigation by establishing a lift irrigation system and the cropping pattern is totally changed.

MPKV-SD-25: Successes Story on Sangamneri goat

Shri.Babasheb Suryabhan Tagad,

A/P- Ambi Tal-RahuriDist- Ahmednagar

Age : 55 yrs.

Details of Management:

Mr. Tagad is a small farmer with holding of 2.00 acres of non-irrigated land, rearing flock of 30-35 goats totally on extensive system. Adopt grazing for 6-8 hours as per availability of grazing land. The goat keeping is his traditional business. Previously local goats were maintained, now he is keeping Sangamneri buck for breeding since last 10 yrs. The vaccination and deworming is provided by AICRP as an intervention. The flock maintained only on grazing, no supplementary fodder or concentrate had been given.

Technology adopted:

- Sangamneri buck for breeding with yearly replacement
- Regular Vaccination and Deworming
- Preparing the bucks for idd.
- Selling the animal on live weight basis

Impact of Technology :

The growth rate is drastically increased i.e.. from 10-15 kg to 17-18 kg saleable age. Most of the goats are giving twin and triplets i.e.. higher growth and enhanced prolificacy is the major impact.

Economics :

The maintenance cost for goat keeping is as good as zero. He is selling 25-30 kids to local market and prepares 2-5 bucks for idd purpose. He earned Rs. 45000/- by selling two bucks for idd purpose and earned Rs.70000/- by selling 28 kids in last year. He purchased one Tempo (APPE) for his son by selling the kids and bucks and developed additional source of income for his Son.

Govt.-SD-26: Success story of Ramagad – A Model Village

Ramagad village is located in Daryapur Tehsil of Amravati district in Maharashtra, India. Daryapur is nearest town to Ramagad village. As a result of continuous efforts, village Ramagad is developed as Model village. Out of the total 250 ha cultivable area 75 ha is under Contour cultivation with Vegetative Contour Key Line for in-situ soil and moisture conservation and Farm Ponds for harvesting runoff and recycling for Protective Irrigation.

Figure 6.17 : Contour cultivation in village Ramagad

Figure 6.18 : Protective irrigation from farm pond

The technologies developed at University were implemented on farmers fields in the Ramagad village. The response for the adoption of technologies in this village was appreciating.

Figure 6.19 : Technology (Brushwood inlet spillway) developed under NAE programme for the protection of inlet of farm pond

Over the period of last 5 years, about 32 new farm ponds were constructed by Agri. Department through various Government Subsidy Scheme (100%) which has created the storage up to 0.7 lakh m^3 and during last year the destiltation of 2 village tanks of 90x90x3 and 110x110x3 m size was undertaken through Jalyukta Shivar Abhiyan of Govt. of Maharashtra in participatory mode which has a storage capacity of 0.5532 lakh m^3.

Figure 6.20 : Farmers providing protective irrigation from village tank

Stored runoff was recycled during kharif season for protective irrigation for >100 ha and during rabi all the 32-40 farm ponds and two village tanks were full of water with the storage of 1.25 lakh m^3. Due to these interventions the double cropping is assured. During this year the Chickpea after Soybean was now possible because of water resource developed through farm ponds/village tanks. Farmers of this village are fully convinced to adopt the two-tier rain water management system as they are getting benefits in terms of enhanced crop productivity.

Govt.-SD-27: Success story of Nardoda – A Model Village

On the similar line of the Ramagadh the Village Nardoda, Tehsil – Daryapur, Dist. – Amravati is also developed as model village and following interventions were promoted as NAE programme activities under Jalyukta Shivar Abhiyaan of Maharashtra Govt.

- Contour cultivation with vegetative contour key line on 60 ha area
- BBF and opening of furrows (area around 30 ha)
- Construction of square basin before commencement of rains (25 ha)

Figure 6.21 : Construction of square basins before commencement of rains

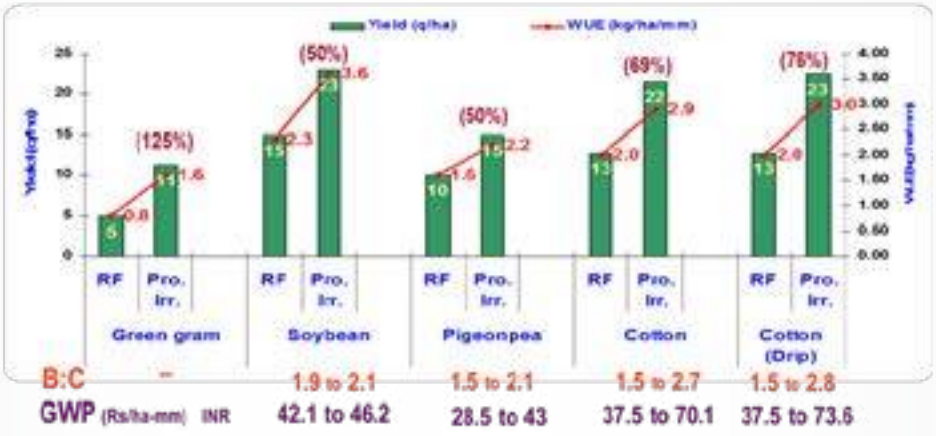
Figure 6.22 : Establishment of contour key line in Saline tract of Purna river valley (Vidarbha)

With the initiative efforts under NAE programme over the period of last 5 years, about 65 new farm ponds and one ENB were constructed by State Agri. and Minor Irri. Department through various Government's 100% Subsidy Schemes which has created the storage upto 2.18 lakh m^3 and presently the construction of 20 farm ponds and one ENB was completed by the end of the month of May 2016 under Jalyukta Shivar Abhiyan of Maharshtra Govt. with the storage capacity of 1.33 lakh m^3. Thus, the total water storage of 3.51 lakh m^3 is available for one time filling at village Nardoda which is sufficient to provide one protective irrigation of 50 mm depth to 700 ha area under kharif and for the second filling the same area of 700 ha can be brought under protective irrigation during rabi with the help of two tier rain water management system. During this year, all the farmers having farm ponds (65 nos.) used the water for protective irrigation during kharif and rabi season and realized the importance of harvesting and recycling of runoff for protective irrigation to enhance the yields.

Figure 6.23 : Runoff harvested in farm pond and recycling for protective irrigation

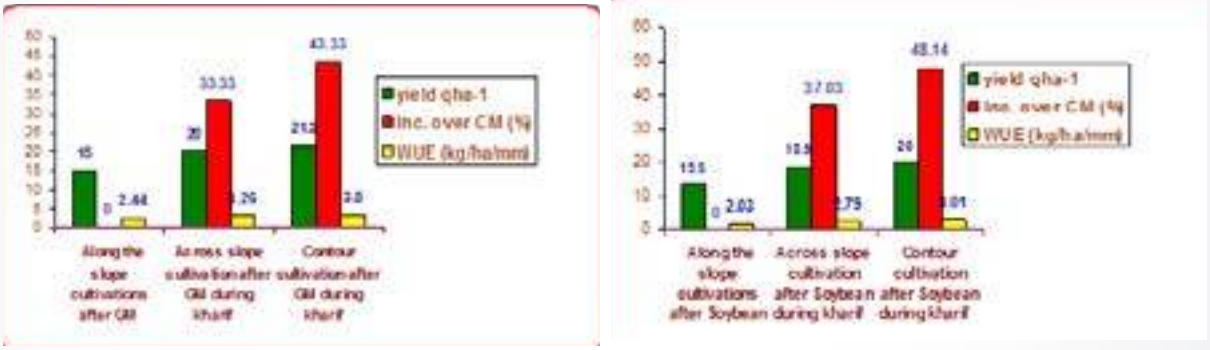
Impact of Protective Irrigation:

By providing one protective irrigation of 30 mm depth in medium to deep soils during dry spell in kharif the yield levels, water use efficiency and B:C ratio were observed significantly enhanced over the period of four years by 100 farmers as shown below.



i) Kharif

Figure 6.24 : Effect of the protective irrigation through sprinkler and drip systems



ii) Rabi

Figure 6.25 : Effect of protective irrigation during rabi through sprinkler irrigation under various cultivation practices on chickpea (after green gram in kharif) (a) Effect of protective irrigation during rabi through sprinkler irrigation under various cultivation practices on chickpea (after soybean in kharif)(b)

Harvesting of runoff from the cultivated fields into farm ponds and utilized to provide protective irrigation during prolonged monsoon break in kharif and moisture stress in rabi enhanced the crop yields and water use efficiency. One protective irrigation from farm pond through drip system enhanced the yield of pigeonpea by 50 per cent and water use efficiency from 1.6 to 2.2 kg/ha/mm. Two protective irrigations through drip systems to cotton enhanced the yield level by 76 per cent and water use efficiency from 2.00 to 3.00 kg/ha/mm. One protective irrigation to soybean through sprinkler system from farm pond enhanced the yield by 50 per cent and water use efficiency from 2.30 to 3.60 kg/ha/mm. Similarly one or two protective irrigations through sprinklers system during rabi season to the chickpea from farm pond and river enhanced the yield levels by 37.03 to 48.14 per cent and water use efficiency from 2.03 to 3.01 kg/ha/mm. This reveals that on farm improvement in land and water productivity in terms of enhanced crop productivity and water use efficiency which only because of linking the rainfed farming with attempts of drought proofing.

MPKV-SD-28 : Success story of In-situ rain water conservation i.e.., opening of ridges and furrows in kharif season

Name of the farmer	Shri. Shrishailya Sudhakar Umbare
	
Address	
i) Village	Narotewadi
ii) Post	Narotewadi
iii) Tehasil	North Solapur
iv) District	Solapur
v) State	Maharashtra
Contact Details	09420764236
Details of the farm	Size = 5.0 ha, Source of irrigation = Well
Membership in Self Help Group, producers co-operative/company, co-operative society,	Member of co-operative society, Member of Custom Hiring Center, Member of Shivratna Farmers Club
Names of the central sector / state scheme utilized by the farmer and period	State Department of Agriculture, NICRA- DLA from 2011

Technologies / good agricultural practices / facilities / benefits obtained with details	In-situ rain water conservation i.e.., opening of ridges and furrows in kharif season. Use of improved cultivar – M35-1 Fertilizer ($N:P_2O_5:K_2O$ kg/ha) – 50:25:0 Seed treatment : Azotobactor, PSB, trichoderma	
Details of results obtained due to adoption of technologies	Improved / present production technologies	Traditional/ past production technologies
Productivity Grain (q/ha)	10.36	8.00
Fodder (q ha-1)	28.17	21.02
Cost of production (q/ha)	13860	11600
Net income (q/ha)	12348	8455
Price realized (q/ha) - Grain	1850	1850
Fodder	250	250
Natural resources saved / conserved like soil, water, etc.	30 per cent more moisture conserved due to ridges and furrows Mitigate the drought Yield increased by 29.50 per cent	--
Marketing strategy – Access to market	Private market	
Factors contributing to success	In-situ moisture conservation (Ridges and furrows) during kharif season, Use of improved cultivar and fertilizer, Timely interculturing (three hoeings at 3, 5 and 8th weeks after sowing.)	
Any other relevant information	Encouraged other farmers to take this activity	

MPKV-SD-29: Success Story of Farmer from ORP village, Solapur

Name of the farmer	Shri. Shrishail Laxman Bagali
	
Address	
i) Village	Maniknal
ii) Post	Maniknal
iii) Tehasil	Jath
iv) District	Sangli
v) State	Maharashtra
Contact Details	9420453375
Details of the farm (size, location, water availability, etc.)	Size = 10.60 ha, Location = Nearby village Source of irrigation = Farm Pond and tube well
Membership in Self Help Group, producers co-operative/company, co-operative society, etc.	Member of co-operative society Hanjagi

Names of the central sector / state scheme utilized by the farmer and the period Technologies / good agricultural practices / facilities / benefits obtained with details	State Department of Agriculture, Operational Research Project 2010 onwards Protective Irrigation. Seed treatment : - Sorghum – Azotobactor, PSB, trichoderma Fertilizer ($N:P_2O_5:K_2O$ kg/ha) – 50:25:0 IPM – Seed treatment, Feromen traps, Neem seed extract spray Cultivars - Sorghum – Anuradha	
Details of results obtained due to adoption of technologies (seasonwise crop grown, techniques adopted, results achieved, etc.)	Improved / present production technologies	Traditional / past production technologies
Productivity q/ha – Sorghum	12.80	5.43
Cost of production Rs./ha	13400	9800
Net income Rs./ha	15700	10200
Sorghum - Grain	2000	--
Fodder	2500	--
Natural resources saved / conserved like soil, water, etc.	Minimized risk under aberrant weather condition, erosion resistant system	--
Marketing strategy – Access to market (through private, co-operative, contract farming, etc.)	Private market	
Factors contributing to success	Sound technology, Motivation of the farmer, minimize risk under aberrant weather condition.	

MPKV-SD-30 : In-situ rain water conservation i.e., opening of ridges and furrows 30 days after sowing.

Name of the farmer	**Shri. Saybanna Dhulappa Kumbhar**
	
Address	
i) Village	Maniknal
ii) Post	Maniknal
iii) Tehasil	Jath
iv) District	Sangali
v) State	Maharashtra
Contact Details	
Details of the farm (size, location, water availability, etc.)	Size = 2.40 ha, Location = Near Rajebagaswar Masjid Source of irrigation = Tube well

Membership in Self Help Group, producers co-operative/company, co-operative society, etc.	Member of co-operative society Maniknal,	
Names of the central sector / state scheme utilized by the farmer and period	State Department of Agriculture, Operational Research Project 2010-2014	
Technologies / good agricultural practices / facilities / benefits obtained with details	In-situ rain water conservation i.e.., opening of ridges and furrows 30 days after sowing. Use of improved cultivar – Vipula Fertilizer ($N:P_2O_5:K_2O$ kg/ha) – 12.5:50 Seed treatment : Raizobium, PSB, trichoderma	
Details of results obtained due to adoption of technologies (seasonwise crop grown, techniques adopted, results achieved, etc.)	Improved / present production technologies	Traditional / past production technologies
Productivity Grain (q/ha)	900	540
Cost of production (Rs/ha)	15200	12900
Net income (Rs./ha)	26120	16700
Price realized (Rs. /q)		
Grain	3200	3000
Natural resources saved / conserved like soil, water, etc.	35 per cent more moisture conserved due to ridges and furrows Mitigate the drought Yield increased 39.33 per cent	--
Marketing strategy – Access to market (through private, co-operative, contract farming, etc.)	Private market	
Factors contributing to success	In-situ moisture conservation (Ridges and furrows) 30 Days after sowing. Use of improved cultivar and fertilizer, Timely interculturing	

MPKV-SD-31: Success stories from farmers – NICRA Village

Name of the farmer	**Shri. Daji Chandu Kale**
	
Address	
i) Village	Narotewadi
ii) Post	Narotewadi
iii) Tehasil	North Solapur
iv) District	Solapur
v) State	Maharashtra
Contact Details	09890808284

Details of the farm (size, location, water availability, etc.)	Size = 6.0 ha, Location: Narotewadi Source of irrigation = Well	
Membership in Self Help Group, producers co-operative/company, co-operative society, etc.	Member of co-operative society- Narotewadi Member of Custom Hiring Center- Narotewadi Member of Shivratna Farmers Club- Narotewadi	
Names of the central sector / state scheme utilized by the farmer and period	State Department of Agriculture, NICRA- DLA Project from 2012-13	
Technologies / good agricultural practices / facilities / benefits obtained with details	In-situ rain water conservation i.e.., opening of ridges and furrows in kharif season. Use of improved cultivar – Phule Vasudha Fertilizer ($N:P_2O_5:K_2O$ kg/ha) – 50:25:00 Protective irrigation facilities Seed treatment : Azotobactor, PSB, trichoderma etc. Utilised with the help of Scientist of AICRPDA, ZARS, Solapur which result in increase in crop production.	
Details of results obtained due to adoption of technologies	Improved / present production technologies	Traditional / past production technologies
Productivity Grain (q/ha)	17.50	7.19
Fodder (q/ha)	35.03	22.89
Cost of production (Rs./ha)	15000	13000
Net income (Rs./ha)	39259	11842
Price realized (Rs./q) Grain	2500	2500
Fodder	300	300
Natural resources saved / conserved like soil, water, etc.	30 per cent more moisture conserved due to ridges and furrows Mitigate the drought Yield increased by 29.50 per cent	--
Product quality improvement	--	--
Marketing strategy – Access to market	Private market	
Factors contributing to success	In-situ moisture conservation (Ridges and furrows) during kharif season, Campartment Bund, ridges and Furrow Hoeing in Rabbi crops Use of improved cultivar and fertilizer, Timely interculturing (three hoeings at 3, 5 and 8th weeks after sowing.) Drip irrigation to the field crops Farm machinery Usage Two bowl fertiseedrill CRIDA planter Tractor Drawn M.B. plough Cycle hoe	
Any other relevant information	Encouraged other farmers to take this activity	

7. Value Chain Development, Market Linkages and Trade Potential

The scope of the agro-processing industry encompasses all operations from the stage of harvest till the material reaches the end users in the desired form, packaging, quantity, quality and price. Agro-processing is now regarded as the sunrise sector of the Indian economy in view of its large potential for growth and likely socioeconomic impact specifically on employment and income generation. Some estimates suggest that in developed countries, more than 18 per cent of the total work force is engaged in agro-processing sector directly or indirectly. However, in India, only about 4-5 per cent of the work force finds employment in this sector revealing its underdeveloped state and vast untapped potential for employment. Properly developed, agro-processing sector can make India a major player at the global level for marketing and supply of processed food, feed and a wide range of other plant product.

Currently of the total production, only 4.4 per cent of fruits and vegetables (F&V), 26 per cent of marine, 6 per cent of poultry, 20 per cent of buffalo meat and 35 per cent of milk is processed. As compared to the food processed in developed countries in India there is quite low value addition because of meager processing and storage facilities. This is resulting in huge post harvest losses to the tune of approximately Rs 55000 crorer per annum which eventually responsible for lowering the farmers income. The increase in value addition will result in prevention of losses and improving income of farmers.

Post Harvest Technology involves primary, secondary and tertiary processing. India's food processing mainly involves primary processing which accounts for 80% of the value. As much as 42% of the food industry is in the unorganized sector, 25 % of the food industry is in the organized sector and 33% in the small scale, tiny and cottage sectors. The value addition to agricultural commodities is less than 10%.

Maharashtra is one of the country's leaders in agro-industry in general, and in food processing in particular. However, the current level of processing in the State, as in the rest of India, is very low by international standards. There is tremendous potential for much higher value addition through processing. In the field of agro-industry and food processing, additional clusters may be initiated for processing of mango (Nashik, Districts in Konkan Regions), Grape and raisin (Nashik and Sangli), soybean (Satara, Districts of Marathwada), Custard apple (Pune), Banana (Jalgaon), Pomegranate (Solapur, Nashik), Guava (Ahmednagar) etc. Addition of value to the agriculture produce may not be restricted to perishable horticulture but also to other crops including Sorghum which is referred as poormans crop and which offers potential for nutri-food trade. Some of the opportunities for value chain development are illustrated in the following session.

7.1. Value Addition to key field crop products

Sorghum

The parching sorghum (hurda) is eaten at soft dough stage as table purpose. Parching sorghum is eaten in milk stage of grain and it gives 2-3 times more rates as compare to the grain sorghum. It can develop a small entrepreneurship for farmers. In several parts of India there is a practice of roasting sorghum heads at the dough stage and eating the threshed grain as a delicacy. The cultivars most suitable for roasting have a sweet endosperm that is dimpled at maturity. Vani sorghum (durra group) of India are especially popular in this respect. However the traditional wani sorghum types are very tall and late due to which they are highly susceptible to attack of midge with the result that availability of hurda has almost vanished. It is better to choose improved early parching sorghum genotypes for getting more yield at soft dough stage and to fetch more market price for its good quality.

If we consider the yield of early parching sorghum varieties (PKV Ashwini and PDKV Kartiki) as 30-40 quintals per hectare and the rate of the green hurda approximately Rs. 60-80 per kg that is 6000-8000 per quintal and the approximate cost of cultivation is about Rs 35000-40000 per hectare(from land preparation to marketing) then the gross monetary return will be 1.80 lakh to 3.20 lakh and net monetary return will be 1.45 lakh to 2.80 lakh per hectare with additional benefit of fodder.

Marketing to get maximum profit

During the last two decades the food demand for rainy-season sorghum grain has declined in India due to faster growth in the production of fine cereals (primarily wheat and rice) and public polices (procurement, and distribution) that provide rice and wheat at subsidized rates to the low and middle- income consumers. At the same time, new alternative markets for sorghum grain uses are emerging, for example as poultry and livestock feed, and in alcohol manufacturing (besides their use in processed foods). However, owing to scattered and small-scale production farmers are unable to meet the requirements of the industry that need grain in bulk quantities. After harvest, the surplus sorghum grain is sold either in a regulated market through Commission Agents or through a broker (middleman) at the village. Owing to small surpluses the marketing and transaction costs are generally high. Despite the fact that India has a well functioning agricultural marketing system under the Agricultural Produce Market Regulation Act, a number of issues impinge on the efficient functioning of the markets. For example, the markets in hinterlands are generally thin, localized and segmented; small holder domination leading to low market surplus; price discovery process often is non-transparent; multi-level with many intermediaries leading to high transaction / marketing costs; interlinked markets (credit/input and output markets); lack of grading and storage facilities and lack of information on market intelligence. For small farmers, a distress scale immediately after harvest is common to repay back debts and cash requirements to meet household needs. Lacks of credit facilities, high transactions costs that exist serve as a disincentive to seek out the best prices for their produce.

The existing marketing system is not optimal for industrial users, who would prefer to obtain sorghum through new institutional arrangements such as contract farming and bulk purchasing that compress the marketing chain and thus reduce transaction and marketing costs. Thus a twin track marketing system; one for food grains and another for industrial users is required.

Among the various innovative market options available to link farmers to industrial users bulk marketing was considered an option for marketing millets to poultry feed and alcohol manufacturers. Under bulk marketing small scale farmers are grouped into farmers associations and linked to industrial users (Source: PDKV, Akola).

Safflower

Milk prepared from safflower seed and groundnut are having health benefits as they contains mono (49.3mg in groundnut) and polyunsaturated (73.5mg in safflower) fatty acids. Household survey conducted to know the consumption of these oilseeds in different products viz., laddu, chikki, chutney powder, holige and payasa using different oilseeds. Groundnut contains, protein (25.3g), fat (45.3g), crude fibre (2.9g) and ash (2.0g), whereas safflower seed contain protein (13.1g), fat (25.3g), crude fibre (35g), ash (2.6g), calcium (235mg), phosphorus (865mg), iron (5.8mg) and zinc (5.53mg). Cow milk was blended with safflower and groundnut milk in the ratio of 80:20, 60:40 and 50:50. Among flavored milk 80:20 ratio was accepted. Cow milk paneer was accepted than safflower and groundnut milk paneer, where as in carrot halwa, CH1 (control) was accepted than safflower and groundnut paste product. The percentage of moisture (88.90%) and fat (5.62g) was noticed higher value in safflower milk. Fat (28.1g) and energy (334kcal) was noticed higher value in safflower milk paneer and moisture (57.1%), ash (2.6g) and calcium (208mg) were noticed higher value in cow milk paneer. In safflower paste it was noticed that higher value of moisture (45.33%), crude fibre (11.5g) and calcium (194.3mg), and groundnut paste had shown higher values for protein (21.8g), fat (28.6g) and ash (2.17g). The sensory attributes were low in products, and results revealed that as number of days increases the microbial population was higher. Utilization of safflower and groundnut milk will make to reach vulnerable group and those who suffers from lactose intolerance.

Safflower Oil has a number of uses both in personal and commercial applications. Although the safflower is now primarily grown for its oil production, it was originally grown for a number of uses; the flowers were originally used in yellow and red dyes for both food and clothing. In addition to the oil production, safflower

oil is also used as cooking oil. Although it is more expensive than other options, it handles higher temperatures than other common cooking oils.

Safflower Oil is also used in the industrial sector as a drying oil that is used in the manufacturing of paints and stains and linoleum tile.

The meal that is left over after the oil has been pressed is used in livestock feed; specifically for cows.

The petals of the Safflower plant can be used in cooking as a substitute for saffron. It provides much of the same flavour and color as the more expensive saffron and has become a popular additive in its own right. The petals can be soaked in water to create a tea which is consumable by itself or made into an extract to be used in cooking. The oil can be used directly on the skin for its moisturizing benefits.

Safflower oil can be used in cooking both for deep frying and for salad dressing and marinades. Safflower oil can be used as a nutritional supplement, but it's most common use is for cooking. The petals of the safflower plant as well and the safflower oil that is produced from pressing have common uses in food preparation. Safflower oil can be used in commercial production as a drying oil used in printing. The remaining mash is used as part of grain sold to put into livestock feeds.

Safflower oil can also be taken as a health supplement. Studies have shown that taking a daily dosage of the oil has reduced inflammation, lowered bad cholesterol, reduced body fat, and promote muscle growth.

The oil can be used to promote healthy hair and nail growth my massaging it into the scalp and nail bed. It is also used in massage oils and lotions as it is low in comodegenic action and doesn't clog pores. It is also used in Chinese medicine to invigorate blood and reduce pain.

Cotton

Surgical absorbent cotton

With the rise in population, economic growth and increasing awareness about personal hygiene, the demand for surgical cotton is increasing. With the current value of Rs. 57000 crore, a 11% growth is predicted for surgical cotton industry (Venugopalan et al 2015). So it is necessary to enhance the per hectare income of marginal &small farmer by suggesting new avenue by producing, processing & marketing of straight varieties. The micro, small and medium enterprise on surgical absorbent cotton is expecting excellent market in India and abroad due to increase in population and development of medical facilities. This will bring self sufficiency and provide employment opportunities to rural and urban youth. Absorbent cotton is also used for making sanitary towels, filters etc.

Cotton Value addition: Bio Pellets and Briquettes

Sardar Patel Renewable Energy Research Institute (2004) has made an estimate of crop residue burnt as 71.6 Mt in selected states of country in 2001 in which Maharashtra cotton crop residues are 29.4 Mt and 11.8 Mt surplus crop residues are burnt every year causing environmental pollution, human health & soil degradation problem etc. Hence converting cotton crop residue into environmental friendly and pollution free fuel for domestic and industrial use has been prioritized through government and non government agencies. The pellets, briquettes of cotton stalk and other crop residues have high specific density, about 1100-1200 kg /m^3 and bulk density about 600-800 kg/m^3 as compared to loose biomass. The calorific value of the cotton stalk is 3700 kcal/kg. If the pellets and briquettes are prepared out of cotton stalk, the calorific value is further enhanced to 4231 kcal/ kg and 4566.9 k cal/ kg, respectively. The cotton stalk and by-product is much easier for handling, storage and transport in industrial places where the stalk and other crop residues are processed in to final products.

Organic farming

Desi cotton varieties are highly amenable for organic farming. The Desi species Gossypium arboreum is not vulnerable for genetic contamination by the existing Bt cotton hybrids which belong to Gossypium hirsutum which is genetically incompatible with the Desi species. Therefore, the new long staple Desi varieties provide an excellent opportunity for India to emerge as global leaders in organic cotton to produce high yields of long

staple fibre at very low production cost based on organic farming systems. This can provide a sturdy road map for sustainability especially in small-scale farming systems.

Mechanisation to promote value chain

- Cotton pickers and strippers for harvesting.
- Cotton stalk chipper shredders for post-harvest field operation can facilitate other value addition process such as mushroom cultivation and compost preparation using chipped cotton stalk.

7.2. Fruit processing

- Citrus Farmer producer companies can establish small scale processing units for Ready-to-Serve beverages. The technology in this regard has been developed by Central Citrus Research Institute, Nagpur for acidlime and Nagpur mandarin and already given to an entrepreneur who had set up a unit with value added products from citrus fruit, thus growers can earn more income. Promotion of contract farming through cluster approach where private companies can establish processing units and purchase all produce of that cluster with assured price. The private companies shall provide inputs and public institutes like SAUs and ICAR shall provide technological support.
- Pomegranate processing: Most of pomegranate fruits are marketed for table purpose in domestic markets. With growing health awareness among consumers not only in high income group but also middle and low income group, the inland marketing opportunities are very high especially in metro and big cities. Improvement in transport and marketing channels is very important for making pomegranate available in different markets in India.
- Grape can be processed for resins and other products which fetch more remuneration for farmers
- Various products like pickle can be produced from mango in addition to juce and pulp as illustrated in the previous sections

7.3. Potential agricultural production and processing clusters in Western Maharashtra

Value addition as main objective, several activities can be carried out to establish processing clusters. The volume of production and trade should determine the location of processing units. Some of the suggestions received from the member of SLCC are as follows.

7.3.1. Cereals :

- **Wheat :** Nashik, Ahmednagar
- **Sorghum :** Solapur, Ahmednagar, Satara, Pune, Jalgaon
- **Bajara :** Nashik, Ahmednagar, Dhule, Nandurbar
- **Rice :** Nashik, Kolhapur
- **Finger millet :** Nashik, Kolhapur
- **Maize :** Nashik, Jalgaon, Dhule, Kolhapur
- **Small Millets :** Nandurbar, Dhule, Nashik, Pune

7.3.2. Pulses :

- **Red gram (Tur) :** Ahmednagar, Nashik
- **Green gram :** Ahmednagar, Pune, Nashik
- **Chickpea :** Ahmednagar, Jalgaon, Dhule
- **Horse gram :** Solapur, Ahmednagar, Jalgaon, Dhule, Nandurbar

7.3.3. Fruits

- **Fig :** Pune, Ahmednagar
- **Pomegranate :** Solapur, Nashik, Ahmednagar

- **Banana :** Jalgaon, Solapur, Kolhapure
- **Grapes :** Nashik, Sangli, Solapur
- **Mangoes:** Ahmednagar, Nandurbar, Kolhapur, Sangli
- **Aonla:** Ahmednagar, Satara, Dhule, Nandurbar
- **Strawberry :** Satara, Nashik
- **Papaya :** Nandurbar, Jalgaon, Solapur
- **Ber :** Solapur, Jalgaon, Nandurbar, Dhule
- **Kagzi Lime :** Ahmednagar
- **Custard Apple :** Pune, Solapur, Ahmednagar, Dhule, Nandurbar
- **Guava :** Ahmednagar, Nashik

7.3.4. Vegetables

- **Potato:** Pune
- **Onion:** Nashik, Pune, Ahmednagar
- **Chilli :** Nadurbar, Dhule, Jalgaon, Sangli, Kolhapur
- **Leafy Vegetables :** Kolhapur, Satara, Sangli, Solapur, Pune, Ahmednagar, Nashil, Dhule, Nandurbar, Jalgaon
- **Brinjal, Tomato, Cabbage, Cauliflower, Beans, Peas :** Pune, Nashik, Ahmednagar, Satara
- **Gourds :** Ahmednagar, Nashik, Pune, Sangli, Kolhapur, Satara

7.3.5. Spices

- **Turmeric :** Sangli, Kolhapur
- **Ginger :** Sangli, Satara
- **Garlic :** Nashik, Pune, Ahmednagar, Kolhapur
- **Oilseeds :**
- **Soybean :** Satara, Ahmednagar
- **Ground nut :** Jalgaon, Nashik, Sangli, Satara
- **Safflower :** Jalgaon, Dhule, Ahmednagar, Solapur
- **Sesame :** Jalgaon, Dhule, Solapur
- **Jaggery/Kakvi :** Kolapur, Sangli, Satara

7.3.6. Organic farming:

- Production of certified organic livestock products viz. Organic milk, organic eggs, organic manure like Jeevamrut.
- Substantial financial support by the governments is necessary to promote organic farming
- Market development for the organic products
- Government support to the producer and consumer associations to market the organic products
- Simplification of the process of certification
- Reduction in certification cost
- Rigorous campaign to increase awareness of both farmers and consumers

Source: MPKV, Rahuri

7.4. Livestock sector products

- Value added Indian traditional milk products like khoa, paneer, dahi, lassi, chakka, butter milk, butter and ghee are always demanding locally and at regional markets.
- Branding of product by the farmer as per the legal requirements.

- Farmers may form farmers company or farmers organization to produce quality livestock products.
- Value added meat/poultry and egg products.
- Production of certified organic livestock products viz. Organic milk, organic eggs, organic manure like Jeevamrut.
- Substantial financial support by the governments is necessary to promote organic farming
- Market development for the organic products
- Government support to the producer and consumer associations to market the organic products
- Simplification of the process of certification
- Reduction in certification cost
- Rigorous campaign to increase awareness of both farmers and consumers.

7.5. Fish Product Development

ICAR-CIFE has developed several products such as:

- Ready to eat products fortified with omega-3 fatty acids
- Ready to eat fish sandwich paste in retort pouch
- Ready to eat extruded products fortified with EPA and DHA
- Fish curry in retortable pouch fortified with EPA and DHA
- Traditional foods with improved functional properties
- Technology of fermented Hilsa fish - Lona Ilish
- Technology of Seadal- A fermented fish product from Puntius species
- Value added products from low cost fish
- Fish protein based extruded snacks
- Prawn and Fish pickles with improved shelf-life
- Papad from prawn and fish
- Ready-to-eat fish meat fortified snack (Fish munch)
- Fish munch is an extruded fish product. Usually starch is used for extrusion because of their temperature tolerance and desirable behavior at high temperature. Addition of protein adversely affects the crunchiness of the product and usually not exceeded beyond 5%.
- CIFE, Mumbai has developed the unique technique of blending up to 25% fish protein (a level that is equal to the protein content in fish) in to extruded product. A temperature controlled twin screw extruder is used for unique blending of starch and protein from different sources.
- The extrusion parameters (feeding rate, moisture, barrel temperature, die diameter and screw speed) have been optimized using response surface technique to get desirable product expansion. Three-layered laminated pouch from aluminum and polyester were developed for nitrogen packing and storage. The product has a shelf life of over 4 months.
- The product showed excellent acceptance in sensory evaluation. Low cost fish has been utilized to make this product cheaper and for better use of the commercially unimportant fish.
- Commercialization status : Technology has been transferred to Vijaya Infra Project (Pvt.) Ltd., Mumbai

7.6. Linking food processing development with government schemes

- Food processing is recognized as a priority sector in the new manufacturing policy in 2011
- Government had announced setting up of special fund of INR 2,000 Crore in the Financial year 2014-15 in NABARD for extending affordable credit to designated food parks and the individual processing units in the designated food parks at concessional rates. The fund is being continued in 2015-16.

- Reserve Bank of India has classified loan to food & agro-based processing units and Cold Chain under Agriculture activities for Priority Sector Lending (PSL) subject to aggregate sanctioned limit of INR 100 Crore per borrower. It will ensure greater flow of credit to entrepreneurs for setting up of food processing units and attract investment in the sector.

7.7. Investment opportunities

- **Fruits and vegetables:** preserved, candied, glazed and crystallised fruits and vegetables, juices, jams, jellies, purees, soups, powders, dehydrated vegetables, flakes, shreds and ready-to-eat curries
- **Food preservation by fermentation:** wine, beer, vinegar, yeast preparation, alcoholic beverages
- **Beverages:** fruit-based, cereal-based
- **Dairy:** liquid milk, curd, flavoured yoghurt, processed cheese, cottage cheese, Swiss cheese, blue cheese, ice cream, milk-based sweets
- **Confectionery and bakery:** cookies and crackers, biscuits, breads, cakes and frozen dough
- **Meat and poultry:** eggs, egg powder, cut meats, sausages and other value added products
- **Fish, seafood and fish processing :** processing and freezing units
- **Grain processing :** oil milling sector, rice, pulse milling and flour milling sectors
- **Food preservation and packaging:** metal cans, aseptic packs
- **Food processing equipment:** canning, dairy and food processing, specialty processing, packaging, frozen food/refrigeration and thermo-processing
- **Consumer food:** packaged food, aerated soft drinks and packaged drinking water
- **Spices :**Chilli powder, turmeric powder, ginger powder, oleoresin, Garlic paste, Ginger paste, Onion dehydration, Mixed Spices etc.
- **Supply chain infrastructure:** This niche has investment potential in food processing infrastructure, the government's main focus is on supply chain related infrastructure like cold storage, abattoirs and food parks
- **The establishment of food parks:** A unique opportunity for entrepreneurs, including foreign investors to enter in the Indian food processing sector
- **Encouragement of Farmers Producer Companies**

7.8. Promotion of processed food quality and safety

Apart from the domestic market, the international processed food markets offer tremendous export opportunities for the agro processing sector in the State. However, in order to ensure the quality and safety of food with fewer or no additives and preservatives, novel packaging technologies such as active and intelligent packaging systems which can monitor product quality and trace a product's history through critical points in the food supply chain have to be encouraged.

While quality improvements should be promoted and safety standards met, the focus should also be on ensuring that consumer prices do not increase. The Government would support quality development for small scale enterprises through institutions like SAUs, NRC, CFTRI, etc. so that they adopt the latest quality measures such as Good Manufacturing Practices (GMP), Hazards Analysis Critical Control Point (HACCP), ISO 9000, Good Laboratory Practices (GLP), Total Quality Management (TQM), Food Labelling, Food Packaging and Irradiation Technology etc.

7.9. Market linkages

Producers, commission agents, merchants, wholesalers, cooperatives, etc. are involved in marketing of many of the commodities. For crops like onion, the cooperatives and NAFED can play significant role in marketing of onion bulbs. NAFED can intervene in the domestic market whenever there is glut in the market and prices reach uneconomical levels. The Agricultural Produce Marketing Committees (APMCs) were established in each state with a view to regulate the marketing of agricultural produce in market areas. The regulation of

markets had several positive features such as sale through auction method, reliable weighing, standardized market charges, payment of cash to farmers without undue deduction, dispute settlement mechanism and availability of several amenities in market yards. Properly graded, well cured and cleaned bulbs should be marketed for fetching better price in the market. Market intelligence should be provided to the farmers by the marketing agencies so that farmers can check market before sending their produce, use market intelligence to sell the produce at appropriate time and get remunerative price rates for their produce. Price is generally lower at Rabi harvest or when production is more. Onion can be stored for some time and sold when market price is good and economical. The market situation needs to be assessed before taking the onion bulbs to the market. Following suggestions were received for improving market linkages.

- Promotion of cluster approach for efficient procurement and disposal of surplus fruits and vegetables in areas
- Creation of better transportation facilities with cool chain at Block level
- Establishment of cold room in different clusters
- Establishment of pack house facilities for fruits and vegetables: Transport, Washing, Grading, Pre-treatment's, Minimal processing, Packaging, Storage etc.
- Establishment of fruits and vegetables processing units : Pulp, Juice, RTS, Jam, Jelly, Squash, Syrup, Toffees, Candy, Dehydrated products, Pickles, Frozen foods, frozen pulp, canned foods etc.
- Establishment of cereal processing units: Flour mills, bakery products, extruded products, snacks foods, Papad etc.
- Establishment of pulse processing units: Dal mill, flour mill, papad, sprouted legumes, premixes, extruded products, snacks foods etc.
- Establishment of oil seed processing units : Oil mills (Mechanical and Solvent extraction), vanaspati oil
- Establishment of soya processing units: Oil, soya clunks/texturised soya protein, soya milk, soya paneer, extruded products etc.
- Establishment of spice processing units: Chilli powder, turmeric powder, ginger powder, oleoresin, Garlic paste, Ginger paste, Onion dehydration, Mixed Spices etc.
- Establishment of clusters for foods processing on custom hire basis viz. refer van, cold storage, processing, value addition etc.
- Creation of direct linkages with food processing industries for better prices and with various stack holders to furnish information on crop produce and surplus
- Popularisation of Cooperative societies as a tool of marketing channels for various commodities viz. fresh as well as processed products prepared from agricultural commodities
- Effective implementation of APMC acts for disposal of agricultural commodities
- The minor oil seeds and millets, wild vegetables etc. having high nutraceuticals value can be exploited in commercial supply chain

7.9.1. Livestock Home and external market opportunities

- Formation of Livestock Producers Marketing Committees at each taluka level to promote livestock marketing
- Small-scale livestock producers are constrained by lack of access to markets, credit, inputs, technology and services which may discourage them from taking advantage of the opportunities resulting from the expanding demand for animal food products in the domestic and global markets
- Low level of public investment in the livestock sector
- Value addition to livestock production is not encouraging amongst small-scale producers
- Exploring the export of sheep meat from the region since Nashik and Pune division is having highest sheep population of the state
- Livestock byproducts such as dung and slurry can be amalgamated with organic waste from farmer for preparation of manure, products like Gomutra , Jeevamrut and cow dung cakes, vermicompost etc.

7.9.2. Actions for improving processing and financial support

- There is need of processing and utilization of different crops /commodities, processes, quality assurance, energy audits and economic competiveness
- Development and promotion of farm storage and rural warehouses for perishables, semi-perishable as well as durables that minimize the losses
- Development of HACCP and food safety measures for different commodities and products and developing mechanisms to apply and certify them, setting up of referral laboratories and human resource development capacities in good /biosafety
- Develop and commercialize diet convenience and specialty foods
- Establishment of agro processing centers (APCs) in the production catchments and owned & operated by targeted beneficiaries, individually or collectively. It has greater capacity for employment and income generation than production agriculture.
- Need to develop infrastructure to speed up agri-business. The infrastructure comprises post-harvest facilities like mass collection centers, sorting grading, packing houses, store houses, refrigerated vans, pre-cooling, cold storage, and establishment of Gramin Information Centers for market of higher value, residue testing laboratories for fruits & vegetables. In the case of agro-processing for food grains & oil seeds, dal mill, soybean processing & oil processing units etc. at the village level.
- The State Government needs to promote and support the development of end to end integrated projects by identifying the need gaps across the entire value chain, and provide specific schemes to address them which will enable particularly small and medium enterprises to attain viability by sharing the cost of major common processing facilities.
- In addition to clusters, there is need to established micro clusters with common facilities which will help in reducing wastage at farm level and to protect farmers from price volatility and realize better value. The micro clusters would supply their output to large processing units, and hence will also work as an aggregation point for larger processing units.
- Food safety and branding of food products manufactured by small entrepreneurs should be given topmost priorities for protecting health of consumers and export reliability
- Government promotional activities for food processing and value addition : Agriculture export zone for important crops, food parks and FPOs etc.

7.10. Skilled manpower is the key for value addition

The agro and food industry needs highly skilled manpower at both the workmen and supervisory levels. There are institutes, which provide education on farm practices and food processing. Specific training programmes need to be designed and disseminated through existing institutions in post harvest management, especially with focus in pulping, grading and sorting, packaging, storing, produce handling and processing. Trainees should get back up with respect to provision of information and extension services to the farmers, development of transport and communication facilities, linkage development with state & central government departments, private agencies, industries for making available the market for sell of produce and also creation of community storage facility

Some of the success stories after imparting training to potential entrepreneurs have been illustrated in the following sections of this chapter.

7.10.1. Success Story: Fruit and Vegetable processing

- **Name of the Entrepreneur:** Mr. Surendra Tulshildas Shinde
- **Address :** Kalpalaxmi Agro Products, At Bhandewadi Post -Tq. Karjat Dist. Ahmednagar.
- **Unit :** Fruit & Vegetable Processing
- **Name of Products :** Onion powder, Anola powder, Bottle gourd powder, Bitter gourd powder
- **Garlic powder, Ragi malt, Anola candy, Ginger powder, Raw mango powder, Ragi papad**
- **Production per year :** 50 Quintal

- **Turn over :** 35-40 Lakh per Year
- **Net profit :** Near about 8-10 Lakh per annum

7.10.2. Success Story: Processed cereal foods

- **Name of the Entrepreneur :** Arati Puranik
- **Address :** Jay Industries, M-42 , MIDC, Ambad Dist. Nashik (M.S.)
- **Name of Unit :** Jay Industries, M-42, MIDC, Ambad Dist. Nashik
- **Name of Products :** Nagali Breakfast cereal, Roasted Soybean, Nagali rawa, Nagali cereal rice, Raw mango powder, Ragi papad
- **Production per year :** 360 Quintal
- **Turn over :** 1 Crore per Year
- **Net profit :** Near about 25 Lakh per annum

7.10.3. Success Story: Fruit and Vegetable processing

- **Name of the entrepreneur :** Shri. Ram Sampat Aher
- **Address:** At. Post. Nilwande, Tal-Sangamner, District- Ahmednagar
- **Educational qualification :** Diploma in Auto Mobile, B. Tech. in Mechanical Engineering
- **Company:** M/s. Vaishnavi Agrotech Industries and M/s. Tridev's Sai Anjali Agro Food
- **Products**
- **Capacity:** Processing of 3 ton fruits per day
- **Investment:** 50 lakh (loan Bank of India)
- **Machinery:** Pomegranate aril extractor , Pomegranate juice extraction machine, Brush Type Pulper, Screw Type Pulper, Cup filling and sealing Packing machine , Pasteurizer,
- **Homogenizer, Pouch filling and sealing machine, Shrink Wrapping machine, printing machine**
- **Fruits processed:** Pomegranate, Aonla, Mango, Guava
- **Products:** Juice, RTS, Jelly, Pulp, Candy etc.
- **Employees:** 10 No.
- **Total turnover:** Rs. 45,00,000/-
- **Net returns:** Rs. 13,50,000/- per annum

7.10.4. Success Story: Fruit processing

- **Name of the entrepreneur:** Mrs. Ashwini P. Lad
- **Address:** At. Post. Diskal, Tal-Khatav, District- Satara
- **Educational qualification:** B. Com, B. Ed.
- **Company:** M/s. Evergreen Food Products
- **Capacity:** Processing of 500 Kg fruits per day
- **Investment:** 15 lakh
- **Fruits processed:** Aonla
- **Products:** Juice, RTS, Pulp, Candy, Supari, Pickles etc.
- **Employees:** 10 women
- **Total turnover:** Rs. 12,00,000/-
- **Net returns:** Rs. 5,00,000/- per annum

7.10.5. Success Story: Fruit processing

- **Name of the entrepreneur:** Miss Namtrata Pandit Arvikar
- **Address:** Silver Cloud Multi-fruit Pulping Unit, Gut No. 112, Karodi, Vaijapur Road, Tal. Dist. Aurangabad

- **Educational qualification :** B. E. (Computer)
- **Company:** M/s. Silver Cloud
- **Capacity:** Processing of 1 ton fruits per day
- **Investment:** 1 Crores
- **Machinery:** Automatic Pulp RTS and Juice Line, Plate freezer, Cold storage
- **Fruits processed:** Papaya, Amla, Mango, Guava, Custard apple etc.
- **Products:** Juice, RTS, Pulp etc.
- **Employees:** 24 No.
- **Total turnover:** Rs. 1,00,00,000/-
- **Net returns:** Rs. 45,00,000/- per annum

7.10.6. Women empowerment to facilitate value chain

- Enhancement of women self-help groups for food processing.
- Providing the facilities specifically to such SHGs.

7.11. Potential for export

7.11.1. Pulses

Pulses are the major sources of protein in the diet. Of all categories of people pulses form an integral part of the Indian diet, providing much needed protein to the carbohydrate rich diet. India is the largest producer of pulses in the world. Major pulses are grown chickpeas (gram), pigeon pea (tur or arhar), moong beans, urd (black matpe), masur (lentil), peas and various kinds of beans. The country has exported 1,24,883.94 MT of pulses to the world for the worth of Rs. 1,140.13 crores/ 171.07 USD Millions during the year 2016-17. Maharashtra being one of the major states producing pulses has opportunities to increase farmers income by export oriented value chain development for pulses.

Table 7.1 : Major countries which import pulses from India

2016-17			
Sr No.	**Country**	**Qty**	**Value**
1	Pakistan	20,730.90	15,706.54
2	Sri Lanka	18,233.26	12,877.17
3	U Arab Emts	12,673.85	12,101.03
4	Algeria	9,763.00	10,448.89
5	Saudi Arab	8,809.76	9,574.01
6	U S A	7,195.38	8,261.16
7	Turkey	6,841.00	6,323.01
8	U K	5,418.26	4,169.58
9	Iraq	4,253.00	4,065.99
10	Tunisia	3,575.00	3,619.54
	Page Total	97,493.41	87,146.92

7.11.2. Onion

Onion which is one of the important crops of Maharashtra is being exported to more than 100 countries. The major countries that are importing fresh onions from India are shown below. There has been an increasing trend in export of this commodity which hints at possibility of increasing the farmers income through export oriented approach.

Table 7.2 : Major countries that import fresh onion from India and the trend during the last 3 years (Quantity in MT and value in Rs Lacs)

	2014-15		2015-16		2016-17	
Country	Qty	Value	Qty	Value	Qty	Value
Bangladesh	4,56,734.50	77,964.61	4,22,075.65	95,014.38	8,46,869.86	97,590.93
Malaysia	2,15,194.39	41,621.67	2,44,272.70	58,641.91	3,71,972.16	49,308.58
United Arab Emirates	1,31,630.19	24,772.72	1,69,684.48	32,728.03	3,02,359.80	39,928.57
Sri Lanka	1,31,646.45	25,839.13	1,99,136.44	44,909.04	2,07,480.57	26,420.65
Nepal	70,543.31	13,940.27	81,146.86	19,664.38	1,33,530.16	16,311.05
Indonesia	45,629.04	5,788.98	11,046.00	1,754.65	81,871.82	11,430.21
Philippines	0.00	0.00	29,617.00	7,565.86	49,395.00	10,245.49
Qatar	25,414.31	5,303.42	33,573.87	6,910.57	67,894.52	9,137.59
Kuwait	24,874.08	5,026.99	36,402.36	6,651.77	65,245.95	8,908.76
Saudi Arabia	13,692.64	3,071.93	17,668.58	3,092.03	58,651.24	7,473.61
Oman	15,082.09	2,891.83	20,657.59	3,607.69	48,934.78	6,133.8
Source:http://agriexchange.apeda.gov.in/indexp/Product_description_32head.aspx?gcode=0201						

7.11.3. Mango

A single mango can provide up to 40 percent of the daily dietary fibre needs – a potent protector against heart disease, cancer and cholesterol build –up .In addition, this luscious fruit is a warehouse of potassium, beta- carotene and antioxidants. In India, mangoes are mainly grown in tropical and subtropical regions from sea level to an altitude of 1,500m. Mangoes grow best in temperatures around 27˚C. India is also a prominent exporter of fresh mangoes to the world. The country has exported 53,177.26MT of fresh mangoes to the world for the worth of Rs. 445.55 crores/ 67.25 USD Millions during the year 2016-17. Alphonso is one of the mango varieties which are exported to other countries. Maharashtra being one of the leading states there is scope for enhancing the income of mango farmers.

Table 7.3 : Top 10 countries which import mango pulp from India

2016-17			
Sr No.	Country	Qty	Value
1	Saudi Arab	32,437.35	18,350.66
2	Netherland	13,404.31	9,414.01
3	Yemen Republc	16,670.84	8,421.17
4	U K	8,984.70	6,905.58
5	U Arab Emts	8,129.97	4,953.79
6	Kuwait	8,364.13	4,912.37
7	U S A	5,039.68	4,501.92
8	Germany	2,680.65	2,473.44
9	France	2,592.92	2,110.08
10	China P Rp	2,780.56	2,064.37
Source : http://agriexchange.apeda.gov.in/product_profile/exp_f_india.aspx?categorycode=0303			

7.11.4. Pomegranate

The pomegranate is being exported to various international destinations from India. In year 2016-17, India exported 49.76 thousand MT of pomegranate worth Rs. 490 Cr (APEDA 2017) which is merely 1.97 per cent of total production (2521 thousand MT). The major destinations for Indian pomegranate are United Arab Emirates with share of 51% followed by Bangladesh, Saudi Arabia, Netherland, USA, Kuwait, Nepal, United Kingdom, Thailand and Sri Lanka (Fig. 1). The pomegranate export should be increased to non traditional markets such as South East Asia, Russia, Japan etc. Strategies of marketing and utilization of produce need to be improved in order to increase the export market. In this context the post-harvest management of produce to improve its shelf life by adopting modern handling, storage, packaging and transportation practices is of high importance for domestic and International marketing of fruit. (Source APEDA 2017)

Figure 7.1 : Top ten export destinations for Indian pomegranate

Source : NRCP

7.11.5. Grape

Grape is one of the important commodity being exported and the state of Maharashtra has significant contribution. To 112 countries across the world. The idea of growing imported varieties of grapes is being mooted to boost the export. In addition, the value addition can further expand the market for grapes. A recently developed variety of grape named "Medica" with medicinal value can fetch additional income for the farmers.

Table 7.4 : Major countries to which India exports grape

2016-17			
Sr No.	**Country**	**Qty(MT)**	**Value(Lakh Rs)**
1	Netherland	55,152.44	61,303.15
2	Russia	27,072.59	27,387.68
3	U K	13,883.20	15,711.04
4	U Arab Emts	16,712.16	14,243.82
5	Germany	11,174.24	12,262.08
6	Saudi Arab	12,388.89	11,418.93
7	Bangladesh	38,358.82	10,354.75
Source: http://agriexchange.apeda.gov.in/product_profile/ exp_f_india.aspx?categorycode=0205			

7.11.6. Flowers

Value of exported flowers to top 10 countries is about Rs 4 billion. With potential areas in Maharashtra engaged in floriculture, it is possible to enhance income of farmers.

Table 7.5 : Top 10 countries which import flower from India

2016-17			
Sr No.	**Country**	**Qty (MT)**	**Value (Cr.)**
1	U S A	3,762.70	9,902.23
2	U K	2,457.84	6,838.96
3	Germany	2,439.66	6,241.66
4	Netherland	1,809.32	5,750.38
5	U Arab Emts	1,438.84	3,449.30
6	Canada	748.52	1,792.93
7	Singapore	1,347.01	1,654.38
8	Italy	555.10	1,609.93
9	Japan	365.05	1,479.33
10	Australia	250.07	1,306.72
	Total	15,174.11	40,025.82

7.11.7. Sheep and goat products

Goats - Sheep constitute a very important species of livestock in India, mainly on account of their short generation intervals, higher rates of prolificacy, and the ease with which the goats as also their products can be marketed. They are considered to be very important for their contribution to the development of rural zones and people. The local initiatives to promote quality labels and innovative products for cheeses, meat and fibres could help goats in keeping a role for sustainable development in an eco-friendly environment all over the world. However, the future of the goat and sheep industry as a significant economic activity will also be very dependent on the standards of living in the countries where there is a market for the goat products. The country is largest exporters of Sheep & Goat meat to the world. The country has exported 22,060.15 MT of sheep & goat meat to the world for the worth of Rs. 871.08 crores/ 130.17 USD Millions during the year 2016-17. Water scarcity zone can adopt small ruminants like goat and sheep as integral component of farming system for enhanced income.

Table 7.6 : Top countries which import sheep and goat products from India

2016-17			
Sr No.	**Country**	**Qty (MT)**	**Value (Cr.)**
1	U Arab Emts	13,003.17	50,025.45
2	Saudi Arab	4,550.69	19,429.41
3	Qatar	2,102.87	8,243.83
4	Kuwait	1,612.95	6,510.96
5	Oman	363.87	1,309.14
6	Baharain Is	274.91	1,160.14
7	Maldives	80.98	238.58
8	Seychelles	16.00	45.23
9	Vietnam Soc Rep	2.00	8.24
10	Nepal	0.64	1.79
	Total	22,008.08	86,972.77

8. Policy and Investment Requirements and Role of the Government

The low level of farmers income and year to year fluctuations in it area major source of agrarian distress. This distress is spreading and getting severe overtime impacting almost half of the population of the country that is dependent on farming for livelihood. Persistent low level of farmers income can also cause serious adverse effect on the future of agriculture in the country. To secure future of agriculture and to improve livelihood of half of India's population, adequate attention needs to be given to improve the welfare of farmers and raise agricultural income. Achieving this goal will reduce persistent disparity between farm and non-farm income, alleviate agrarian distress, promote inclusive growth and infuse dynamism in the agriculture sector. Respectable income in farm sector will also attract youth towards farming profession and ease the pressure on non-farm jobs, which are not growing as per the expectations. Doubling farmers income by 2022 is quite challenging but it is needed and is attainable. In addition to development initiatives and technology there is need of policy reforms in agriculture to double farmers income.

In many of the occasions, it is opined that productivity and production are not constraint but the uncertainty of price severely affects farmers income. For example there is no minimum support price for important commodities like onion. Farmers produce high quality commodity but they avoid harvesting the fruits like orange because of lack of customers. Hill farmers were growing kinnow but were not harvesting as this crop came as a part of horticulture project without any processing unit. Cost of production for potato growers is higher than the price of potato and cost of milk production is often more than the price while the cost of bottled water is more than that of milk sold by farmer. Recently, pigeonpea farmers, who produced more grains, are struggling for selling the produce. Hence, there is a need to extend MSPs for perishable commodities.

The policy interventions are necessary to address inadequate crop insurance support, inadequate crop credit, lack of varietal breakthrough, inadequate storage infrastructure, inadequate processing facilities for value addition, poor marketing facilities, and slow pace of watershed development, inadequate micro level planning of agricultural production and weak training & extension setup after discontinuation.

While policies of government are increasingly inclined towards welfare of farmers, there a lot of concerns expressed by member of SLCC for doubling farmers income in Maharashtra. Some of these issues are as follow

Problems with pricing policy and some suggestions

- The agriculture prices are not fixed taking into livelihood needs of the farmers.
- The rising inflation always had a double impact on farmers with increasing costs of living and decreasing incomes due to reduction in agriculture prices as a result of price intervention mechanisms of the government.
- Minimum Support Prices are announced for 25 commodities and market intervention operations exist only for rice and wheat. So farmers growing other crops are left to the mercy of the markets.
- Remunerative pricing policy
- MSPs should take into account actual costs of cultivation and living costs (corrected to inflation rise)
- NFC's recommendation (Cost C2+50 %) can be used as a guide (Rs. 1800/q for 2010 paddy and wheat based on 2009 cost calculations)
- Price differential (MSP –actual realised/procurement price) should be paid directly to farmer
- Producers are consumers: Only 20-30 % is procured…what about more than 40 % produced-consumed

- Costs cannot be based only on COC as they could be low for crops like sorghum and where people use their own inputs
- Recast input subsidies
- Nutrient based subsidies to be extended to organic food; Recast fertiliser subsidy to support farm made organic inputs; Rs. 5000/ha which as soil nutrient subsidy which can be used for organic inputs
- Labour subsidies: Subsidise Farm labor by Rs. 100 per day (which is equivalent to unskilled work under NREGA) balance if any to be borne by farmer; Labor subsidy (40 days/crop @ Rs. 100/day) which may cost about Rs. 76,000 cr/year
- For working in their own fields or hiring labor. Generates additional labor days Brings down costs of cultivation by Rs. 4000/ha
- Seed and other input subsidies Rs. 1000/ha
- Success Mantras
- Prioritization of strategic framework
- Clearly bringing out the expected contribution of each strategy
- Breaking-up the required interventions into short term, medium term and long term
- Preparing the Investment plan and feasibility of financial resources

Table 8.1 : Reforms in agriculture sector that can influence farmers income

1	Institutional reforms : Make provisions for 1.1 to 1.7	
	1.1	Private mandi
	1.2	Direct marketing
	1.3	Contract farming
	1.4	e-Trading
	1.5	Single point levy
	1.6	Direct sale to consumers by farmers
	1.7	Single traders license
2.	Special treatment to fruits and vegetables : Denotify from APMC	
3.	Participation in e-NAM	

8.1. Price incentives for producers

Experience of last five decades indicate that prices have profound impact on agricultural growth and they are significant determinant of farmers income. It is hoped that market reforms will bring competition and efficiency in agricultural market to ensure remunerative prices for the producers and reasonable prices for the consumers. In case there forms fail to have desired effect on prices received by farmers then government should expand price intervention to ensure that prices in the harvest season do not fall below the MSP. This should be implemented either through direct price intervention through procurement or through the system of deficiency price payment. The latter involves paying the producers the difference between MSP and farm harvest prices in representative market for the quantity of produce sold by farmers in the market.

8.2. Promoting responsible agricultural investments

Our farms are starved of capital and knowledge on modern methods and practices. Contract farming with modern firms help farmers in provisioning inputs and advance technology, skill transfer, guaranteed and remunerative prices, and access to reliable market. Market risk is the main hindrance in diversification to wards high value products. A marketing contract can overcome this risk. A few cases where contract farming is practiced in the country show wonderful results.

Recognising the role of private sector participation to infuse modern knowledge and capital into agricultural production, sharing risk, providing attractive market for produce and promote diversification towards high value crops the Finance Minister in his speech for the budget 2017-18 stated that a model law on contract farming would be prepared and circulated among states for adoption. The Budget speech also emphasised market reforms to de-notify perishables from APMC.

Precision farming is getting popular in developed countries as it reduces cost, raises productivity significantly and improves quality. However, this is knowledge intensive and it requires high skill and hand holding of farmers. Many commercial firms and corporates are now evincing interest in agri-business. There is a need to provide facilitating environment to organized private sector to engage with farmers in precision farming

8.3. Promoting value chains

Agriculture in India is characterized by informal or traditional supply chains that deliver products to local middlemen and then to small local stores. Formal value chains can deliver the same product, usually in better or more uniform quality, to more commercial firms-wholesalers, super markets or exporters. We need to find ways to integrate small producers into more modern value chains, both domestic and export-oriented.

Bulk of the produce is sold by farmers in raw form and as such taken from field to mandi after harvest. This causes glut in the market and suppresses prices to low level. Farmers do not keep produce for sale in lean months. There is now a provision for Warehouse receipt and keeping produce in WDRA registered ware houses. Few farmers make use of this facility.

8.4. Promoting producer's alliances

Agriculture is undertaken by very small sized production units who operate on tiny land holding sand keep a few live stock. Such operational units are not economically viable on their own because of their scale factor, poor bargaining strength, and reach to market. Such producers need some institutional mechanism for collective action, pooling of resources, group marketing and post-harvest value addition. At the level of Centre, SFAC and NABARD are promoting Farmers Producers Organizations (FPO) in the country. However, given the size of the country, there is a need to involve state level agencies in creating, nurturing and establishing FPOs.

Provisions have been created in law to facilitate formation of Farmers Producers Companies (FPC) to undertake agribusiness activities like other business entities. Some FPCs are showing impressive success in raising income of small holders by raising production and linking them to market. Such experiences need to be up-scaled.

8.5. Linking production to processing

Despite fast growth in demand for processed foods, their production is growing very slowly in the country. During 2011-12 to 2015-16, output of food processing industry increased by merely 3.6 percent per year. An important reason for this is that farmers do not get attractive market for their produce and processors do not get assured supply. Thus, linking processors with producers (farmers) through contract farming or market liberalisation has vast scope to raise output and farm income.

Food processing industry is also found to be much more labour intensive as compared to other industries (Rao and Dasgupta 2009). Promoting food processing in rural areas will also generate employment and help in shift of work force from agriculture to industry.

8.6. Policy issues for cotton

- Minimum Support Price (MSP) for Cotton should be ensured to farmers in case prices go down and should be based on the cost of cultivation plus reasonable profit margins to the farmers to ensure doubling of income.

- Information and knowledge management, particularly for institutional capacity building
- Procurement at farm gate to minimize the cost of transport to the farmer
- Installation of quality measurement devices at market level so that farmers will not face discrepancy to their produce and will get good price.
- At micro level storage facility of raw cotton shall be installed and proper security like insurance to the stock be given with minimum charges.
- Strengthening of market intelligence
- Remunerative minimum support price
- Provision of ginning facilities at mandi level to reduce the transport cost.

8.7. Policy issues for dryland agriculture

- Timely availability of quality seed of promising varieties to the farmers as per their requirement.
- Selection of variety as per soil types
- Limited soil moisture generally coincides with reproductive phase (terminal drought) resulting in substantial reduction in pigeonpea yield
- Mostly seed treatment is not followed by the farmers
- Use of Biofertilizers like Azotobactor, rhizobium and PSB culture is not much popular among the farmers owing to paucity of reliable source and ready availability of pure culture of biofertilizer in the market
- Timely availability of quality chemical fertilizers
- Lack of mechanization
- Lack of storage facility at field level
- Inadequate processing and un-organized marketing
- Development of irrigation facilities such as farm pond/small irrigation projects which can be utilized for use of protective irrigation at critical growth stages
- The farmers are mostly having less income from the agriculture due to the uncertainty of monsoon hence the farmers are defaulter of the crop loan from co-operative societies and other credit institutions
- As compared to the Urban area the village labourers are getting less wages and hence the labourer availability is less
- The basic needs of villager viz., medical aid, drinking water, transport facilities etc. are very meager
- The village farmers are mostly uneducated or illiterate due to which unable to adopt improved technologies developed by the University viz., soil testing and fertilizer use, use of pesticides, use of new improved implements
- Common storage facilities are not available at local level
- In the watershed area, the villagers are not having sufficient animals due to unavailability of fodder, reduction in grazing lands, high prices of animals, unavailability of timely veterinary aids

Source: MPKV

8.8. Policy issues for horticulture

Pomegranate

- Strict regulation for restriction on sale of unregistered chemicals required. Several unregistered pesticides and bogus bioformulations are being sold unrestricted which result in loss to farmers directly or through crop loss.
- **Regulation for Agridoctors/consultants required :** Self proclaimed Agridoctors/consultants without proper qualification is a big business today to which farmers are falling prey and suffering high input cost even failures.

- **Nursery Certification requires strict regulations :** Strict regulation for Nursery Certification is required so that diseases transmitted through planting material/potting mixture are restricted from spreading to new areas and avoiding heavy losses to the farmers. Sale through unauthorized agencies should e checked through imposition of penalties.
- **Unattended Orchards require policy :** Many farmers orchards suffering heavy losses due to some disease or in order to get subsidies are not removed for several years. Unattended orchards are source of breeding ground for several insect pests and diseases, that form inoculum source for neighbouring orchards, hence policy to remove such orchards is necessary for checking unwanted increase in pest population
- **Label claims regulations :** require revision or quick action for important export crops. Label claim is available only for 7 pesticides in pomegranate, with which it is just impossible to get exportable produce, hence companies may be asked to get label claims for pesticides used for important export crops or pesticides with label claim in other fruit crops in similar climatic conditions be allowed in other fruit crops also till label claim for individual crop has been granted.
- **Soil testing :** of each farm at periodic intervals should be made mandatory through state agricultural officers.

Grapes

- For protected cultivation, the cost involved for plastic cover on per acre basis is between Rs 3.8 – 4.5 Lakhs
- The cost of structure for providing additional support on the existing Y trellis will be approximately Rs 1.5 Lakhs/acre, whereas, for erecting independent support structure irrespective of Y trellis, the cost may range between Rs 3.11 to 4 Lakhs/acre. Suitable
- Suitable package in the form of subsidies to be provided by Govt. involving both the cost of structure and plastic cover will make them more affordable to the growers.

Citrus

- Procurement at farm gate to minimize the cost of transport to the farmer
- Installation of quality measurement devices at market level so that farmers will not face discrepancy to their produce and will get good price
- At micro level storage facility of raw cotton shall be installed and proper security like insurance to the stock be given with minimum charges
- Strengthening of market intelligence
- Remunerative minimum support price
- Provision of ginning facilities at mandi level to reduce the transport cost

Mushroom

- Availability of good quality seed (Spawn) of promising mushroom strains to the mushroom growers in adequate quantities and in time
- Selection of mushroom types for cultivation as per the availability of infrastructure and funds with the farmers
- Development of centralized processing units for production of value added mushroom products
- Development of organized marketing facilities using internet, E-mandi, E-nam portals of Govt. of India
- The vast publicity of nutritional and medicinal properties of mushroom through mass and electronic media in order to make awareness among the people
- Regular supply of energy (Electricity) at affordable and subsidized costs for commercial production of mushrooms
- Assurance of Minimum Support Price for fresh mushrooms and its by products
- Popularization of mushrooms and its cultivation technologies through KVK's, NGO's and SHG's (self help groups)

- Inclusion of mushrooms and it's by products in different processed food products and Mid Day Meal programme of Govt. of India in order to increase the nutritive values of meal
- The training should be imparted only through Govt. recognized mushroom training centers
- Establishment of government recognized mushroom spawn labs in the states
- Establishment of Mushroom Grower's Association for organized marketing and technical support

Floriculture

- For promotion of floriculture and for enhancing the income it is necessary to create integrated marketing facilities that includes
- florihats, florimalls, essential oil extraction, extraction of pigments and flower colours
- tie up with other byproduct based industries (soap, agarbatti, etc.)
- cryodrying for extraction of gulal, dyes pigments in major cities
- creation of cold storages at major airports of the country
- Huge amount of artificial flowers are being imported from the other countries which has significant impact on the flower cultivation as well as on the environment. Hence there should be regulation on import of artificial plastic flowers
- There is a need to evolve regulation of export and import norms for flowers and other inputs like fertilizers & other chemicals used in floriculture
- There is a need to regulate import of various new flower crops and its planting material in the country and it is necessary to address the IPR issues
- There should be policies to promote development of marketing platforms like Maha-Flower, Maha-Flori, Maha-Plantae (Nursery Plants)

8.9. Policy issue for livestock

- Focus on inefficient use of financial resources
- Links among sister institutions have weakened and accountability declined over time: Rethink of the R&D in livestock and agriculture system
- Farmers need to be ensured to receive remunerative prices. This issue has two aspects, one relating to the Minimum Support Price (MSP) and the other relating to the farmers share in the price paid by the final consumer
- Integrating smallholders in the process of industrializing livestock
- Public policy support for participating smallholders
- Estimating and reducing the economic losses from animal diseases
- Information and knowledge management, particularly for institutional capacity building
- Focus and inefficient use of financial resources
- Links among sister institutions have weakened and accountability declined over time
- Farmers need to be ensured to receive remunerative prices. This issue has two aspects, one relating to the Minimum Support Price (MSP) and the other relating to the farmers share in the price paid by the final consumer
- Integrating smallholders in the process of industrializing livestock
- Public policy support for participating smallholders
- Estimating and reducing the economic losses from animal diseases

8.10. Policy issue for fisheries

- Extension and monitoring from Fisheries department for CCRF implementations

8.11. Other key concerns for policy reforms

- **Reforming agriculture land policy:** Land owners get benefit of many of the agricultural schemes while those landless workers/entrepreneures have less scope. Hence there is a need for reforms in agricultural land policy particularly taking into consideration possibilities of consolidating economically unviable sizes of land for new agri entrepreneurs with due credit for land owners.
- Strict regulation for restriction on sale of unregistered chemicals required. Several unregistered pesticides and bogus bio formulations are being sold unrestricted which result in loss to farmers directly or through crop loss.
- **Regulation for Agridoctors/consultants required :** Self-proclaimed Agridoctors/consultants without proper qualification is a big business today to which farmers are falling prey and suffering high input cost even failures.
- **Nursery Certification requires strict regulations :** Strict regulation for Nursery Certification is required so that diseases transmitted through planting material/potting mixture are restricted from spreading to new areas and avoiding heavy losses to the farmers. Sale through unauthorized agencies should e checked through imposition of penalties.
- **Unattended Orchards require policy :** Many farmers orchards suffering heavy losses due to some disease or in order to get subsidies are not removed for several years. Unattended orchards are source of breeding ground for several insect pests and diseases, that form inoculum source for neighbouring orchards, hence policy to remove such orchards is necessary for checking unwanted increase in pest population
- Label claims regulations require revision or quick action for important export crops. Label claim is available only for 7 pesticides in pomegranate, with which it is just impossible to get exportable produce, hence companies may be asked to get label claims for pesticides used for important export crops or pesticides with label claim in other fruit crops in similar climatic conditions be allowed in other fruit crops also till label claim for individual crop has been granted.
- Soil testing of each farm at periodic intervals should be made mandatory through state agricultural officers
- **Reforms in forest laws :** Some of the forest produces can provide additional income for rural youth. However, some of the laws do not fully facilitate agro forestry. These laws to be revisited as it has been done recently for bamboo which is a no longer considered as forest produce. There is also scope for diversification in forestry with high value crop like sandalwood; however, forest conservation policies should not inhibit marketing of the produce from such ventures.
- **Registration of farmers with crop plan :** Farmers do not get a guaranteed price from domestic market while government Export-Import policies are often skewed towards traders benefit. To facilitate high income process and avoid market glut it is necessary to compel farmers for registering their crop in village offices before planting. This can greatly help in improving access to market intelligence for more gain from farm produce and developing online decision support system.
- **Enabling policies for increase in production:** The productivity of almost all the crops of Maharashtra state is less than national productivity except cotton and sugarcane crops. This yield gap should be reduced by way of adopting improved production technologies. In case of livestock, improvement in herd quality, better feed, increasing artificial insemination, reduction in calving interval and lowering age of first calving are the potential source of growth.
- **Policies for reduction in cost of cultivation :** The unbalanced and below recommended use of inputs leads to increase in cost of cultivation. The input should be used as per requirement, soil type and judiciously. The timely and balanced use of inputs leads to increase the output.
- **Increasing cropping intensity :** The Maharashtra cropping intensity in the year 2015-16 was 130.17 per cent. The cropping intensity of dry land agriculture varies from 100 to 125 percent and that of irrigated area ranges from 110 to 150 percent. Hence the cropping intensity needs to be increased by way of intercropping, mixed cropping, short duration crops, cultivating vegetables and flowers etc. The farmers income can be increased by way of increasing the more number of crop on same piece of land i.e.. by increase in the area under double cropping. This needs access to irrigation water and improved efficiency in irrigation methods.
- **Diversification involving high value crop :** The cropping pattern of Maharashtra is still cereal based. Farmers are mainly concerned with the profit he gets from a particular crop like paddy, wheat, rabbi

Jowar, Bajara, Maize etc. This crops can be replaced by the crops like soybean, pulses, oilseed, fruits and vegetables which are high value crop and economically viable.

- **Increased Price realization :** The low level of farmers income and year to year fluctuations in it are a major source of agrarian distress. This distress is spreading and getting severe over time, impacting almost half of the population of the state that is dependent on farming for livelihood. About one third of the increase in farmers income is easily attainable through better price realization. This requires comprehensive reforms in market. There is a need to liberalize agriculture to attract responsible private investment in production and market. Similarly, FPO's and FPC's can play big role in promoting small farm business, Ensuring MSP alone for farm produce through competitive market or government intervention will result in sizeable increase in farmers income in the state.

8.12. Effective implementation of marketing strategies and agricultural prices:

The effective implementation of marketing strategies and agricultural prices need to be emphasized by policy makers and development functionaries in the state. Some of these are being aggressively pointed out by farmers organizations though the state. Some of the issues regarding marketing policies are as below

Effective implementation of minimum support prices

As MSP is a price guarantee, MSP operations are required to be carried out a) in all the markets where prices dip below MSP, and (b) throughout the marketing season till farmers continue to offer their produce at MSP to the purchase agencies (c) advance arrangements should be made in terms of adequate number of purchase centre, handling logistics and timely payment to the farmers/sellers.

Reduce the farmers risk

The farmers face several kinds of risks like weather risks, production process risks (input availability and quality, insect pests, diseases etc.) and marketing risks. The risks associated with marketing process are of three type's viz. physical risk, institutional risk and price risk. Risk and uncertainties cannot be eliminated but can be minimized. For minimizing the price risks of farmers, at least two major schemes viz, minimum support price scheme and market intervention schemes are in operation for crops since long. But there are several question related to their effective implementation.

Establishment and Networking of Agriculture Market Intelligence centers.

This project was operational during the period 2009 to 2014. The consortium leader was Tamil Nadu Agricultural University (TNAU), which had successful experience of operating a similar project as a part of their domestics and export market intelligence cell (DEMIC). Consortium Partners were 10 State Agriculture Universities. Dr. PDKV, Akola was only one centre from Maharashtra state. The team reviewed globally available price forecasting models (ARIMA). They forecast prices regularly for the pre sowing and pre-harvesting period. The price for cast widely disseminated through print and visual media. Their price forecast accuracy is also good. Therefore, such type of networking of market intelligence centers should be located in all 4 universities of Maharashtra for the benefit of the farmers in all region.

Speeding up of third phase of Agricultural marketing reforms

There is a urgent need of reforms in agricultural marketing. It should includes

- Declaration of whole state as one unified market
- Provision of single state- wide trading license.
- Allowing and promoting private wholesale market yards
- Promoting farmer- consumer markets
- Promoting e-trading
- Moving to a common national market for farm products.

These reforms should be effectively implemented for the benefit of farmers in the state.

Mechanism of MSP + 50% profit

As Swaminathan Committee report suggested 50% profit should be added in the cost of production, so as to get the prices as high as possible to the farmers. However CACP consider 14 different factors other than cost of production. So MSP always remain lower than market prices of the crops. Hence, the MSP mechanism is not useful to the farmers for increasing their farm income.

More yield per drop

It is a regular practices of many farmers from khamkhed group to fill the dry wells with tanker in the month of Jan-Feb and them planting the cotton in the field at the end of May on drip irrigation by using all scientific methods. They are harvesting 28 to 30 q of cotton per acre i.e.. 4 to 4.5 times more than normal yield

Emphasis on E-NAM

National Agriculture Market (NAM) is a pan-India electronic trading portal which networks the existing APMC mandis to create a unified national market for agricultural commodities. The NAM Portal provides a single window service for all APMC related information and services. This includes commodity arrivals & prices, buy & sell trade offers, provision to respond to trade offers, among other services. While material flow (agriculture produce) continue to happen through mandis, an online market reduces transaction costs and information asymmetry.

Agriculture marketing is administered by the States as per their agri-marketing regulations, under which, the State is divided into several market areas, each of which is administered by a separate Agricultural Produce Marketing Committee (APMC) which imposes its own marketing regulation (including fees). This fragmentation of markets, even within the State, hinders free flow of agri commodities from one market area to another and multiple handling of agri-produce and multiple levels of mandi charges ends up escalating the prices for the consumers without commensurate benefit to the farmer.

NAM addresses these challenges by creating a unified market through online trading platform, both, at State and National level and promotes uniformity, streamlining of procedures across the integrated markets, removes information asymmetry between buyers and sellers and promotes real time price discovery, based on actual demand and supply, promotes transparency in auction process, and access to a nation wide market for the farmer, with prices commensurate with quality of his produce and online payment and availability of better quality produce and at more reasonable prices to the consumer.

8.13. Investment and role of Government

- Continued investment in irrigation schemes to realize full potential of irrigation resources in the state
- There is a need of investment in promoting efficient irrigation system/methods to achieve the goal of crop per drop
- There should be investment in monitoring system to ensure judicious use of irrigation water, inputs including fertilizers and other agrochemicals to reduce the cost to farmer and environment
- Investment in e-marketing and essential support involving transport to support FPOs
- The system to ensure appropriate crop plan evan at village or block level particularly for avoiding market glut and losses due to dip in commodity prices
- Custom hiring centres at village and block level for farm machineries can reduce the cost of cultivation and can also promote FPOs including small and marginal farmers
- The government should substantially invest in realizing the benefit of E-Market and making the agribusiness remunerative
- Government should invest on capacity building of rural youths to harness recent advances in agricultural and information technologies for attracting them to agricultural business
- Government should promote activities related to promotion of modern technologies through digital media

9. Implementation Plan and Institutional Responsibility

With opportunities and scope provided by advances in science in all the sectors of agriculture including field crops, horticulture, livestock, fisheries and allied activities any plan for doubling the farmers income should include three way strategies synergizing each others. The first one should include increasing the production from farming system, the second should be provision for reducing the cost of production and the third and most important is enhancing income through remunerative prices for agricultural products and also diversified activities dependent or independent of agricultural activities.

The approaches for implementation plan should primarily focus on low lying fruits for eg already available technologies for enhancing the production and reduction the cost. In the second step a robus communication system between the farmer, consumer and technologist should be made functional to bridge the gaps in technologies to make production feasible and acceptable. This also should facilitate paradigm shift from traditional agriculture to precision agriculture to enhance input use efficiency for the cause of farmers and environmental benefits. All these activities to be propped by improved marketing system to protect farmers interest in addition to those of consumers.

9.1. District wise action plan to enhance farmers income to be prepared

For facilitating implementation the plan for doubling the farmers should be at least at district level taking into consideration the ground truth at block and village level. This needs delineation of agroecological features at smallest scale such as village level. Detailed map of soils as revealed by GIS tools will be crucial for making decision on land use plan and crop plans. For enhancing the value of digital maps developed through GIS tools ground truth data has to be collected. Soil health card data obtained for each of the sites to be matched with GIS data. Government of Maharashtra should make investment in this field.

Responsibilities: Agriculture Departments, ICAR-NIASM, ICAR-NBSSLUP, concerned SAUs Department of Agriculture, Horticulture, Animal Husbandry and Fisheries of Maharashtra State.

The efforts should include crop plans to doubling the income of farmers based on agro ecological conditions at Tahsil levels and those who follow these plans to be given incentives.

The plan should include at least one integrated farming system module for each of the agroecologies in every districts to start with and then to be scaled to block level gradually.

The plan should also explore crop intensification and diversification options to get maximum benefit of agro-ecologies and the market in the vicinity and away from local as well as big towns and metros.

Soil health card should be made more meaningful by adding action plans to improve and get benefit by matching appropriate production and protection technologies. Government should support such activities through incentives for farmers for contributing to the long term sustainability of agroecosystem.

Demonstration of crop production and protection technologies and input use efficiency tools promoting water saving and fertilizer saving irrigation/application methods should followed NFSM approach and those commodities which have not been covered in this scheme should be taken care by the state departments.

Responsible Agencies: ICAR-institutes, SAUs NHRDF, Marketing Board, NeML, APMC, State Departments, KVKs, SAUs

9.2. Dissemination of technology through cluster of farmers

Clusters of farmers can be formed districts for collaborative actions from various agencies for conduction of demonstrations, trainings, distribution of literature and inputs, etc. are required to increase income of the farmers engaged in onion cultivation.

It is possible to promote contract farming through cluster approach where private companies can establish processing units and purchase all produce of that cluster with assured price. The private companies shall provide inputs and public institutes like SAUs and ICAR shall provide technological support.

Responsible institutes: SAUs, ICAR Institutes, Department of Agriculture, Horticulture, Animal Husbandry and Fisheries of Maharashtra State

9.3. Superior varieties/breeds for enhanced production

Since technologies are already available, development of improved cultivar and effective seed replacement should be the driving factor for adoptation by farmers and to bridge the yield gaps.

Responsible Agencies: ICAR-institutes, SAUs NHRDF, Marketing Board, NeML, APMC, State Departments, KVKs, SAUs

9.4. Optimised use of agricultural Inputs

Input use efficiency is beneficial for both farmers and environment thus can immensely contribute to the sustainability of agriculture. This should include drip irrigation and Fertigation, soil test based input recommendations and IPM technologies.

Responsible institutes: SAUs, ICAR Institutes, Department of Agriculture, Horticulture, Animal Husbandry and Fisheries of Maharashtra State

Advance machineries are required for reducing cost on labourers and intercultural operations. Custom hiring services such as pruners, sprayers, tractors cultivator/rotavator services shall be provided by State Agriculture Dept. Offices at Taluka level at reasonable charges.

Responsible Agencies: ICAR Institutes, SAUs, State Departments, KVKs

9.5. Post-harvest management

Cold storages and cold-chain facility and small scale processing units under farmer Producer Company shall be promoted. Farmer producer companies can establish small scale processing units for Ready-to-Serve beverages. The technology in this regard has been developed by Central Citrus Research Institute, Nagpur for acidlime and Nagpur mandarin and already given to an entrepreneur who had set up a unit with value added products from citrus fruit, thus growers can earn more income. Onion farmers can be motivated for advance technology for post-harvest management. Subsidy can be provided for graders and storage structures for onion, and processing for pomegranate

Responsible Agencies: ICAR-Institutes, State Departments, KVKs, SAUs.

9.6. Infrastructures and basic facilities

For further promoting livestock as integral components of farming system for enhanced profit, there is a need to increase number of Veterinary Hospitals, Insemination units, Hatcheries etc.

Responsible Agencies : ICAR-institutes, MAFSU, Animal Husbandry Departments, KVKs, SAUs

9.7. Remunerative price

Fixing of minimum support price is important factor particularly to avoid market related distress for farmers at the time of glut. Market intelligence should also be provided to the farmers time to time.

Responsible Agencies: ICAR institutes, SAUs, KVKs Marketing Board, NeML, NAFED, APMC, State Departments

9.8. Promotion of export

Fix export policy is essential for commodities like onion export. Farmers should be motivated for export of commodities like onion, flower, vegetables in addition to grapes and pomegranate to get remunerative income. If a particular cultivar of a specific commodity is in great demand in the international market, necessary efforts to be made to integrate such items in agribuisiness mode. This can significantly contribute to enhanced income of farmers including those who are already availing advantages of export oriented crop cultivation.

Responsible Agencies: CAR institutes, SAUs, KVKs Marketing Board, NeML, NAFED, APMC, State Departments

9.9. Agro clinics and other training institutes

These basic amenities are essential to provide front and back end support from seed to gains from various agricultural sectors

Responsible Agencies: ICAR-DOGR, NHRDF, APEDA, Marketing Board, NeML, APMC, State Departments, KVKs, SAUs

9.10. Integration of plan with national schemes for farmers welfare

Fasal Bima Yojna, More Crop per Drop, Pradhanmantri Sichai Yojna, Organic Farming , E-Marketing, Mobile apps/ICTC etc. Sponsored by central government and also schemes like Jalayukta Shivar sponsored by State government.

Responsible Agencies: ICAR institutes, SAUs, KVKs Marketing Board, NeML, NAFED, APMC, State Departments

9.11. Digital technology & mobile apps for knowledge dissemination

In western Maharashtra, farmers use various apps for assessing agriculture related information specially on plant protection measures, weather forecasting, trends of market rates , crop technology, water management and schemes of Agriculture and allied department. It is necessary to further develop robust IT tools for regular advisories and complete information. Since development of web applications for ready to use information has become a routine, there should be system to verify quality of information. This is essential to avoid confusion about the choice to make among various technologies that are in the market and at technology generating institutes.

Responsible Agencies: ICAR-institutes, SAUs, NHRDF, Marketing Board, NeML, APMC, State Departments, KVKs, SAUs

Table 9.1 : Mobile apps for knowledge dissemination

Sl. No.	Name of Mobile App	Information available on App	From where it can be downloaded
1.	Pusa Krushi	Various crop varieties and improved technology	Google play stores /Farmer Portal/ mkisan portal
2.	Shetkari Masik	Articles on Agricultural aspects	Google play stores/Farmer Portal/ mkisan portal
3.	Maharain	Information related to rainfall received from Circle/ Tahsil / District/Region)	Maharain
4.	Crop Clinic	Information on Soybean Cotton Paddy, Pigean pea and Gram Pest & Diseases ,control measures and trade names	mahaagriqc.gov.in
5.	Krishi mitra	Tahsil wise Seed Fertilizer pesticide dealers list	Farmer Portal/mkisan portal
6.	mKisan India	Information on agro climatic situation, metrological data	Google play stores/Farmer Portal/ mkisan portal

Sl. No.	Name of Mobile App	Information available on App	From where it can be downloaded
7.	Kisan Suvidha	Climate, Agri-input dealers list Market rate, plant protection measure advisory	Google play stores/Farmer Portal/ mkisan portal
8.	Crop Insurance	Crop Insurance information	Google play stores/ FarmerPortal/ mkisan portal
9.	Digital Mandi India	Tahsil District and states level Agriculture Produce Market Committee commodity wise rates	Google play stores/Farmer Portal/ mkisan portal
10.	AgriMarket	commodity wise rates with in 50 km , District /States /National level	Google play stores/Farmer Portal/ mkisan portal
11.	Pashu Poshan	Animal Nutrition information	Google play stores /Farmer Portal/ mkisan portal
12.	Cotton (Kapus)	Cotton Cultivation Practices	Google play stores
13.	IPM	Major crop integrated pests management	Google play stores
14.	Halad Lagwad	Turmeric Cultivation ,Processing and technological information	Google play stores
15.	Pik Poshan (Plant Nutrition)	Information on Macro and Micronutrients requirement of various crops	Google play stores
16.	Limbu Vargiya Phaljhad Lagwad (Citrus Cultivation)	Citrus and Lime cultivation information	Google play stores
17.	Shekaru	Information on Agricultural Schemes Exhibition and Trainings	Google play stores
18.	Iffico Kisan	Weather data ,Market rates , advisory, news,market profile and videos	Google play stores
19.	KrushiKing	Sharing of information and knowledge about agriculture, weather forecast, crop management, market rates, general updates, governmental schemes, answers of farming queries by agriculture professionals and success stories in agriculture	Google play stores
20.	Krushi Kranti	Commodity Selling and Purchasing rates	Google play stores
21.	Krishi Jagran (Marathi)	Agricultural Magazine	Google play stores

Maha Krishi Sanchar CUG Plan –

Prepaid and Post paid mobile plans started for Farmers, University scientists and Agriculture officers. Facilities provided are 1000 minutes free local calls to any mobile .Free net connectivity 1 GB data/day.Free 100 SMS per day. Special Tariff voucher is Rs 141/month.

9.12. Agro Tourism as Off-Farm Income Avenue

Farmers can think upon other sources than farming avenues for earning more money from other sources by using their available resources.

Agri Tourism is the Holidays concept of Visiting a working farm or any agricultural, horticultural, or agribusiness operations for the purpose of enjoyment, education, or active involvement in the activities of the farm or operation. This approach to be promoted at places of tourist attractions.

Responsible Agencies : ICAR-institutes, SAUs NHRDF, Marketing Board, NeML, APMC, State Departments, KVKs, Tourism departments

10. Summary and Recommendation

10.1. Summary

Farmers income in Maharashtra is substantially lower than those who are in other sectors and particularly in service sector. Though he is responsible for feeding ha million his struggle to have comforts in life in in progress despite significant advances in agricultural sciences and technologies. Hence aptly though mission for doubling the farmers income by 2022 needs a strategic plan and implementation models to realize this dream in all the villages of all the 36 districts of Maharashtra and also in Metro districts such as Mumbai where some are involved in urban farming, animal husbandry or dairy and fisheries.

Nearly 50% of the geographical area in Maharashtra is under cultivation and half of it depends totally on rains. Only about 18% of the cultivated area has access to irrigation. Despite these constraints the state is contributing significantly to agricultural produces particularly pulses, jowar, sugarcane, grapes, pomegranate etc. with farmers active involvements of farmers cooperatives. However, despite clear demonstration of profits from horticultural crops, many farmers are below poverty level. The n and natural endowments are not really sufficient to make farmers rich.

Water scarcity is one of the major constraint and hence huge gap between crop productivity and achievable yield exist for different crops including both field and horticultural commodities. To great extent limited infrastructures for post harvest storage and processing further limits income from perishable horticultural commodities and also important pulse crops.

Several technologies and success stories have been demonstrated by SAUs and ICAR-institutes in the state which needs to replicated as they have great potential to enhance the income for farmers. Since profit from single commodity or sector is unlikely to help in doubling the farmers income, it is essential to develop site specific integrated farming system modules involving crops, horticulture, livestock and fisheries wherever feasible. Such systems can significantly contribute to sustainable and more income for the farmers.

There is a lot of scope for enhancement of farmers income through technological interventions for increasing the production through enhanced productivity, reduction in cost of cultivation through input use efficiency and enhancing the remuneration for product through market reforms and value addition. This can be achieved through integrating the farm activities with well thought government schemes at central and state level.

The plan for implementation of strategies for doubling the farmers income in Maharashtra should start with delineation of agroclimatic features at district level supported by technological interventions for enhancing the productivity, reducing the cost and income generation through diversification, intensification and improved marketing support involving information technological tools. The plan should bring together all the promising technologies to design appropriate site specific Integrated Farming System modules for each district. This needs involvement of SAUs, ICAR institutes in the state and department of agriculture of the State. Improved infrastructure for post harvest storage, value addition and direct marketing can significantly contribute towards doubling farmers income. Some of the recommendations for the same have been given in the next section of this chapter.

10.2. Recommendations

- The agriculture prices are not fixed taking into livelihood needs of the farmers. The rising inflation always had a double impact on farmers with increasing costs of living and decreasing incomes due to reduction in agriculture prices as a result of price intervention mechanisms of the government. Minimum Support Prices are announced for 25 commodities and market intervention operations exist only for rice and wheat. So farmers growing other crops are left to the mercy of the markets.

Hence

- MSPs should take into account actual costs of cultivation and living costs (corrected to inflation rise)
- NFC's recommendation (Cost C2+50 %) can be used as a guide (Rs. 1800/q for 2010 paddy and wheat based on 2009 cost calculations)
- Price differential (MSP –actual realised/procurement price) should be paid directly to farmer
- There is a provision for enhancing the production by technology interventions for bridging the yield gap and reducing the cost of production.

Hence

- Government should promote and give a boost to dissemination of promising technologies to the farmers
- Incentives should be tagged with adoption of Soil health card based input use and integrated pest management that can reduce pesticide load on environment and also the adverse effect on human health
- Cost intensive soil moisture conservation and soil conservation technologies to be supported by the Government in the larger interest of sustainable agriculture
- Soil health card schemes should be effectively utilized as ground truth data to employ GIS based mapping technologies for devising decision support system on choice of crop and appropriate production and protection technology
- Diversification and value addition can add income for farmers and this can involve non farm or off-farm activities to reduce total dependence on agriculture.

Hence

- Government should encourage district level or even tehsil level crop plan
- Introduction of new crop or cropping system
- Storage, processing and marketing structures even at small administrative setup such as Tehsil by appropriately bridging the gaps in existing system
- Should promote rural artisans which can boost Agro-tourism
- Doubling the income of farmers income by 2022 is not an easy task but not an impossible task if a perfect coordination is established between research and educational institute implementing agencies i.e. state departments

Hence

- Necessary action has to be taken to ensure involvement of SAUs, ICAR institutes and line departments are established
- The government schemes to be appropriately tagged with technology dissemination and incentives for adoption.
- There should be custom hiring centres and storage structure at smallest unit of administration