Designing Rural Technology Delivery Systems for Mitigating Agricultural Distress:

A study of Wardha District

M S Swaminathan Research Foundation
Chennai

Office of the Principal Scientific Adviser
to the Government of India, New Delhi

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FOREWORD

The US Department of Agriculture has forecast a shortfall of 15 to 17 million tonnes in India's rice output during 2009-10. Government has announced that about 2 million tonnes of rice may have to be imported soon to feed the public distribution system without interruption, since government stock has come down to 15.35 million tonnes on 1st October 2009. The reduction in *Kharif* crop production is largely due to widespread drought in many parts of the country as well as heavy flood in parts of Andhra Pradesh and Karnataka. Ensuring food security for a human population of 1.1 billion and a farm annual population of 1 billion is thus a formidable task.

Fortunately, unlike in China, whose annual food grain production is currently 500 million tonnes, we have a large untapped yield reservoir in most cropping systems, even with the technologies on the shelf. A Rs.25,000 crore Rashtriya Krishi Vikas Yojana has been launched to help in bridging the prevailing gap between potential and actual yields.

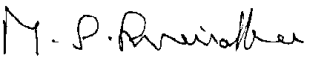
Designing Rural Technology Delivery Systems for Mitigating Agricultural Distress: A Study of Wardha District focuses on the technological dimension of the agricultural crisis that is currently gripping the Indian economy. A perusal of this study will show that it will be possible to bridge the prevailing yield gap in the district, provided integrated attention is given to knowledge delivery, input supply, popularization of appropriate technologies, soil health, water harvesting and management, and market management. Dr R Rukmani and Ms Manjula have adopted a methodology that combines secondary data analysis with primary survey. A cross section of key persons - Farmers, Farm Leaders, Scientists, Academicians and Bureaucrats were interviewed by them.

The study was funded by the Office of the Principal Scientific Adviser to the Government of India and was closely monitored by a Project Review and Monitoring Committee. Our gratitude goes to Dr R Chidambaram as well as the Chairman and members of the Committee, Dr Panjab Singh, Former Vice Chancellor of Banaras Hindu University; Dr C R Bhatia, Former Secretary, Department of Bio-Technology; Dr S F D'Souza, Associate Director, Bio-Medical Group and Head, Nuclear Agriculture and Biotechnology Division, BARC, Mumbai and Dr R P Sharma, INSA Sr. Scientist, National Research Centre on Plant Biotechnology, IARI, New Delhi and Dr R P Gupta of the Office of the Principal Scientific Adviser to the

Government of India, for all the interest they have taken in this important project and for the encouragement and guidance they have given to the researchers.

The results of the study show that there are considerable opportunities for increasing the productivity and profitability of small and marginal farm holdings through a technological upgradation of farm practices, supported by assured and remunerative marketing opportunities.

I hope this study will help to spread a mood of confidence in our agricultural capability. Those who are designing the "bridge the yield gap" programme in State Governments will benefit from studying this Report. My sincere thanks go to Dr R Rukmani and Ms Manjula Menon for their painstaking and meticulous documentation and for the compilation of this "Message of Hope Report".



M S Swaminathan

November 2009

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This study has been funded by the Office of the Principal Scientific Adviser to the Government of India. We owe a special word of thanks to Dr R Chidamabaram, Principal Scientific Adviser, GoI, for his support. The Project Review Monitoring Committee that was set up to review and monitor the work was initially chaired by Dr Panjab Singh and later on by Dr C R Bhatia with Drs S F D'Souza, R P Sharma, and R P Gupta as members of the Committee. We thank the chairpersons and members, for their guidance and encouragement all through.

Prof V B Athreya, Dr T N Balasubramanian, Dr J Jeyaranjan, and Prof K Nagaraj, apart from being a source of support for us, have provided critical inputs, guidance, and valuable comments all through. We acknowledge the active help and support extended right through our project period by several people in Wardha and Nagpur. We particularly thank Mr Vijay Javandhia, Kisan Sanghatana Leader, Wardha; Mr Atul Sharma, Project Officer, Community Polytechnic, Pipri, Wardha; and Dr S A Nimbalkar, Ex-Vice Chancellor, Panjabrao Deshmukh KrishiVidyapeet, Akola, Dr K S Gajbhiye Ex-Director of National Bureau of Soil Survey and Land Use Planning, and Mr Avinash V Shirke, Fellow, ASHOKA, Yavatmal. We are also grateful to the scientists of the Panjabrao Deshmukh Krishi Vidyapeet at Akola and Central Institute of Cotton Research and National Bureau of Soil Survey and Land Use Planning at Nagpur, for their time and technical insights. We also thank the government officials from various Government departments in Wardha and Pune for taking time off to answer all our queries and providing valuable inputs.

We feel a deep sense of gratitude to the farmers of Lonsavali and Kosurla villages, for their valuable time and patience in answering our queries. Last but not the least, we are very grateful to Mr Ratnakar B Parimal for helping us with our field work at Wardha. Our interactions with the farmers largely depended on his translations.

The support and help received from our friend and colleague, Dr Vishwanath Pallad, the site co-ordinator, Wardha Site Office, and his team members need a special mention. The inputs provided by the MSSRF staff at the Waifad VRC and

the Knowledge Workers at Lonsavali VKC were very helpful in planning our field surveys. We cherish with fondness the warm hospitality extended to us by Dr Vishwanath and his family during our visits to Wardha.

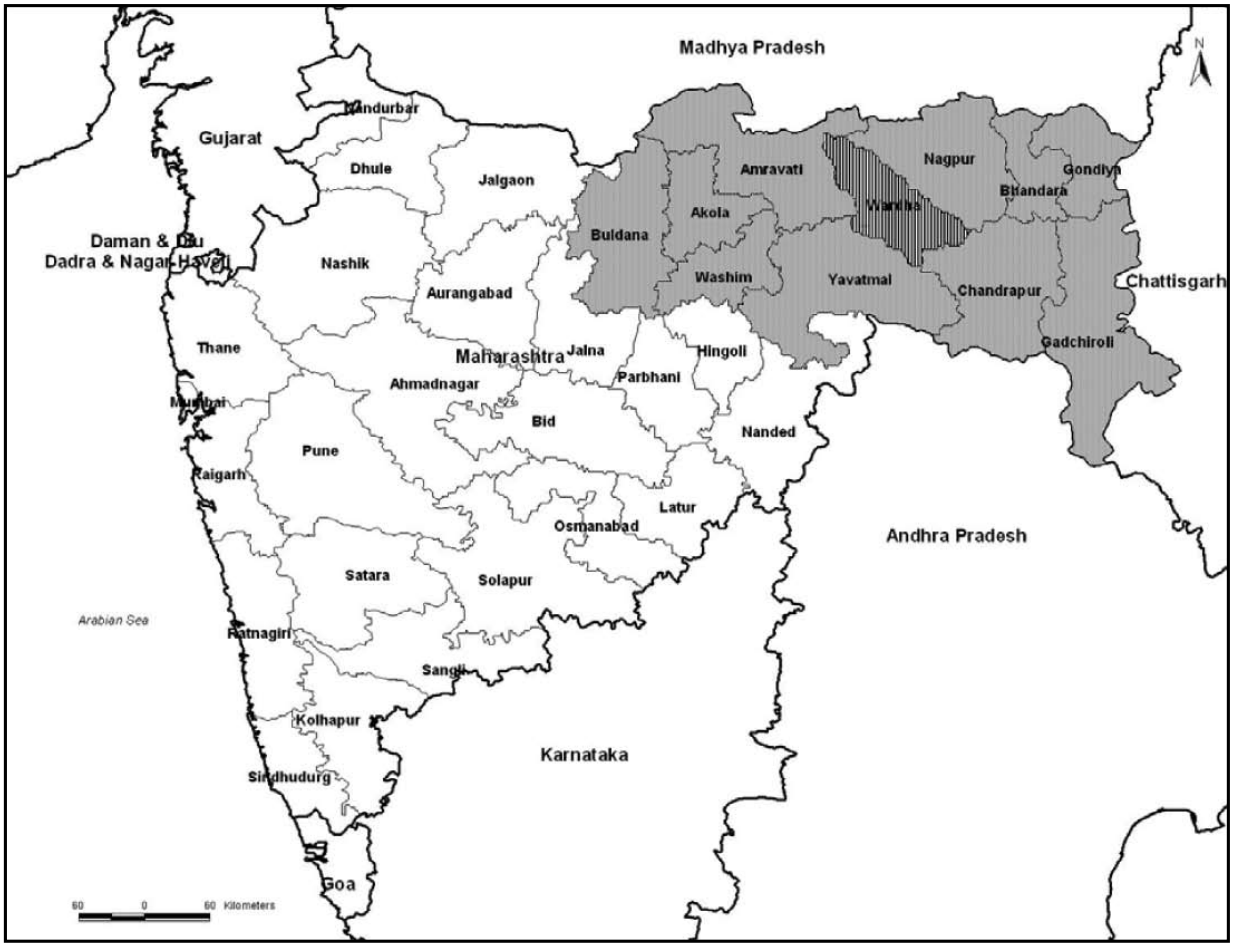
We thank Dr Shubashree Desikan for her help in editing the report. Our special thanks to Mr Sakthi Velan for his help in the final stages of the report. Finally, thanks are due to all our colleagues who helped in various ways in the completion of the study.

R Rukmani *and* **Manjula, M.**
November 2009

Introduction

It is well recognised that Indian agriculture is currently in a state of crisis. Factors underlying the crisis are complex and manifold and relate largely to the nature of economic strategy pursued by the state as well as several institutional, technological, ecological, and weather-related factors. While a large number of factors contribute to the crisis in agriculture, leading to enormous distress among people dependent on it, the focus of the current study is to address one dimension of the agricultural problem, namely, the technological. The technological dimension would encompass a wide spectrum of non-price factors relating to crop production and crop productivity. Issues that influence agricultural production, namely, the physical environment; the extent and nature of agricultural inputs used; the nature of crop-protection practices followed; and the overall management practices adopted in cultivation including aspects of irrigation and technology delivery would all be addressed in this study on Wardha District.

Map 1 Map of Maharashtra Showing Wardha District within Vidarbha



Wardha District lies in the Vidarbha region of Maharashtra. It has been experiencing a distress situation in agriculture over the last decade and has been identified as one of the six districts where a special package to alleviate agricultural distress was launched by the government of Maharashtra in the year 2005.[1] Further to this, in the year 2006, Wardha was one of the thirty-one districts identified by the Government of India as prone to agriculture-related suicides and has received a rehabilitation package involving short-term and long-term measures to be implemented during 2006–2009.[2]

In our attempt to understand the technological dimension of the agricultural crisis in Wardha District we used information collected from primary surveys as well as from secondary sources. While an analysis of secondary data on Wardha District provides a macro picture of changes in the district as a whole, the personal interaction with key informants-farmers, scientists, extension officers and other experts-provides an insight into specific local concerns. Two villages, Lonsawali in Wardha Taluk and Kosurla in Hinghangat Taluk, were chosen for purposes of detailed enquiry and interviews were conducted with selected farmers in these villages. The attempt in the village survey was essentially to understand the constraints faced by farmers with regard to adoption of technology and problems encountered by them with regard to cultivation in general. The village-level enquiry also examined the agricultural extension system that is responsible for technology delivery to farmers.

The report is organised as follows: in Section 1 a macro picture of major changes pertaining to agriculture in Wardha District is provided; in Section 2, on the basis of a field study conducted in two villages in the taluks of Wardha and Hinganghat, the problems encountered by farmers are explored; in Section 3, a critical examination of the agricultural extension system is followed by a documentation of the contribution of the State Agricultural University of the region; in Section 4, a set of recommendations is provided.

1 The six districts of Vidarbha where the package is applicable are Yavatmal, Amravati,Akola, Buldana, Washim, and Wardha.

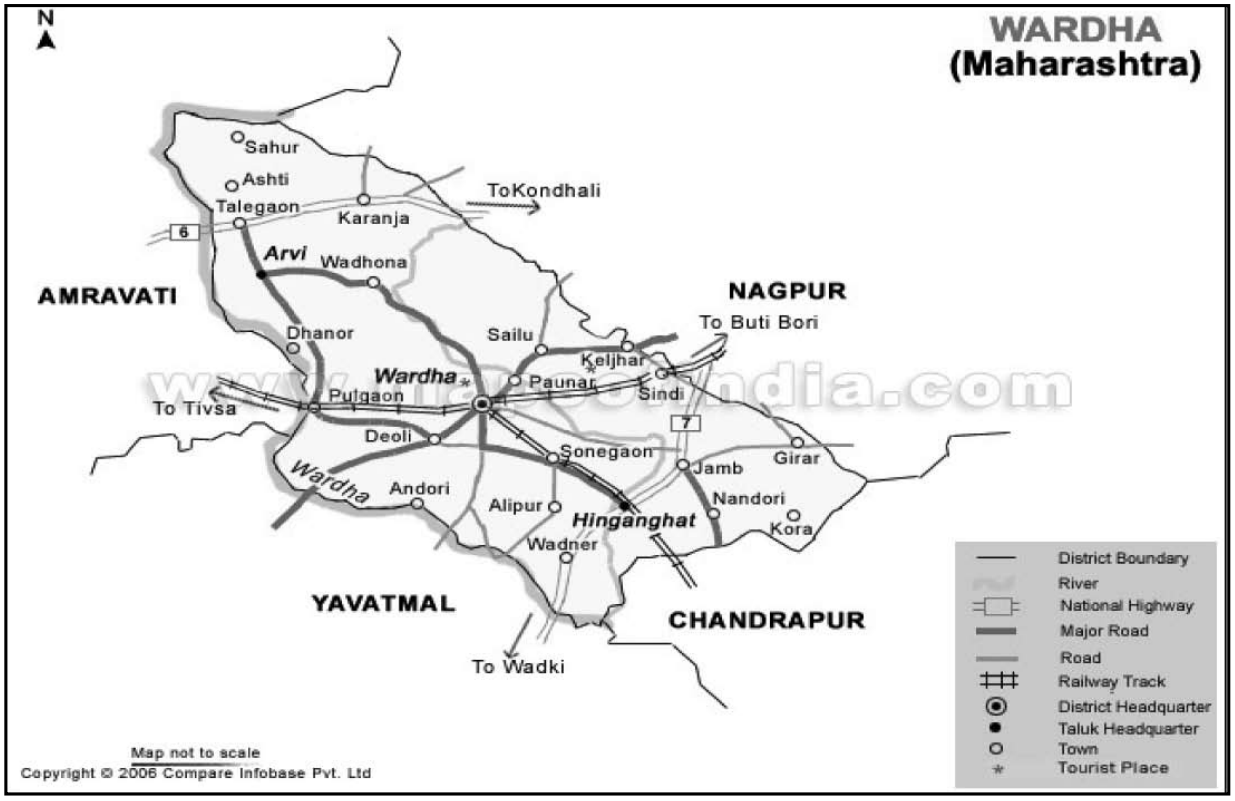
2 Of the thirty-one districts identified, six are in Maharashtra while the rest are from the states of Andhra Pradesh, Kerala, and Karnataka. These are: Akola, Washim, Wardha, Buldhana, Amravati, and Yavatamal in Maharashtra; Prakasam, Guntur, Nellore, Chitoor, Kadappa, Anantapur, Kurnool, Adilabad, Karim Nagar, Khammam, Mahbubnagar, Medak, Nalgonda, Nizamabad, Rangareddy, and Warangal in AndhraPradesh; Belgaum, Hassan, Chitradurga, Chikmagalur, Shimoga, and Kodagu in Karnataka; and Wayanad, Palakkad, and Kasaragod in Kerala.

Section 1
Salient Features of Wardha District

Wardha District is located in the Vidarbha region of Maharashtra state and is named after its most important river, the Wardha. The district is bounded on the west and north by Amravati District, on the south by Yavatmal District, on the southeast by Chandrapur District and on the east by Nagpur District. The boundaries with Amravati and Yavatmal districts are identified by the river Wardha. The district covers 6,309 sqkm and the total population of the district is 1.2 million of which 74 percent, or 9.1 lakh, population live in rural areas according to the Census of 2001. The percentage of population living in rural areas in Wardha District is far higher than in the state as a whole. Maharashtra being one of the most urbanised states in the country accounts for less than 60 percent of its total population in rural areas by 2001. Thus, Wardha District is more rural compared with the state as a whole.

There are eight taluks in the district[3] and the taluks of Karanja, Ashti, and Samudrapur are entirely rural with no settlement being classified as urban. The

Map 2 Map of Wardha



Source: *www.mapsofindia.com*

3 The taluks are Wardha, Seloo, Samudrapur, Hinghanghat, Deoli, Arvi, Ashti, and Karanja.

seven towns counted in Wardha District in 2001 are spread across the remaining four taluks. Wardha, the district headquarters is the most populous town of the district with a population of 1.1 lakh, followed by Hinghanghat with a population of 92,000 in 2001. The other five towns are medium and small towns with population in the range of 10,000 to 50,000. The district has a town density (number of towns per 1,000 sqkm) of 1.1 in 2001, and while this means that on average there is one town per 1,000 sqkm, given that large tracts do not have any towns at all this average does not quite reflect the reality. The predominantly rural character of the district is further borne out by an analysis of distribution of workers in Wardha District, which is discussed later on in this section.

1.1. Agro-Ecological Classification[4]

Agriculture in an area is dependent on various elements of the physical environment such as soil and climate, along with other factors such as irrigation and inputs. The agro-climate of Wardha District is characterised by hot, dry, and subhumid bioclimate with dry summers and mild winters. In discussing the agro-ecological conditions that prevail in Wardha, the *District Gazetteer* published in 1974 notes, '….most of the disasters that befell Wardha District were not due to scarcity of rain but excess of it. This has been confirmed by the Fact Finding Committee appointed by the then Government of Bombay in 1960. It reported that the incidence of crop failure in the district is very low and whenever it happened it was due to excessive rains. It concluded for that reason that none of the *tahsils* of the district could be regarded as scarcity area. But yet rainfall is the only determinant of the pattern and rotation of crops and the productivity of land'. (GoM, 2006) This comment regarding the rainfall pattern as well as the dependence of Wardha's agriculture on rainfall continues to hold even today, as will be clear from the ensuing analysis. An examination of the rainfall data over the period 1966 to 2006 for the district of Wardha indicates an assured rainfall pattern with an annual mean rainfall of 1041.1 mm.[5] The analysis of rainfall data

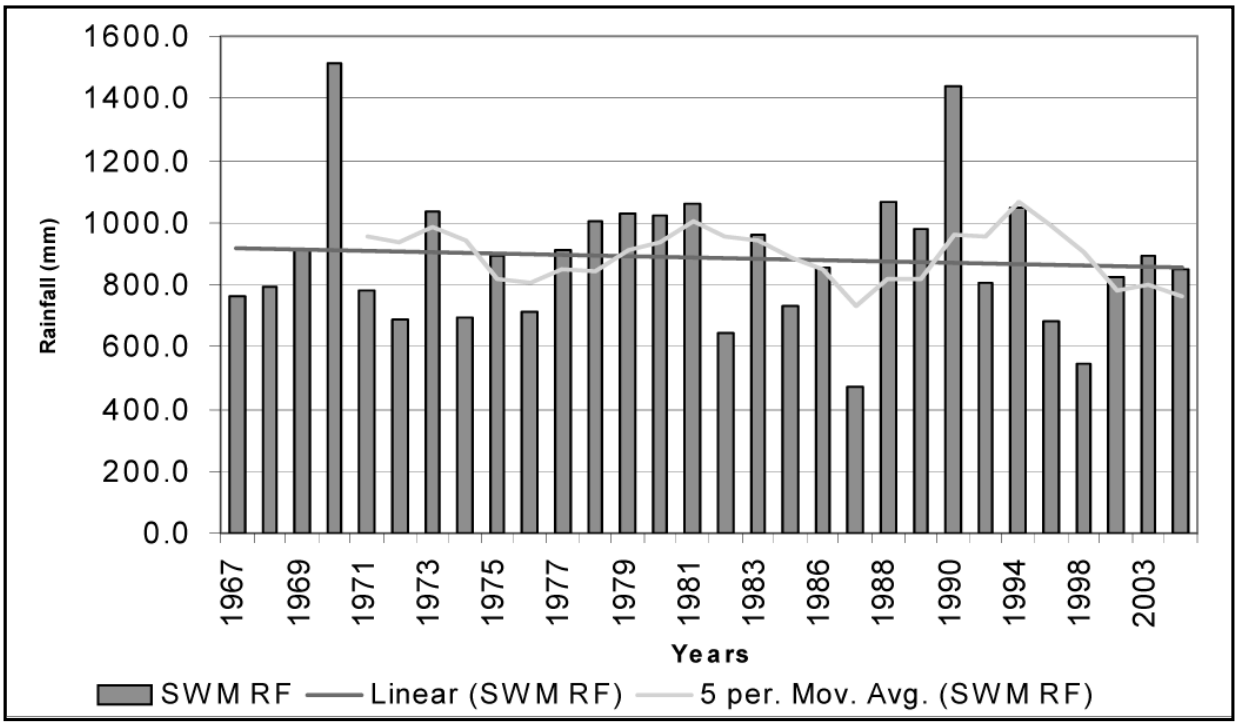
4 This section relies heavily on publications of National Bureau of Soil Survey and Land Use Planning, in particular, Challa O, K.S. Gajbhiye, and M.Velayutham et.al. (1999) ;Sharma J.P;.K.S.Gajbhiye; C.Mandal et.al. (2005); Velayutham, M.; D.K.Mandal; C.Mandal et al.(1999); and Kolay A.K. (1993) & Magdoff F. and Harold van Es. 2000.

5 Data on monthly rainfall and rainy days have been collected from National Data Centre, Indian Meteorological Department, Pune. The following years 1984, 1992, 1993, 1995, 1996, 1999, 2000, 2002, 2004, and 2005 are not included in the analysis, as the data set for these years is incomplete. The analysis thus covers data for forty years over the period 1966–2006.Generally, a coefficient of variation less than 25 percent for the annual rainfall series is indicative of assured rainfall, and the coefficient of variation was 19 percent for Wardha district.

for 30[6] years indicates that only in two years, the annual mean rain fall was below 75 per cent of the annual mean, indicating the occurrence of drought in those two years, that is in 1972 and 1998. An analysis of rainy days in Wardha District over the period 1966–2006 indicates fifty-three days as the mean annual rainy days with an average daily rainfall of 19.6 mm, which is equal to Indian mean daily rainfall of 20 mm/day.

The district receives its rainfall essentially from the south–west monsoon. This monsoon contributes 85 percent of the total annual rainfall. The north-east monsoon accounts for 9 percent while hot weather and cool weather periods account for 4 percent and 2 percent, respectively.[7] An analysis of the quantum of rainfall during the south–west monsoon over the thirty years in Wardha District indicates a mild decreasing trend (Figure 1).

Figure 1 South-west monsoon (June-September) rainfall - Wardha District



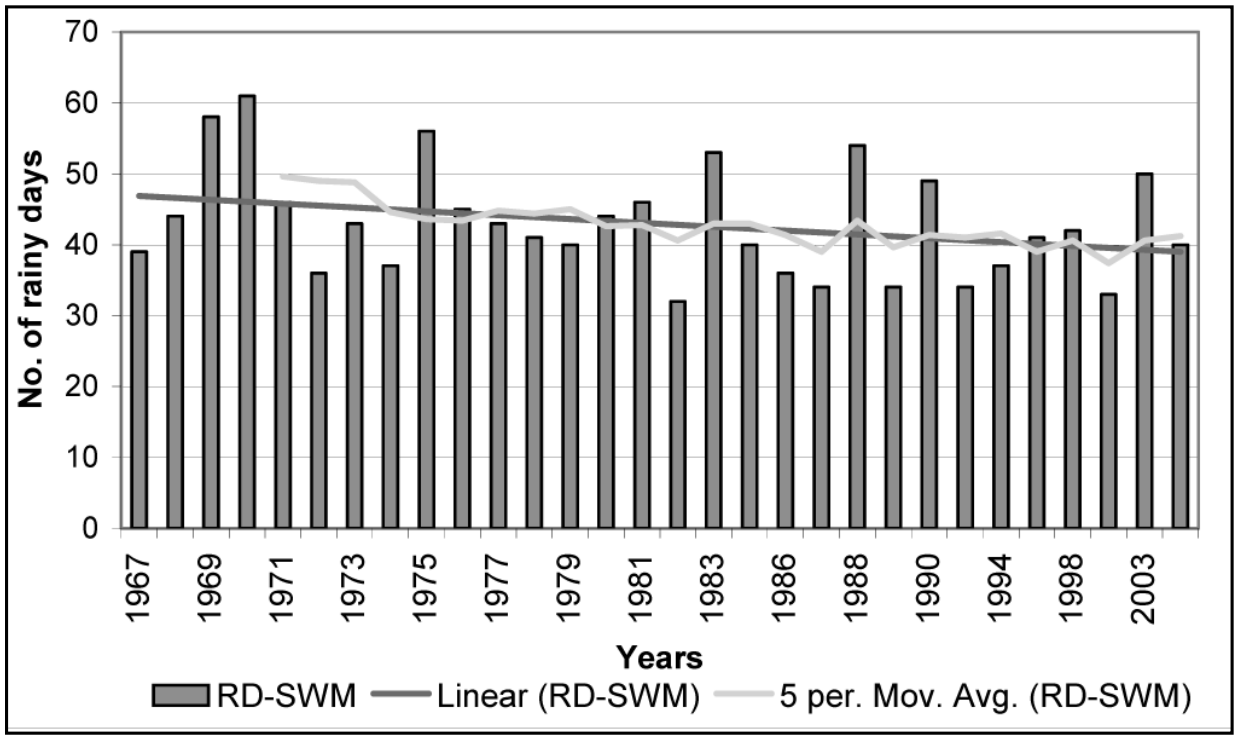
***Note**: SWM= south west monsoon; RF= rainfall*
***Source**: IMD, Pune*

6 Monthly rainfall and rainy days were obtained from DDGM (Research), IMD, Pune for analyis. Though the supplied data were from 1966 to 2006 (40 years), considering the data gap between months of a year , for analysis 30 years data were taken (1967 to 1983; 1985 to 1991; 1994, 1997, 1998, 2001, 2003 and 2006.

7 Our analysis of monthly rainfall data considers June to September as south–west monsoon period; October to December as north–east monsoon period; January to February as the cool weather period; and March to May as the hot weather period.

The contribution of rainy days across different seasons to total annual rainy days corresponds to the rainfall pattern and was 82 percent for the south–west monsoon and 3 percent, 6 percent, and 9 percent, respectively, for cool weather, hot weather, and north–east monsoon seasons. An analysis of the number of rainy days corroborates the rainfall pattern, that is, a decrease in the number of rainy days was noticed for the south–west monsoon season. (Figure 2).

Figure 2 Rainy Days: south-west monsoon (June-September) - Wardha District



***Note**: RD-Rainy days; SWM-south-west monsoon*
***Source**: IMD, Pune*

The analysis of rainfall pattern during the south–west monsoon indicates a mean annual rainfall of 888 mm. Considering that the south–west monsoon is the lifeline of agriculture in the district of Wardha, the effective rainfall and run-off during the south–west monsoon has important implications for crop production in the district. The effective rainfall for the south–west monsoon is computed to be around 533 mm and its distribution is 110, 162, 175, and 85 mm, respectively, for the months of June, July, August, and September.[8] On integrating the effective rainfall of the

8 Effective rainfall is defined as that portion of total annual or seasonal rainfall, which is used by the plants directly without pumping and at the site where it falls, to meet both its consumptive and nonconsumptive needs in crop production. The consumptive use of water refers to the use of water for plant growth and crop production. The nonconsumptive uses include land preparation, land submergence, leaching and so on. Thus, the effective rainfall also includes water lost by evapotranspiration; evaporation from soil surface; and through leaching and percolation.

district with the water-holding capacity of the soils of the district, which is around 100–150 mm per metre depth, the run-off water is estimated to be 355 mm or 3,550 cubic metre of rain water per hectare per annum. The run off takes away the fertile top soil, leading to severe soil erosion in the district.

'Soil erosion is a surface feature which signifies the loss of soils from the particular area' (Sharma J.P; K.S. Gajbhiye; C. Mandal et al. 2005). Soil erosion adversely affects the fertility status and land use. National Bureau of Soil Science and Land-Use Planning has grouped the soils of Wardha into different erosion classes (Table 1).

Table 1 Soil erosion classes, Wardha District

Erosion Class	Area		Expected Soil Loss (tonnes/hectare/year)
	In Hectare	Percentage of Total Geographical Area	
Slight	46,508	7.3	5–10
Moderate	473,447	75.2	10–15
Severe	104,043	16.5	15–20
Water Bodies	4,902	1.0	

***Source**: Sharma J.P; K.S. Gajbhiye; C. Mandal et al. 2005*

As per their estimate, soil loss in the district is in the range of 5–20 tonnes per hectare per year in the slight erosion class. The moderate erosion class includes 75 percent of the geographical area of the district and this accounts for an expected soil loss of 10–15 tonnes per hectare per year, and about 16.5 percent of the area falls under the severe erosion class with an expected soil loss of 15–20 tonnes per hectare per year. Just about 7.3 percent of the geographical area of Wardha District, which roughly corresponds to the area under nonagricultural use in the district, registers soil erosion within the conventionally permissible limit of 10 tonnes per hectare per annum. This suggests that almost the entire area that is used for agriculture in the district is subjected to a level of soil erosion that is beyond the permissible limit. After accounting for the maximum permissible limit of soil loss of 10 tonnes per hectare per year, the extent of soil loss in the district due to erosion is estimated to be of the order of 19.6 lakh tonnes per annum. Soil erosion results not only in soil degradation and reduction of soil depth in areas where erosion occurs but also results in silting of water bodies. About 10 percent of the eroded material usually gets deposited in the water reservoirs resulting in silting up of the water bodies and thereby reducing their water storage capacity.

Analysing the soil type in the district, it is found that black soil is the predominant soil type. This is classified into *kanhar (*Heavy soils), *madhyam* (Medium soils), and *bardi* (Light soils).[9] In the district as a whole, the extent of *kanhar* is 35.4 percent; *madhyam,* 43 percent; and *bardi,* 20.6 percent. *Kanhar* soils are very deep[10] and have slow permeability, which facilitates good crop growth. However, these soils are in the low–medium category of organic carbon content, indicating low level of availability of macronutrients such as nitrogen. *Kanhar* soils are also alkaline in nature, implying that many of the micronutrients like aluminium, copper, cobalt, manganese, and zinc becomes less available to plants. In addition to this, *kanhar* soils are high in calcium and magnesium carbonate which have adverse implications for crop growth. Phosphorous reacts with calcium and magnesium carbonate and gets fixed as calcium phosphate and magnesium phosphates which are highly immobile phosphorous compounds. This results in unavailability of phosphorous, a major macronutrient to the plants. However, the cation-exchange capacity (CEC) of these soils is high which makes them more responsive to fertiliser application and nutrient management. That is, to overcome the inherent deficiencies of *kanhar* soils it is possible to employ appropriate corrective measures.

Madhyam soils are shallow[11] and the organic carbon content is in the low-to-medium category. As explained earlier with regard to *kanhar* soils, low organic carbon content is indicative of low level of nitrogen in the soil. *Madhyam* soils are also alkaline in nature having adverse implications for the level of micronutrient availability. These soils are very gently sloping but are subjected to severe erosion, which is the dominant limiting factor for plant growth. *Madhyam* soil is clayey and well drained and has slow permeability. These are noncalcareous soils as their calcium carbonate content is nil and therefore do not face the problem of phosphorous fixation. *Madhyam* soils are considered to be of average productive potential. However, the CEC of the soil is high, indicating that the soil would respond well to fertiliser application and nutrient management.

9 In soil taxonomy *kanhar* is referred to as Chromic/Typic Haplusterts; *madhyam* as Vertic/Typic Haplustepts; and *bardi* as Lithic/Typic Ustorthents.

10 Soil solum depth ranges from 125 cm to 150 cm in kanhar soils; Soil solum consists of the surface and subsurface layers that have undergone the same soil-forming conditions. The depth of the soil solum influences the root development of the plant.

11 The soil solum is 27–36 cm deep.

Bardi soils are very shallow soils.[12] These are also noncalcareous soils as their calcium carbonate content is nil and the problem of phosphorous fixation is absent here. These soils fall in the medium-to-high category of organic carbon content. But these soils have low CEC, which indicates that the soil does not respond much to fertiliser application and nutrient management. The dominant limiting factor in *Bardi* is the soil texture and erodability factor. These soils are considered to be of very poor productive potential.

To sum up, integrating rainfall climatology information with the soils of the region a substantial extent of run-off is estimated. The run-off water is estimated to be 355 mm (3,550 cubic metre of rain water/ hectare/annum) especially during the south–west monsoon. The run-off results in loss of fertile top soil, leading to serious problems of soil erosion. The south–west monsoon, the lifeline for agriculture in this region, shows a mild declining trend. Further, an analysis of the soil characteristics of Wardha District indicates that one-fifth of the soil is classified as *bardi,* which is not very conducive for crop growth, while four-fifths is accounted for by *kanhar* and *madhyam* that have relatively better levels of productive potential. However, *kanhar* and m*adhyam* category soils have several inherent problems and deficiencies such as low level of availability of macro- and micronutrients; problem of phosphorous fixation; soil erodability, and so on, which would act as limiting factors for crop growth unless ameliorative measures are taken to overcome the natural deficiencies of the soils. The natural conditions that prevail in Wardha District are such that soil and water conservation measures become extremely relevant here.

1.2. Land Use

An analysis of the land-use pattern in Wardha District over the four-and-half decades since the 1960s indicates some very disturbing trends: first, the net sown area has declined since 1978–79 in absolute terms (Table 2 and Figures 3, 4). In early 1960s, the net sown area was of the order of four lakh Ha and it decreased by about 35,000 Ha by mid-2000s. Second, area under current fallows and other fallows, that is, cropped area kept fallow during the current year and land that is temporarily out of cultivation for a period of between one and five years, respectively, has been increasing rapidly over the years.

The increase in current fallows has been particularly sharp since 2001–02. The extent of area under current fallows has increased seven times over 1961–62 to 2004–05,

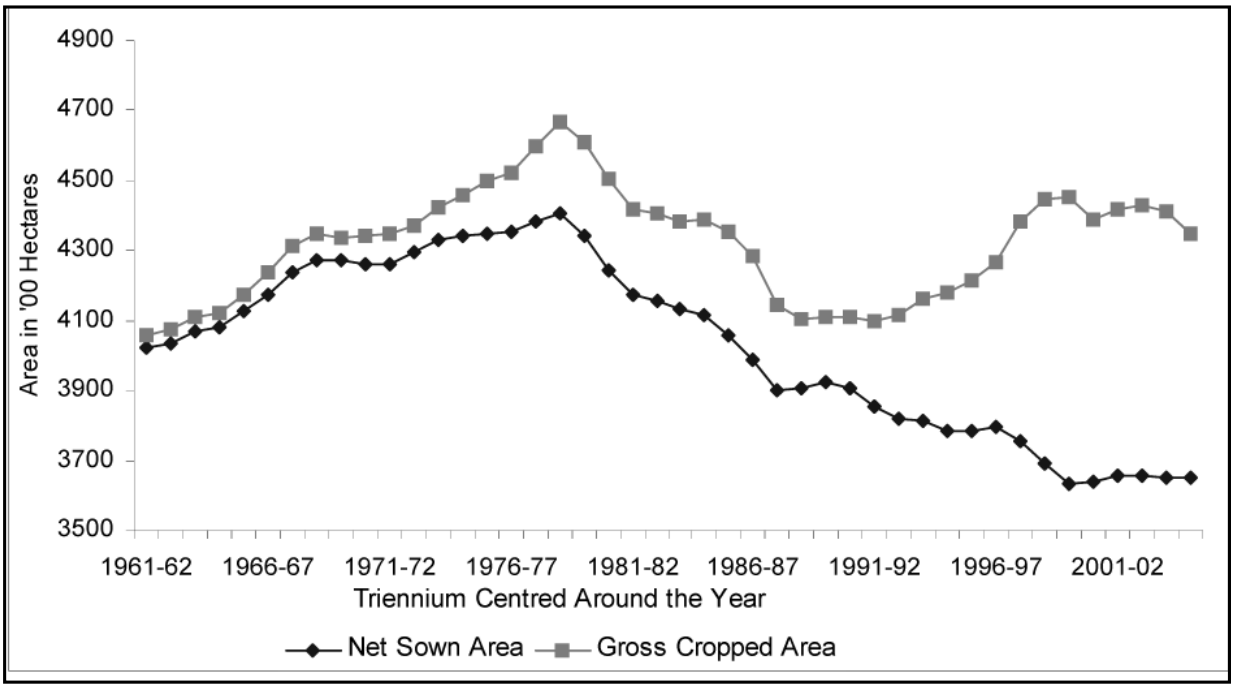
12 Soil solum being 8–20 cm deep.

Table 2 Change in Land-use Pattern in Wardha District, 1961–62 to 2004–05

Three years average centred around the year	Net sown area		Current Fallows		Other Fallows		Culturable Waste Land		Barren unculturable land		Permanent Pasture		Forest area	
	In ' 00 ha	%	In ' 00 ha	%	In ' 00 ha	%	In ' 00 ha	%	In ' 00 ha	%	In ' 00 ha	%	In ' 00 ha	%
1961-62	4024.00	63.91	87.73	1.39	132.40	2.10	274.40	4.36	74.00	1.18	519.33	8.25	648.80	10.30
1971-72	4262.00	67.61	67.33	1.07	74.00	1.17	182.33	2.89	68.33	1.08	510.33	8.10	669.33	10.62
1981-82	4171.33	66.12	121.33	1.92	174.33	2.76	142.00	2.25	68.00	1.08	463.00	7.34	671.00	10.64
1991-92	3855.33	61.11	201.33	3.19	246.00	3.90	203.00	3.22	186.00	2.95	459.33	7.28	758.00	12.01
2001-02	3655.00	57.93	624.33	9.90	232.67	3.69	148.33	2.35	107.00	1.70	388.00	6.15	620.33	9.83
2004-05	3650.33	57.86	630.33	9.99	220.00	3.49	155.00	2.46	105.33	1.67	382.00	6.05	624.67	9.90

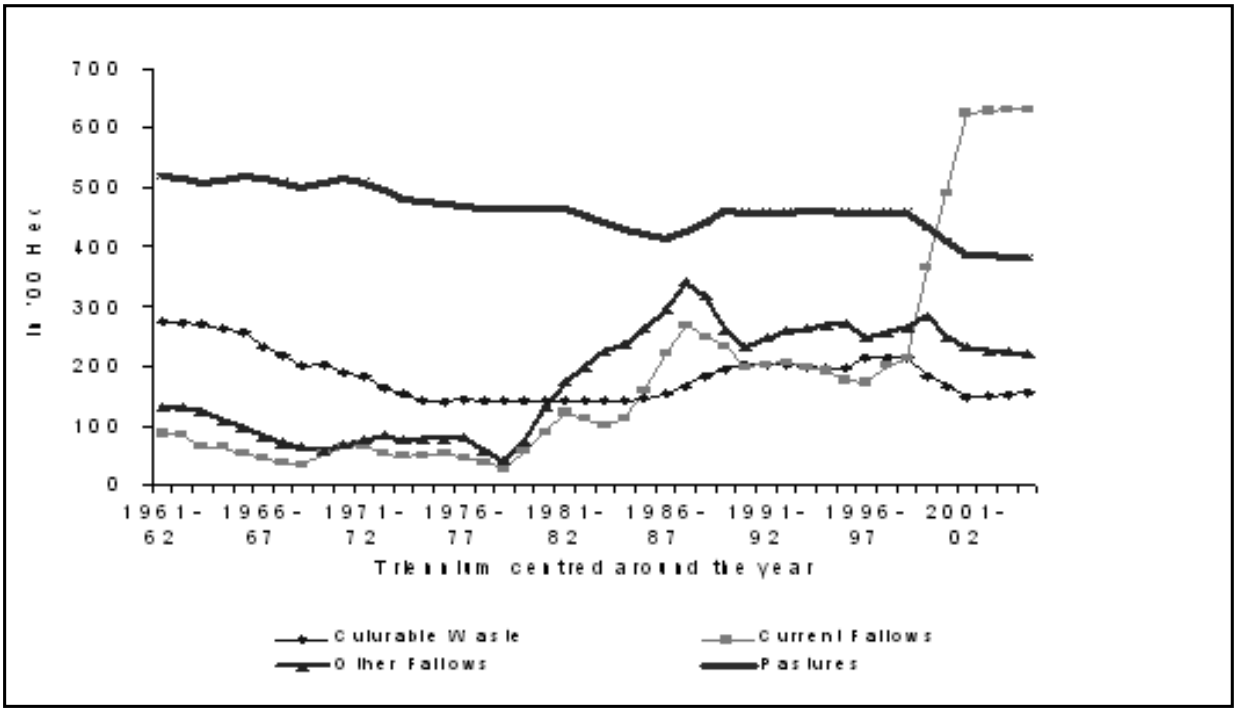
Note: *The percentages are with respect to the geographical area of the district*
Source: *Data pertaining to 1960–61 till 1997–98 are from EPWRF, 2004*
Data pertaining to 1998–99 onwards are from Government website, http://dacnet.nic.in/lus/dt_lus.aspx cited on 17-06-08

Figure 3 Gross cropped area and net sown area - Wardha District



***Source**: EPWRF, 2004; http://dacnet.nic.in/lus/dt_lus.aspx*

Figure 4 Land use pattern - Wardha District



***Source**: EPWRF, 2004; http:dacnet.nic.in/lus/dt lus.aspx*

and over the 1990s it has more than tripled. The trend in current fallows and other fallows clearly indicates the growing tendency among farmers to keep land out of cultivation in the recent years. As per data shown in Table 2, while total fallow lands— current fallows and other fallows combined—accounted for 5 percent of net sown area in the early 1960s, it reached an astronomically high percentage of 23 percent of net sown area by mid-2000s. Nearly 85,000 Ha of cropped area remained fallow in early 2000s in Wardha District. This pattern exhibited by Wardha District is entirely different from that of the state of Maharashtra where net sown area as a percentage of geographical area remained more or less constant, in the range of 56 percent to 59 percent, over 1961–62 to 2004–05. Further, in Maharashtra, total fallow lands account for about 7 percent to 8 percent of geographical area throughout the forty-four years under consideration, a pattern very different from that of Wardha District.

In Wardha District, culturable waste land that includes land once cultivated but not cultivated for five years in succession has come down considerably over the forty-four years under consideration. One possible explanation for the decline in culturable wastes on the one hand and an increase in total fallow lands on the other could be that there are two tendencies in operation simultaneously: a tendency to bring land under cultivation as well as a tendency to withdraw land from cultivation. However, considering that there has been no overall increase in net sown area, it is clear on balance that the tendency to keep land fallow has been relatively greater.

The area under permanent pastures has also declined over the years and very sharply since 1998–99. Permanent pastures form an important component of common property resources (CPR), and several research studies have observed a decline in CPRs in the dry regions of the country over the years (Nagaraj and Jeyaranjan 2004). As can be seen from Figure 4, in Wardha District, over the forty-four years under consideration, the decline in pasture land is of the order of 13,700 ha.

Other categories of land such as forest area, barren area, and area under nonagricultural use do not record very significant changes over the forty four years under consideration. The positive trend as far as land use in Wardha District is considered is to do with the increase in gross cropped area since early 1990s, which is related to the increase in area under irrigation in the district. Over the decade of the 1990s, the area cropped more than once increased threefold, from 24,000 Ha to nearly 75,000 Ha, pushing up the cropping intensity to 1.21 in 2001–02 from 1.06 in 1991–92. Though the increase in cropping intensity over the years

indicates an increase in the practice of double crop, the most prominent tendency in the district, as far as land use is concerned, is the trend to withdraw land from cultivation. This is a very serious problem that has grave implications for growth of agriculture in Wardha District.

1.3. Irrigation

It is a well-established fact that development of irrigation is extremely crucial for the nature of agricultural development in an area. From Table 3, it is clear that in the district of Wardha, less than 2 percent of net sown area was irrigated in early 1960s. Though there was considerable expansion of area under irrigation over the years, as can be seen from Figure 5, even by early 2000s just about 7 percent of net sown area is under irrigation.

The major spurt in irrigation has occurred over the 1970s due to expansion of area under wells as well as surface sources. A major irrigation project at Bor and three medium irrigation projects at Dongargaon, Panchdhara, and Dham, respectively, were completed during the 1970s while the number of dug wells increased from 9,621 in 1970–71 to 15,854 in 1980–81 (EPWRF 2004).

Table 3 and Figure 6 clearly bring out the overbearing importance of well irrigation in the district of Wardha. Wells are predominantly dug wells and till about 1967–68 oil engines were used. Since 1968–69 electric pumps have been in vogue, and there were more than 26,000 electric pumps in Wardha District by 1997–98 accounting

Table 3 Salient Features of Irrigation in Wardha District

Triennium Centred around the year	Area Irrigated by wells In '00 ha	Area irrigated by Surface Sources In '00 ha	Net Area Irrigated In '00 ha	Area Irrigated by wells as a percentage of NIA	Area irrigated by surface sources as a percentage of NIA	NIA as a percentage of NSA	GIA as a percentage of GCA
1961–62	53.20	2.00	55.20	96.38	3.62	1.37	1.47
1966–67	68.13	4.40	72.53	93.93	6.07	1.74	1.98
1971–72	92.33	12.67	105.00	87.94	12.06	2.46	2.62
1976–77	229.00	51.67	280.67	81.59	18.41	6.45	6.97
1981–82	143.67	29.33	173.00	83.04	16.96	4.15	5.39
1986–87	146.67	22.33	169.00	86.79	13.21	4.24	5.09
1991–92	185.33	32.33	217.67	85.15	14.85	5.65	7.04
1996–97	190.33	33.33	223.67	85.10	14.90	5.89	7.78
2001–02	167.00	90.67	257.67	64.81	35.19	7.05	7.21

***Source**: EPWRF, 2004 and http://dacnet.nic.in/lus/dt_lus.aspx cited as on 17-06-08*

Figure 5 Area under irrigation - Wardha District

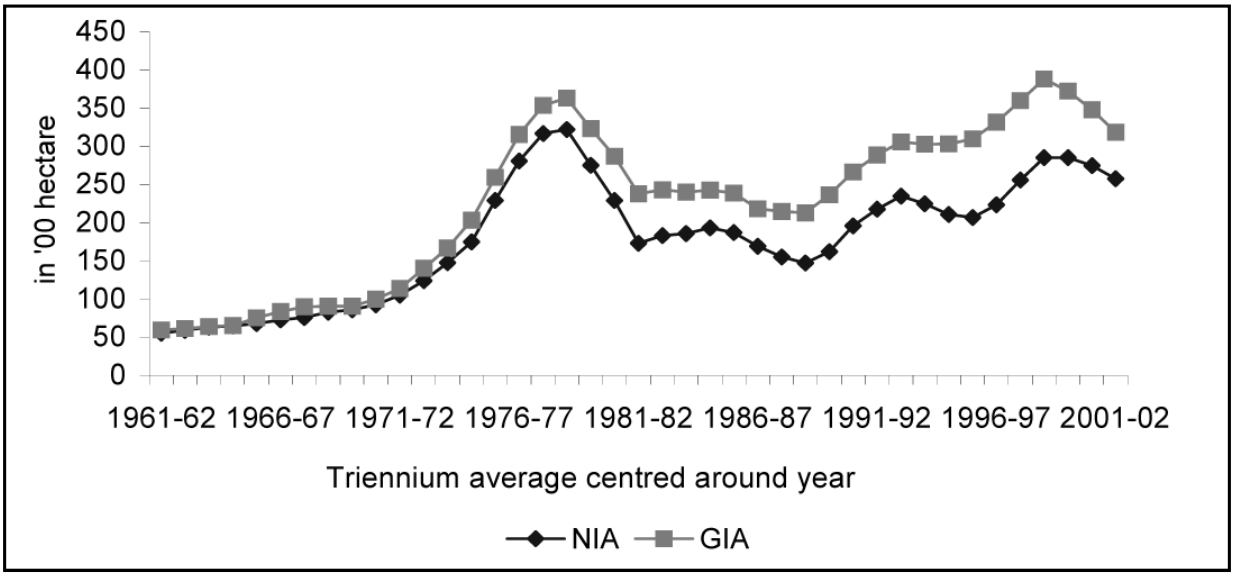
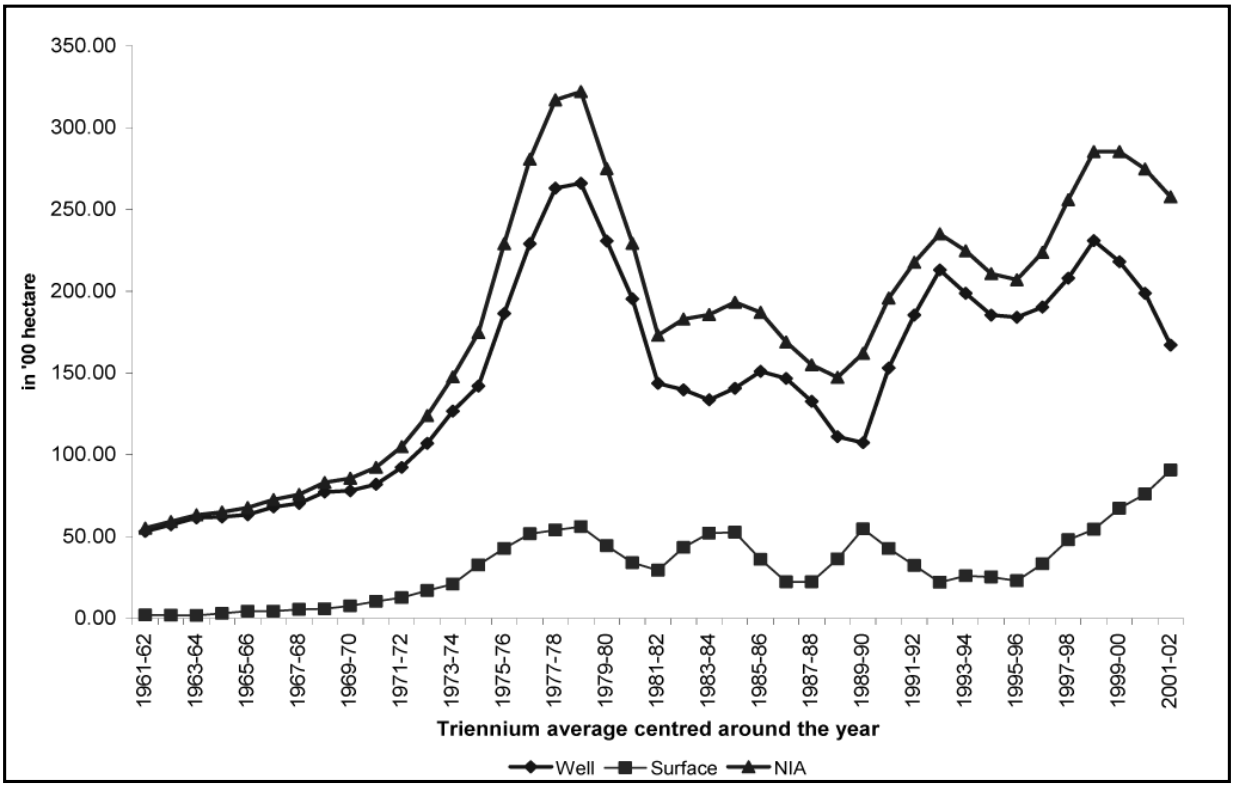


Figure 6 Sources of Irrigation - Wardha District



Source: *EPWRF, 2004 and http://dacnet.nic.in/lus/dt_lus.aspx*

for a ninefold increase over the three decades. About 90 percent of open dug wells had been fitted with electric pumps by late 1990s. The area irrigated by wells as well as surface sources fluctuates a great deal, as irrigation in Wardha District is closely related to the rainfall pattern.

Analysing data on area irrigated by different sources over four decades, 1960–61 to 2002–03, we find that while the contribution of well irrigation is substantial all through, the importance of surface irrigation has increased since mid-1990s. By 2001–02, one-third of the net irrigated area was accounted for by surface sources. The increase in surface irrigation over the recent years is largely related to the expansion of medium and minor irrigation projects in the district. Wardha District forms a part of Wardha river basin. Wardha River runs along the northern, southern, and western boundaries of the district. Wena is a large and important tributary of Wardha while Pothra, Bor, Dham, Asoda, Bakli, and Kar are some of the other tributaries of Wardha River. Of the four major irrigation projects that have been planned, Upper Wardha, Lower Wardha, Lower Wena, and Bor, only Bor project has been completed. From Table 4, it is clear that since the 1980s, while no plans have been made for any major irrigation projects, two medium irrigation projects and a number of minor irrigation projects have been proposed.[13]

Table 5 reveals a shocking fact that only one-fourth of surface irrigation potential that was planned has been actually created. Moreover, of the irrigation capacity created, only one-third is actually being utilised. However, with regard to smaller projects that irrigate less than 100 Ha (the Kolhapur-type dams), 183 out of 200 dams that were planned have been completed. The dismal achievement with regard to major and medium irrigation projects combined with a highly fluctuating pattern of well irrigation is the crucial issue that explains the heavy reliance of agriculture in Wardha on rainfall.

The committee set up by the Planning Commission in 2006 to study the regional disparities and rural distress in Maharashtra with particular reference to Vidarbha, recommends: The strategy should be to provide increased funding to the Vidarbha Irrigation Development Corporation to complete on-going projects in 7–10 years.. ……On going projects may be reprioritized to ensure that these projects where only canal development remains are given high priority.' (GoI 2006, 91–2).

13 Data collected from Wardha Irrigation Department, June 2008.

Table 4 Details of Proposed Irrigation Projects, Wardha District

Period	Names of Major Project	Names of Medium Projects	Names of Minor Projects (above 100 Hectare)	
			Minor Dams	Evacuation Schemes
1956 to 1980	1. Bor 2. Upper Wardha 3. Lower Wena 4.Lower Wardha	1. Dongargaon 2. Panchdara 3. Dham 4. Pothra 5.Madan	1.Ashti 2.Mamdapur 3.Pilapur 4. Takali Borkhedi 5.Kawadi 6.Kannamwargram 7. Digras 8. Kunbadi 9 Sawangi 10.Lahadevi 11.Ambazari 12.Panjra Bothli 13. Umri 14. Anji Borkhedi 15. Malkapur 16. Pargothan 17.Khapri 18. Wagholi	1.Khadka 2.Deurwada 3.Partoda 4.Bharaswada
1981–2004	Nil	1.Kar 2.Lal Nala	1.Mandla 2. Malatpur 3.Parsodi 4.Kurha 5. Kotamba 6.Parsodi 7.Rotha-1 8.Tadgaon 9.Sukali 10Rotha-2 11.Tembhri 12.Harashi 13.Hiwra 14.Goji 15 Deulgaon 16.K.T.Dam	

Note: *1. Irrigation projects are delineated by their capacity to irrigate: major projects are those whose potential for irrigation is 10,000 Ha; medium projects refer to potential irrigation of 600–10,000 Ha; minor projects refer to less than 600 Ha of potential irrigation.*

2. Evacuation refers to a lift irrigation scheme which was in operation on river Wardha whereby water was lifted through electric pumps, taken to the delivery chamber and then passed on to the fields through channels. This project has been discontinued as consumption of electricity was said to be high.

3. The list of minor irrigation schemes here excludes trickle tanks, village tanks, and evacuation schemes of less than 100 Ha.

Source: *Data collected from Wardha Irrigation Department, June 2008*

Table 5 Plan versus actual achievement in Surface Irrigation Schemes, Wardha District

Type of irrigation project	No. of Projects as per plan 1951–2006	No. of projects completed as on June 2006	Potential irrigation capacity (In Ha)	Irrigation capacity achieved as on June 2006 (In Ha)	Actual area irrigated as on 2005–06 (In Ha)	Irrigation capacity achieved as a percentage of potential capacity	Actual area irrigated as a percentage of achieved irrigation capacity
Major Projects	4	1	103,645	16,190	5,956	15.62	36.79
Medium Projects	7	3	25,593	12,690	4,064	49.58	32.03
Minor irrigation (above 100 Ha.)	34	25	13,171	7,681	2,022	58.32	26.32
Total	45	29	142,409	36,561	12,042	25.67	32.94

Note: *Schemes that irrigate above 100 Ha. are only considered here*
Source: *Data collected from Wardha Irrigation Department, June 2008*

The analysis clearly points out the need to concentrate on the following aspects in future: (a) to bring down the gap between potential irrigation and actual irrigation as far as surface irrigation is concerned; (b) to tap the potential of ground water sources and to concentrate on water conservation measures that will help bring down the instability in irrigation regime.

1.4. Area, Production, and Yield of Crops

In the district of Wardha *kharif* and *rabi* are the two agricultural seasons, and *kharif* has always been the most important season with regard to area brought under cultivation.[14] The *kharif* season begins in mid-June with the onset of the monsoon and extends upto December depending on the type of crop sown. The *rabi* season commences in October and extends upto February or March. The important crops grown in *kharif* season are cotton, sorghum, and pulses, and since the mid-1980s, soyabean has become an extremely important *kharif* crop in Wardha District. In the *rabi s*eason, wheat and gram are cultivated.

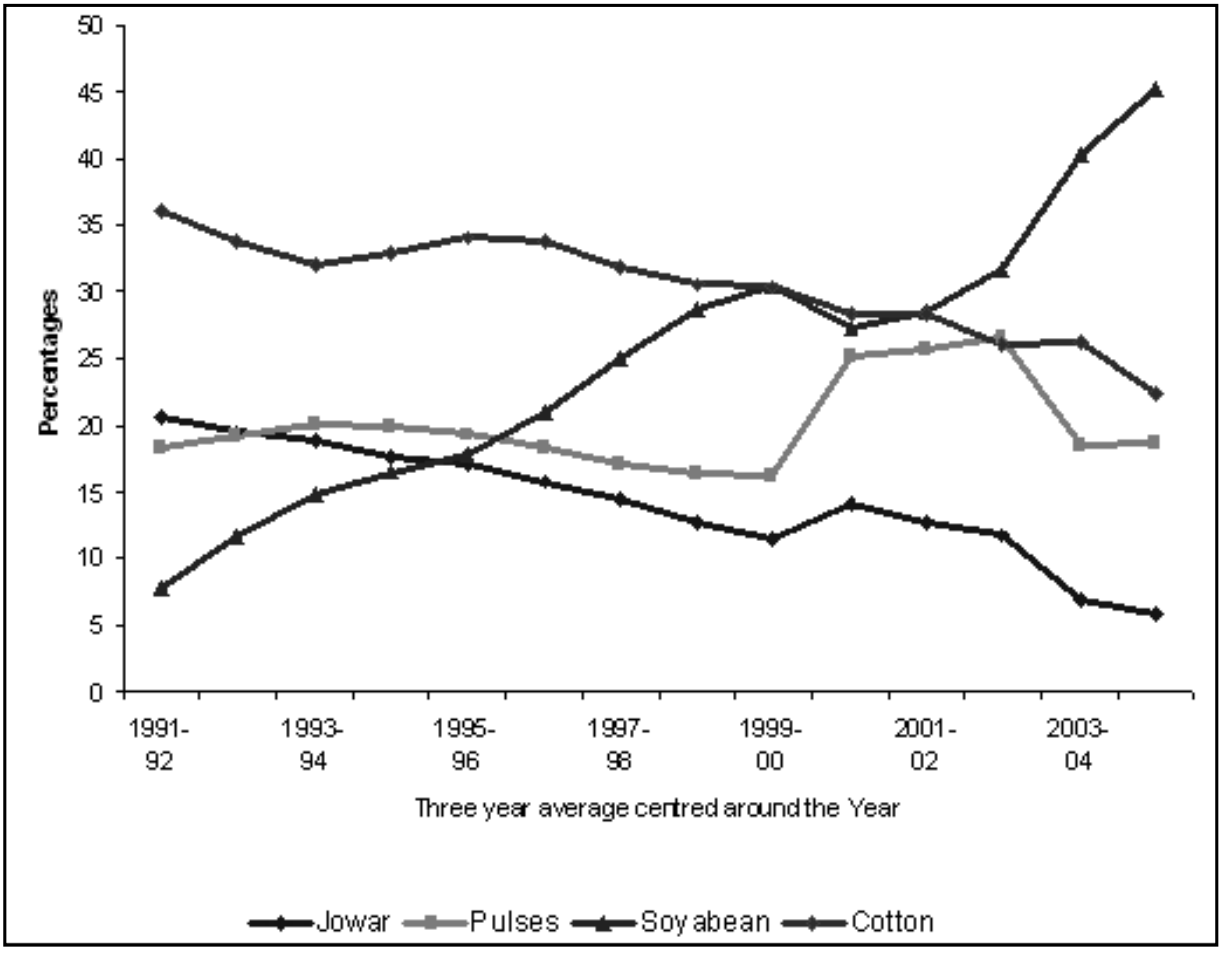
According to the Wardha 'District Gazetteer', even in the early years of the twentieth century, cotton and sorghum have been the major crops in the district.

14 In Wardha District, in 2006–07, 384,145 Ha was cropped in kharif season and the corresponding figure for rabi season was 60,900 Ha.

To quote from the gazetteer: "In 1904–05 cotton covered 400,000 acre or 40 percent, of the cropped area, juar 310,000 or 30 percent, wheat nearly 100,000 or 10 percent, and linseed 600,000 or 6 percent. Cotton and juar now, therefore, cover two-thirds of the whole area and overshadow all other crops. Next in importance to the above staples comes red gram with an acreage of 85,000 or 8 percent of the total. This pulse is usually grown as a mixture with cotton. Til occupies 22,000, or 2 per cent of the total, and rice only 3,000, while the pulses urad and tiura are grown on about 9,000 acres". (GoM 2006) This cropping pattern seems to have remained intact till the introduction of soyabean in the 1980s.

Considering a time span of forty-four years, from 1960–61 upto 2005–06, it is seen that sorghum and cotton together had accounted for two-thirds of gross cropped area till the late 1980s, as can be seen from Table 6. Seen together, Figure 7 and Table 6 clearly point out that soyabean has grown at the expense of cotton and

Figure 7 Area under major crops as a percentage of gross cropped area - Wardha District



Source: *EPWRF, 2004 and http:dacnet.nic.in/lus/dt_lus.aspx*

Table 6 Area under Major Crops –Wardha District

(area in ′00 hectare)

Crop	Triennium Average Centred around the Year								
	1961–62	1966–67	1971–72	1976–77	1981–82	1986–87	1991–92	1996–97	2004–05
Sorghum	1,244.40	1,358.80	1,269.33	1,372.00	1,323.00	1,134.00	844.33	703.33	255.67
	30.65	*32.08*	*29.19*	*30.33*	*29.96*	*26.47*	*20.60*	*16.49*	*5.88*
Wheat	437.87	377.20	344.00	423.00	350.00	235.33	182.33	703.33	255.67
	10.78	*8.90*	*7.91*	*9.35*	*7.93*	*5.49*	*4.45*	*3.91*	*4.23*
Total Cereals	1,732.27	1,804.40	1,712.33	1,903.00	1,750.00	1,430.67	1,068.00	883.33	442.33
	42.67	*42.60*	*39.38*	*42.06*	*39.63*	*33.39*	*26.05*	*20.71*	*10.18*
Total Pulses	517.33	417.20	523.67	507.67	424.00	575.67	751.67	704.67	807.00
	12.74	*9.85*	*12.04*	*11.22*	*9.60*	*13.44*	*18.33*	*16.52*	*18.57*
Food Grains	2,249.60	2,221.60	2,236.00	2,410.67	2,174.00	2,006.33	1,819.67	1,588.00	1,249.33
	55.41	*52.45*	*51.43*	*53.29*	*49.23*	*46.83*	*44.39*	*37.24*	*28.74*
Cotton	1,546.67	1,722.13	1,819.33	1,735.00	1,917.00	1,719.67	1,476.67	1,608.00	970.67
	38.10	*40.66*	*41.84*	*38.35*	*43.41*	*40.14*	*36.02*	*37.71*	*22.33*
Soyabean	0.00	0.00	0.00	0.00	0.00	34.67	319.67	792.00	1,945.33
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.81*	*7.80*	*18.57*	*44.75*
Total Oilseeds	194.93	215.47	226.33	300.33	247.67	470.00	674.33	941.67	1,985.67
	4.80	*5.09*	*5.21*	*6.64*	*5.61*	*10.97*	*16.45*	*22.08*	*45.68*
Gross Cropped Area	4,060.00	4,235.67	4,348.00	4,524.00	4,416.33	4,284.67	4,099.67	4,264.67	4,346.67
	100.00	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*

Note: *The last column is based on data provided by the Govt of Maharashtra website while earlier columns are on the basis of EPWRF,2004.*
Figures in italics are the percentages with respect to gross cropped area.

Source: *EPWRF, 2004.; www.mahaagri.gov.in*

sorghum (grown in *kharif*) and dry wheat (grown in *rabi*) in Wardha district. Dry *rabi* crop in Wardha district used to be grown in fields that were unirrigated and left fallow during the rainy season. Such fields would often be the ones that were prone to flooding and had the ability to retain moisture. With the introduction of soyabean, lands that were earlier reserved for dry *rabi* are getting cultivated in *kharif* season.[15] Area under wheat has come down from 11 percent in early 1960s to less than 5 percent by early 2000s. All in all, more than two-fifths of gross cropped area has come under soyabean cultivation by early 2000s. Soyabean has become

15 Soyabean can moderately withstand water-logging conditions when the crop is in its vegetative phase and even give some sub-optimum yields.

not only the most important oil-seed crop in Wardha district but also the most important crop itself. Red gram is usually grown as an inter-crop with cotton as well as soyabean and therefore an expansion in area under soyabean has resulted in an increase in area under pulses over the years. The importance of sorghum has declined drastically since the late 1980s and that of cotton since the mid-1990s. The agricultural economy of Wardha District is increasingly becoming a cash-crop economy.

The decline in area under foodgrain, essentially contributed by a decline in area cultivated with sorghum, has resulted in a fall in total foodgrain production over the years in Wardha District, as illustrated by Table 7. This has important implications for food security of the local population. Foodgrain production per capita per day in Wardha District has declined from 532 g in 1961 to 369 g in 2001: a 31 percent decline over the forty-year period. Soyabean production, on the other hand, has registered a ninefold increase over the years 1991–92 to 2004–05. Production of cotton has declined at the rate of 4 percent per annum since the mid-1990s, that is, 1996–97 to 2004–05.

Table 7 Production of Different Crops - Wardha District

(in '00 metric tones)

Crop	Triennium Centred around the Year								
	1961–62	**1966–67**	**1971–72**	**1976–77**	**1981–82**	**1986–87**	**1991–92**	**1996–97**	**2004–05**
Sorghum	595.68	805.46	430.00	1,012.00	1,289.67	942.33	812.33	744.33	229.00
Wheat	190.06	137.36	144.67	399.33	283.00	189.33	201.00	165.00	224.00
Total Cereals	808.18	964.92	641.33	1,510.33	1,656.00	1,167.67	1,038.67	921.00	454.00
Total Pulses	422.96	206.38	288.00	315.67	294.67	391.67	469.67	391.00	728.00
Food Grains	1,232.16	1,171.64	929.33	1,826.00	1,950.67	1,559.33	1,508.33	1,312.00	1,182.00
Cotton	82.80	134.95	103.32	102.51	192.16	222.76	223.38	283.39	208.00
Soyabean	–	–	–	–	–	–	246.33	829.67	2,126.00

Note: *The last column is based on data provided in Maharashtra website while earlier columns are on the basis of EPWRF, 2004.*

Source: *EPWRF, 2004.; www.mahaagri.gov.in*

Table 8 presents the yield of sorghum, red gram, cotton, and soyabean in the districts of Wardha, the state of Maharashtra, and the country as a whole, over the years 1961–62 to 2004–05. Yield levels of soyabean and redgram in Wardha District, in general, are equivalent to or higher than that of Maharashtra and all India. However, cotton yield in Wardha District is lower than the country but higher than the state of Maharashtra, while sorghum yield is lower in the district compared to the state. The pattern of yield of soyabean, the most important crop in Wardha district, indicates a decline in yield level by about 15 percent over the years 2001–02 to 2004–05. This is contrary to the pattern exhibited by the country as

Table 8 Yield of Major Crops
Triennium Average Centred around the Year

(in kilogram per Hectare)

Crop	Area	1961–62	1971–72	1981–82	1991–92	2001–02	2004–05
Sorghum	Wardha Dist	473.12	339.87	982.98	964.23	951.00	896.00
	Maharashtra	699.11	395.53	1,056.64	1,339.62	1,334.50	1,232.67
	India	500.67	458.33	681.33	817.00	763.00	797.67
Red Gram	Wardha Dist	1,379.46	870.72	1,065.03	690.45	1,121.67	1,086.00
	Maharashtra	697.89	414.49	564.07	450.99	667.50	665.00
	India	684.33	740.67	704.67	637.67	649.33	700.67
Cotton	Wardha Dist.	54.20	56.95	100.03	149.71	169.00	211.33
	Maharashtra	91.61	64.01	93.11	104.41	129.00	184.33
	India	1,16.67	128.00	160.33	232.67	189.00	329.00
Soyabean	Wardha Dist.	–	–	–	810.45	1,243.67	1,056.33
	Maharashtra	–	–	–	878.29	1,182.00	1,018.17
	India	–	–	–	897.00	841.33	1,058.00

Note: *The last column is based on data provided in Maharashtra website while earlier columns are on the basis of EPWRF, 2004.*

Source: *EPWRF, 2004; www.mahaagri.gov.in*

a whole where soyabean yield has registered a 25 percent increase over the years 2001–02 to 2004–05, as can be deduced from Table 8. Not only is there a decline in yield levels of all crops, except cotton, over the period 2001–02 to 2004–05, in Wardha district, but the fluctuations in yield levels estimated over a long period, 1960–61 to 2005–06, is comparatively higher in the district, as illustrated by data in Table 9.

Instability in yield is measured as the average percentage deviation of actual value in each year around the three-year moving average value for that year. This simple measure of instability indicates that the level of instability in yield, with regard to all four crops, is the highest in Wardha district compared to Maharashtra and India. Fluctuations in yield with regard to cotton and soyabean are more than two

Table 9 Index of Instability in Yield of Crops, 1960-61 to 2005-06 (percentage)

	Wardha	Maharashtra	India
Soyabean	27	11	11
Cotton	18	16	6
Jowar	15	11	6
Redgram	11	10	7

Note: *Calculations for soyabean is for a period 1987–88 to 2005–06*
Source: *EPWRF, 2004; www.mahaagri.gov.in*

times higher in Wardha District compared with the whole of India. This suggests that the risk factor in cultivation is relatively much higher in Wardha District.

A study on the issue of crop yields in Vidarbha region conducted by Dr. Panjabrao Deshmukh Agricultural University, Akola, using districtwise data for cotton (for 1980–2004) and soyabean (for 1987–2004), suggests that the highest probability of crop failure for average yield of cotton is observed for Wardha District along with Amravati and Nagpur districts (PDKV2007). In Wardha District, the probability of crop failure is 44 percent; during the years of crop failure, the loss in yield is estimated to be 29 percent. For entire Vidarbha region, the probability of crop failure is 40 percent. As regards soyabean, the highest probability of crop failure among the districts of Vidharba, over the years 1987–2004 is observed for Wardha District along with Amravati. The analysis indicates that in more than half the number of years under study, that is, in 56 percent of years, the productivity of soyabean differed from the trend in productivity by a margin of more than 5 percent in Wardha District. During the years when crop failure is experienced, the loss in yield was to the extent of 17 percent in Wardha District. This suggests that instability in yield is relatively high there as compared to other districts of Vidarbha. This analysis, seen along with the foregoing comparison of yield across Wardha, Maharashtra, and India, clearly bring out the extent of vulnerability or risk factor in cultivation for the farmers of Wardha District.

The above study has also analysed the factors underlying yield gap for cotton and soyabean crops using data from 120 farmers for cotton and 100 farmers for soyabean, for the year 2005-06. Data on yield and input use for the demonstration plots has been collected from the research units of the University. Difference between yield levels in demonstration plots and farmers fields is seen to be related to quantity of inputs used. The study shows that correlation coefficient between the yield gap of cotton and the input gaps reveal that the coefficient was the highest, at 0.42, for manures used. That is, use of more manure will result

in reducing the yield gap in cotton. In soyabean, the analysis by the University indicates that input gaps in plant protection and machine power contribute to yield gaps.

1.5. Land Holdings

In 1947, Government of Bombay enacted the Prevention of Fragmentation and Consolidation of Holdings Act with an aim to prevent further subdivision of small holdings, and this Act was made applicable to Wardha District in 1959. The standard area sizes specified as the minimum necessary for profitable cultivation under the Prevention of Fragmentation and Consolidation of Holdings Act are 2.0 acre (0.8 Ha) in case of dry crop lands and 0.5 acre in case of *bagait* lands.[16] (GoM 2006). In 2001, the average size of marginal holdings in Wardha district is 0.74 Ha, which is lower than the standard viable holding size set by the Act in 1959.[17] In 2001, marginal holdings account for 16 percent of all holdings and 5 percent of operated area in Wardha District indicating that a substantial number of these holdings are likely to be unviable holdings of size less than 0.8 Ha, as per data presented in Table 10.

From Table 11, it is seen that the average size of holdings in the district as a whole has more than halved from 5.72 Ha in 1970–71 to 2.43 Ha in 2000–01. Both the tables seen together bring out some obvious changes that have occurred with regard to the land holding pattern in the district. First, large land holdings accounted for 15 percent of number of holdings, covering 45 percent of total area of operational holdings in 1970–71. Since then, there has been a reduction in concentration of land holdings over the years, and by 2000–01, only 1 percent of total holdings are with large land owners, thereby accounting for 7 percent only of total area. Medium-sized land holdings, of 4–10 Ha, accounted for 33 percent of all holdings, in 1970–71; this declined to 14 percent by 2000–01. However, there is a difference: the area operated by 'medium' farmers has not declined sharply; it has fallen from 36 percent in 1970–71 to 32 percent in 2000–01. Second, there has been an increase in fragmentation of holdings, indicated by an increase in number as well as area of marginal, small, and semi-medium land holdings in the district. Area covered by marginal, small, and semi-medium holdings accounted for less than 20 percent of total area in 1970–71 and this more than tripled and was 60.7 percent of total

16 Bagait land refers to land under horticultural crops.

17 While the holdings Act refers to ownership of the holdings, the World Agricultural Census provides data for operational holdings. However, the point to note is that the average size of the operational holdings is lower than what is referred to as the viable size.

Table 10 Operational Holdings according to Size Groups, Wardha District

(area in hectare)

Year	Marginal		Small		Semi-medium		Medium		Large		Total Holdings	
	Number	Area	Number	Area	Number	Area	Number	Area	Number	Area	Number	Area
1970	6,702	4,363	13,959	20,594	21,417	61,496	26,629	168,018	12,122	208,255	80,829	462,726
–71	*8.29*	*0.94*	*17.27*	*4.45*	*26.50*	*13.29*	*32.94*	*36.31*	*15.00*	*45.01*	*100.00*	*100.00*
1976	9,782	6,858	19,757	30,022	28,701	82,054	32,484	202,019	9,299	138,096	100,023	459,049
–77	*9.78*	*1.49*	*19.75*	*6.54*	*28.69*	*17.87*	*32.48*	*44.01*	*9.30*	*30.08*	*100.00*	*100.00*
1980	11,973	8,672	34,383	48,563	36,321	101,629	32,488	197,054	6,854	96,741	122,019	452,659
–81	*9.81*	*1.92*	*28.18*	*10.73*	*29.77*	*22.45*	*26.63*	*43.53*	*5.62*	*21.37*	*100.00*	*100.00*
1985	15,663	11,505	37,279	54,589	41,170	115,728	31,752	190,516	5,272	77,697	131,136	450,035
–86	*11.94*	*2.56*	*28.43*	*12.13*	*31.39*	*25.72*	*24.21*	*42.33*	*4.02*	*17.26*	*100.00*	*100.00*
1990	18,468	13,696	45,189	65,954	41,888	117,017	28,051	165,500	3,912	54,502	137,508	416,667
–91	*13.43*	*3.29*	*32.86*	*15.83*	*30.46*	*28.08*	*20.40*	*39.72*	*2.84*	*13.08*	*100.00*	*100.00*
2000	28,860	21,373	70,502	101,225	50,683	137,550	24,284	137,935	2,220	30,476	176,549	428,558
–01	*16.35*	*4.99*	*39.93*	*23.62*	*28.71*	*32.1*	*13.75*	*32.19*	*1.26*	*7.11*	*100.00*	*100.00*

Note: *Figures in italics refer to percentage of total number of operational holdings and percentage of total area of operational holdings in Wardha District.*
The last row is based on data provided in Maharashtra website while earlier columns are on the basis of EPWRF, 2004.
Marginal: upto 1 Ha; Small: 1–2 Ha; Semi-Medium: 2–4 Ha; Medium-: 4–10 Ha; Large: More than 10 Ha.

Source: *EPWRF, 2004; http://agcensus.nic.in cited on 19-04-2008*

Table 11 Average size of Holdings, Wardha district

Year	Marginal upto 1 Ha	Small 1–2 Ha	Semi-medium 2–4 Ha	Medium 4–10 Ha	Large More than 10 Ha	Total (Ha)
1970–71	0.65	1.48	2.87	6.31	17.18	5.72
1976–77	0.70	1.52	2.86	6.22	14.85	4.59
1980–81	0.72	1.41	2.80	6.07	14.11	3.71
1985–86	0.73	1.46	2.81	6.00	14.74	3.43
1990–91	0.74	1.46	2.79	5.90	13.93	3.03
2000–01	0.74	1.44	2.71	5.68	13.73	2.43

Source: *EPWRF, 2004; http://agcensus.nic.in.cited on 19-04-08*

area by 2000–01. That is to say three-fifths of operated area is with smaller farmers while two-fifths are with medium and large farmers. While nearly one-half of the number of holdings in the district was either medium or large in 1970–71, the percentage of such holdings declined to less than 15 percent by 2000–01. Small and semi-medium holdings together accounted for 70 percent of all holdings by 2000–01. There was an increase in the absolute number of holdings in the district from 80,000 in 1970–71 to 1.76 lakh by 2000–01 and this increase essentially came about by an increase in the number of small holdings followed by semi-medium and marginal holdings. Thus, the changes over the three decades indicate a rapid reduction in concentration of land holdings on the one hand and an increase in fragmentation of land holdings on the other.

Tables 12a & 12b further show some interesting features of operational holdings in Wardha District in 2000-01. The percentage of holdings with irrigation across different size classes indicate the expected pattern of higher access of irrigation to large farmers and relatively lower access to small farmers. The gross irrigation ratio (gross irrigated area as a percent of gross cultivated area) which measures access to irrigation against the area under cultivation, however, is more or less the same across all size classes of landholdings. If anything, this ratio is marginally lower for the large landholdings compared to the average for the district as a whole. This implies that though a lower proportion among the small farmers have access to irrigation, they manage to irrigate a larger portion of their holdings. The pattern among big farmers is the reverse, namely, a larger proportion of holdings are covered by irrigation but irrigation is carried out more sketchily so that a lower proportion of their holdings is irrigated. This is supported by the data on number of pumpsets per 100 Ha of gross cropped area, which is much higher for the relatively smaller farmers compared to the big farmers. That is, in Wardha, smaller farmers seem to

Table 12a Access to Irrigation across different size class of holdings of farmers, Wardha District, 2000-01

Size-class of holdings	Percentage of holdings with irrigation	Gross irrigation ratio	Number of Pumpsets in use per 100 Ha of GCA	Percentage of total area that is Fallow	Percentage of total area under Institutional Holdings
Marginal	5.22	3.92	6.60	2.62	0.61
Small	9.34	4.48	6.19	2.08	0.27
Semi-medium	14.21	4.59	5.08	2.92	0.46
Medium	21.69	4.67	3.96	4.61	1.04
Large	25.41	4.12	2.41	7.84	10.19
All size-classes	11.96	4.52	4.90	3.60	1.30

Source: *World Agricultural Census, 2001; http://agcensus.nic.in cited as on 19-04-08*

Table 12b Distribution of irrigation sources across different size class of holding of farmers, Wardha District, 2000–01

Size-class of holdings	Distribution of irrigated area by source (Percentage)				Percentage of wells without Pumpsets	Percentage of wells not in use
	Canals	Tanks	Wells	Tube wells		
Marginal	16.93	1.47	77.67	1.10	4.93	8.05
Small	12.59	0.71	81.79	1.09	6.35	7.41
Semi-medium	10.51	1.16	83.78	0.56	4.91	5.09
Medium	8.82	0.65	86.72	0.37	3.77	5.77
Large	11.51	0.37	78.72	0.00	2.35	6.93
All size-classes	10.78	0.85	83.71	0.62	5.00	6.25

Source: *World Agricultural Census, 2001; http://agcensus.nic.in cited as on 19-04-08*

be using their land much more intensively than big farmers. Another piece of data that substantiates this argument is that big farmers are keeping a larger proportion of their land as fallow. While 7.8 percent of total operated area that is part of large holdings is reported as fallow, which includes current as well as other types of fallow, the corresponding number is less than 3 percent for the marginal, small, and semi-medium land holdings. Moreover, the area under institutional holdings is as high as 10 percent of the total for large holdings, while the corresponding figure for the district was only 1.3 percent.[18]

Analysing the access to irrigation by different sources, the importance of well irrigation across all size classes of holdings comes out very clearly. More than 75

18 Holdings managed by trusts, government farms etc are referred to as institutional holdings. Cultivation on institutional land would have implications for long-term investments in agriculture.

percent of area across all the five major size classes is irrigated by wells and there is not any substantial difference across size classes. However, medium-size holdings reported the highest percentage of irrigated area by wells while lowest percentage is reported by marginal holdings. While percentage of wells without pumpsets and percentage of wells that are not in use are higher for small and marginal holdings, the larger holdings also report a high percentage of wells that are not in use. All in all, with regard to well irrigation, which is generally considered to be of better quality, the differential in access across various size classes of holdings is not very sharp, indicating that farmers irrespective of size classes have access to similar resources and work under similar constraints in Wardha district. While the role of tanks as a source of irrigation is quite negligible across all size classes, the importance of canals as a source of irrigation is higher among small and marginal land holdings.

1.6. Animal and Mechanical Power used in Agriculture

Draught animals have always been an integral part of the agricultural system in Wardha district. Animals are used for several agricultural operations and the organic manure needed for the fields are also supplied by the livestock. According to the Livestock census carried out in 1992 there were 1.3 lakh male working animals in Wardha district and their number increased to 1.8 lakh by 1997, an increase of over 41 percent, as per data presented in Table 13.

However, over the years 1997–2003 there was a drastic reduction in number of working males, accounting for just about 1.2 lakh male working animals in the district in 2003. This implies that while there were forty-three male working animals per 100 Ha of gross cropped area in 1997, this reduced drastically to twenty-eight

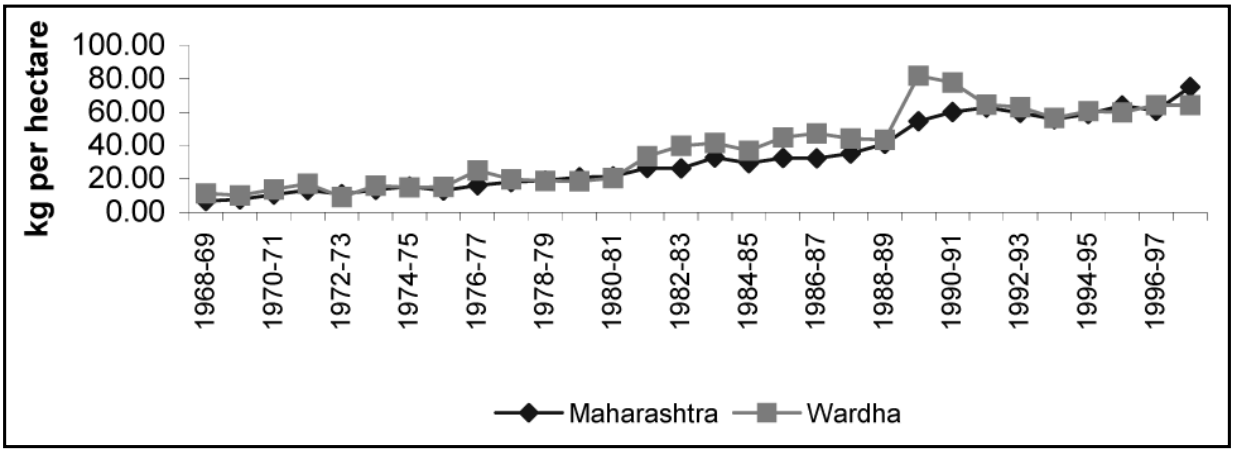
Table 13 Animal and Mechanical Power used in Agriculture, Wardha District (W), Maharashtra (M)

Year	No. of Male Working Animals		No. of Male Working Animals per 100 Ha of GCA		No. of Tractors per 100 Ha of GCA		No. of Electric pumpsets per 100 Ha of GCA		No. of Diesel pumpsets per 100 Ha of GCA	
	W	M	W	M	W	M	W	M	W	M
1992	130,889	7,031,299	32	33	—	—	—	—	—	—
1997	184,889	7,025,425	43	33	0.13	0.38	2.94	3.98	0.73	0.52
2003	124,442	6,436,458	28	35	0.11	0.57	3.58	5.41	0.72	0.91

Note: *Male working animals include indigenous and crossbred cattle and buffaloes.*
Source: *Government of Maharashtra GoM, 1997 and 2003; EPWRF.2004*

in 2003. The decline in availability of working animal per unit of cultivated area has happened alongside a tendency to keep land out of cultivation and this perhaps is indicative of the increasing stress faced by farmers to maintain draught animals. In the district of Wardha the major crops during *kharif* are soyabean and cotton. Both these are intercropped with red gram. All the three crops use draught animals for various agricultural operations: sowing is carried out either with animal-driven dibbler or *phandi*[19]*;* animals are used in harrowing operations; threshers that are used for sorghum, soyabean, red gram, other pulses and wheat are brought to the field with the help of animals; and animals are also used to carry the agricultural produce back from the field. Given this, a decline in number of draught animals has serious implications for agriculture. While the number of draught animals has declined in the state of Maharashtra over 1997–2003, the rate of decline is much lower in the state compared to Wardha District. As regards power-driven agricultural implements, we observed the following: density of tractors is not only relatively lower in Wardha District but has also declined marginally over 1997–2003 as the number of tractors has declined from 550 to 477 during this period. More than 3,000 electric pumpsets have been added over 1997–2003 in Wardha District pushing up the density of electric pumpsets. In Wardha District, as on 2001, only 334 villages out of 1,004 villages have electricity connection for agricultural purpose (Census 2001). However, the number of pumpsets, electric as well as diesel, per 100 Ha of gross cropped area is much higher in the state of Maharashtra as a whole, as seen in 2003.

Figure 8 Consumption of chemical fertilisers, per hectare (NPK)



Source: *EPWRF 2004*

19 Phandi is a traditional implement used for sowing.

As regards the per-hectare consumption of chemical fertilisers, the pattern exhibited by the district and the state are quite similar as seen over thirty years since 1968–69, as can be seen from Figure 8.

1.7. Soil and Water Conservation Activities[20]

The importance of soil and water conservation activities for Wardha District, given its specific agro-ecological characteristics has been elaborated earlier, in Section 1.1. Given the relevance of soil and water conservation activities for sustainable agricultural growth of Wardha, it is important to critically examine the status of intervention with regard to these activities in the district as well as in the state of Maharashtra.

Though soil- and water-conservation activities were carried out even in the pre-Independence period in the state of Maharashtra, the importance attached to these activities and the range of activities varied a great deal over the years, in particular, during 1992–98, which is referred to as the pre-Single Window System period, and the post-1998 period, which is the Single Window System period. Until about the early 1980s, soil-conservation activities were carried out as isolated single activities, when contour bunding, graded bunding etc were constructed as independent activities. In the early 1980s, the concept of watershed development replaced the single activity approach and comprehensive watershed programmes were implemented. In 1992, in Maharashtra, a separate department named Water Conservation Department (*Jalasandara)* was formed that included Soil Conservation, Minor Irrigation, Social Forestry and Groundwater Survey and Development Agency. During the period 1992–98, the Department of Agriculture had three major wings: Soil and Water Conservation, Horticulture, and Agricultural Extension. Each one of these wings had a separate set of staff. Each of these three wings was placed in the charge of a Director at the state level who was the administrative and technical head of that wing. The administrative structure was such that below the Director at the state level were placed the staff representing the various administrative levels such as the division, district, sub-division, circle, and village.[21] Table 14 indicates the staff structure that was prevalent from 1992 to 1998 in the state of Maharashtra.

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20 The discussion in this section owes a great deal to the insights shared very generously by many officers in the Commissionerate of Agriculture, Pune.

21 The state of Maharashtra is divided into 8 divisions, 33 districts, 90 subdivisions, 352 taluks, 910 circles and 43,711 villages in 2001.

Table 14 Staff Structure in the Department of Agriculture, Maharashtra, Pre-1998 period

Administrative Level	Name of Posts		
State	Commissioner of Agriculture		
	Director Soil and Water Conservation (S&W)	Director Agricultural Extension (AE)	Director Horticulture (H)
Division	Superintending Agricultural Officer (S&W)	Divisional Joint Director Agriculture (AE)	Superintending Horticulture Officer (H)
District	Divisional Soil Conservation Officer (S&W)	Principal Agricultural Officer Agricultural Development Officer (AE)	Deputy Director Horticulture (H)
Sub-division	Sub-divisional Soil Conservation Officer (S&W)	Sub-divisional Agricultural Officer (AE)	Village-level Nursery Assistant (H)
Taluk	–	–	–
Circle	–	Circle Agricultural Officer (AE)	–
Village	Agricultural supervisor (S&W); Agricultural Assistant (S&W).	Agricultural supervisor (AE); Village Extension Worker (AE).	–

Note: *S&W refers to Soil and Water Conservation; AE, Agricultural Extension; and H, Horticulture.*
Source: *Data collected from Commissionerate of Agriculture, Pune, in May 2008*

Total sanctioned posts in the department of agriculture in the pre-1998 period, in the state of Maharashtra, was about 30,000. Of the total posts in the department of agriculture in the entire state of Maharashtra, 17,116 posts (52 percent) were exclusively in the department of Soil and Water Conservation, 12,761 (39 percent) was in agricultural extension and the remaining 10 percent was in the horticulture department.[22] While the staff could be transferred from one wing to another wing, it happened exceptionally, say in case of promotion or willingness of field worker or officer. This system ensured that staff in each department developed a specialised skill. For instance, it was mandatory for the staff recruited in the soil and water conservation department to undergo a six-month-long basic course in soil and water conservation activities as well as a three-month-long refresher course if needed. In the pre-Single Window System period, a substantial number of posts were created to carry on the work at the village level. Of the total sanctioned posts, the staff working at the village level, viz. agriculture supervisors and agriculture assistants, numbered in the order of 46 percent in the case of soil

22 Data collected from Commissionerate of Agriculture, Pune, in May 2008.

and water conservation and 57 percent in agricultural extension. The staff working at the grass roots, the field staff not only received the mandatory training in their specialised area but also gained by continuously working on the same subject over many years. Thus the field staff was endowed with a combination of rich practical experience and formal training received from various training institutes. This fact has enormous implication for the successful implementation of any soil- and water-conservation programme. For instance, with regard to any conservation activity, it is the agricultural assistant who is required to choose a site. He should therefore have the necessary skills to decide whether or not a site is technically suitable for a particular soil- and water-conservation activity. Once the site that is chosen by the assistant is inspected by the agricultural supervisor and is finalised, it is necessary to carry out the surveying and levelling of the site which is also work that requires technical know-how. Following this is the preparation of an estimate of the project cost, and once the work gets sanctioned relevant markings will have to be made on the site to carry out the soil- and water-conservation activity. Thus, the system of staff structure that prevailed until 1998 had the scope to carry on activities with the help of their specialised field staff.

In 1998, a Single Window System was introduced in the department of agriculture, Maharashtra, whereby the three major wings of the agricultural department, namely, soil and water conservation, agricultural extension and horticulture, were merged. Table 15 gives the staff structure in the post-1998 period.

Table 15 Staff Structure in the Dept of Agriculture, Maharashtra: Single Window System

Administrative Level	Name of Posts
State	Commissioner of Agriculture
Division	Divisional Joint Director of Agriculture
District	District Superintendent Agricultural Officer
Sub-division	Sub-divisional Agricultural Officer
Taluk	Taluk Agricultural Officer
Circle	Circle Agricultural Officer
Village	Agricultural supervisor Agricultural Assistant.

Source: *Data collected from Commissionerate of Agriculture, Pune, in May 2008*

Under this system, staff members were expected to carry on the activities of all wings, that is, soil conservation, horticulture, and agricultural extension. The system was reduced to one of 'general' staff from 'specialised skilled staff'. This change in the staff structure meant that staff no longer had members exclusively to carry out soil and water conservation activities. In the perception of many officers who have long years of experience in the department of agriculture in Maharashtra, the soil and water conservation activities suffered a set back with the introduction of single window system. Moreover, even though the total number of sanctioned posts remained more or less the same in the pre- and post-1998 phase, a large number of posts did not get filled up and remained vacant in the post-1998 phase. Table 16 illustrates the status of filled and vacant posts in the district of Wardha. It is unfortunate that more than 40 percent of staff positions remain vacant in the Office of the District Superintendent of Agriculture Officer, Wardha. Two-fifths of all sanctioned posts in the Department of Agriculture remains vacant in Wardha district and this is much higher than the corresponding figure for the state as a whole. In Maharashtra, as per data pertaining to November 2007, one-fifth of the total sanctioned positions remained vacant.[23] Thus the reduced availability of manpower on the one hand combined with the restructuring of the agricultural department, which had implications for availability of staff exclusively for soil- and water-conservation activities, resulted in an absolute decline in the quantum of soil- and water-conservation activities in the state of Maharashtra as well as in Wardha District. Analysing the soil-and water-conservation activities carried out during pre-Single Window System and post-Single Window System, it is clear that in Wardha District, except 'Farm ponds' that received particular attention in the special packages announced for Wardha, all other activities have dwindled drastically, as presented in Table 17. However, in the state of Maharashtra there is a general decline of all watershed activities except farm ponds, graded bunding, continous contour trenches, loose boulder structure, as per data shown in Table 18.

Apart from a decline in the sheer magnitude of activities related to soil-and water-conservation, there are other serious problems encountered in their implementation. While a watershed is divided into three parts: upper reaches, middle reaches, and lower reaches, and watershed programmes should follow a ridge-to-valley system for effective results, it is believed that in the recent years watershed activities are

23 Data collected from Commissionerate of Agriculture, Pune in May 2008.

Table 16 Sanctioned / Filled / Vacant positions in the Department of Agriculture, Wardha District (as on 31-07- 2007)

Sr.	Designation	Number of Posts		
		Sanctioned	Filled	Vacant
1	District Superintendent Agriculture Officer	1	1	0
2	Deputy Director of Agriculture	1	0	1
3	Sub-divisional Agriculture Officer	3	3	0
4	Technical Officer-MAS	10	2	8
5	Taluk Agri Officer	8	4	4
6	Soil Survey and Soil Testing Officer	1	0	1
7	Assistant Statistician	1	0	1
8	Technical Officer	1	0	1
9	Assistant Administrative Officer	1	1	0
10	Account Officer	2	0	2
11	Agriculture Officer	34	21	13
12	Superintendent	4	2	2
13	Stenographer-Lower Grade	1	0	1
14	Steno – Typist	3	1	2
15	Agriculture Supervisor	72	55	17
16	Agriculture Assistant	236	199	37
17	Assistant Superintendent	11	5	6
18	Senior Clerk	29	16	13
19	Statistician Assistant	1	1	0
20	Clerk	54	18	36
21	Tracer	51	18	33
22	Draftsman	1	0	1
23	Artist cum operator	1	0	1
24	Jeep driver	19	9	10
25	Naik	1	0	1
26	Peon	75	31	44
27	Watchman	20	5	15
28	Bullock man	1	0	1
29	Tiller man	1	0	1
30	Grade-1 Mazdoor	32	4	28
31	Nursery Assistant	31	13	18
	Total	**707**	**409**	**298**

Source: *Office of the District Supdt. Agriculture Officer, Wardha, 2007*

Table 17 An Analysis of Watershed Activities, Wardha District

Item	Period	Graded bund	CCT	Loose boulder structure	Earthen structure	Cement nala bunding	Clay nala bund	Under ground bund	Live filter strip	Farm ponds	Live check dam	Brush wood dam
		Ha	Ha	No.	No.	No.	No.	No.	Ha	No.	No.	No.
Watershed activities completed	1992–1999	24,165.	654	14,529	1,004	394	465	641	4,239	226	749	9,934
	1999–2007	22,524	54	3,383	383	552	155	19	1,691	1,715	338	68
Average activity/ year	1992–1999	3,452	93	2,076	143	56	66	92	606	32	107	1,419
	1999–2007	2,815	7	423	48	69	19	2	211	214	42	9
Index of Activity	1992–1999	100	100	100	100	100	100	100	100	100	100	100
	1999–2007	82	7	20	33	123	29	3	35	664	39	1

Note: *CCT refers to Contour continous trench; Index of Activity for 1999–2007 is worked out keeping the activity in the base year 1992–99 as 100.*

Source: *Office of the District Supdt. of Agriculture, Wardha, Data collected in March 2008*

Table 18 An Analysis of Watershed Activities, Maharashtra

Item	Period	Graded Bund	Terracing	C.C.T.	Loose boulder structure	Earthen nala bund	Cement Nala bund	Gabion structure	Undergr ound Bund	Diversio n Bund	Farm Ponds
		Ha	Ha	Ha	No.	No.	No.	No.	No.	No.	No.
Watershed activities completed	1992–1999	174,822	182,036	121,422	841,754	70,607	24,990	1,524	4,068	1,651	4,656
	1999–2007	618,203	111,431	220,715	1,016,129	66,917	18,048	843	554	1,768	51,671
Average activity/ year	1992–1999	24,975	26,005	17,346	120,251	10,087	3,570	218	581	236	665
	1999–2007	77,275	13,929	27,589	127,016	8,365	2,256	105	69	221	6,459
Index of Activity	1992–1999	100	100	100	100	100	100	100	100	100	100
	1999–2007	309	54	159	106	83	63	48	12	94	971

Note: *Index of Activity for 1999–07 is worked out keeping the activity in the base year 1992–99 as 100*

Source: *Commissionerate of Agriculture, Pune, Data collected in May 2008.*

predominantly carried out on the lower reaches.[24] However, when conservation activities are not carried out in the upper and middle reaches, water and soil run-off from first and second reaches will affect and nullify the work that has been carried out in the lower reach.

To sum up, while soil- and water-conservation activities are exceedingly important for Wardha's agriculture, these activities have declined over the years due to restructuring of the agricultural department into a Single Window System and due to non-recruitment of staff.[25]

1.8. Other Issues

1.8.1. Distribution of Workers

Tables 19 and 20 present some basic data on workers in the rural and urban areas of Wardha District.

In 1991 as well as 2001, a substantial section of main workers in rural areas of Wardha District were engaged in agricultural activities, either as cultivators or as agricultural labourers. However, a sharp decline is seen in the percentage of main agriculture workers in rural Wardha in 2001 compared with 1991, from 84.9 percent to 78.12 percent. This decline is essentially related to a drastic fall in the number of agricultural labourers, especially among females. The number of female agricultural labourers declined by 33 percent, while the number of males declined by 10 percent in rural Wardha over this period, 1991–2001.

Number of cultivators also declined among females while it increased marginally among males. The overall reduction in workforce engaged in agriculture is also true of urban areas. While one-fifth of the urban workforce was engaged in agricultural occupations in 1991, this proportion declined to one-tenth by 2001. This suggests a general reduction in employment in agriculture over the period 1991 to 2001. As a corollary to the observed pattern of decline in agricultural employment, non-agricultural employment has increased in rural as well as urban areas and among

24 Many officials pointed out that soil- and water-conservation works are carried out essentially in lower reaches for several reasons: it is relatively easier to show tangible results on the lower reaches; the nature of activities in lower reaches are relatively more labour-intensive and therefore shall create more employment opportunities; labourers are more willing to undertake work in the lower reaches than in the middle or upper reaches. Another serious problem is that a major part of funding for these activities is through the employment guarantee scheme, and because it is considered that the lower reach activities are more labour-intensive, only these activities are taken up

25 Fund allocation for soil- and water-conservation activities over the years has not been analysed. This remains a gap in our analysis

Table 19 Classification of Main Workers by Major Activity, Wardha District

Year	Region	Cultivator			Agricultural Labourers			Percentage of Workers in Agriculture		
		Males	Females	Total	Males	Females	Total	Males	Females	Total
1991	Rural	79,685	40,851	120,536	90,605	104,256	194,861	77.94	94.84	84.90
	Urban	4,142	536	4,678	7,145	5,910	13,055	17.04	50.37	22.44
	Total	83,827	41,387	125,214	97,750	110,166	207,916	63.77	91.41	73.94
2001	Rural	84,153	35,791	119,944	81,392	69,759	151,151	72.36	89.24	78.12
	Urban	3,087	275	3,362	3,739	2,339	6,078	9.37	22.88	11.20
	Total	87,240	36,066	123,306	85,131	72,098	157,229	57.15	83.40	65.04

Source: *Census of Maharashtra, 1991 and 2001*

Table 20 Classification of Workers as Main and Marginal, Wardha District

Year	Region	Population			Main Workers			Marginal Workers			Work Participation Rate		
		Males	Females	Total	Males	Females	Total	Males	Females	Total	Males	Females	Total
1991	**Rural**	403,503	380,337	783,840	218,498	153,003	371,501	5,622	16,856	22,478	555	447	503
	Urban	146,867	136,650	283,517	66,240	12,798	79,038	964	1,633	2,597	458	106	288
	Total	550,370	516,987	1,067,357	284,738	165,801	450,539	6,586	18,489	25,075	529	356	446
2001	**Rural**	470,610	441,085	911,695	228,765	118,272	347,037	37,748	65,128	102,876	566	416	493
	Urban	168,380	156,661	325,041	72,866	11,427	84,293	9,232	6,913	16,145	488	117	309
	Total	638,990	597,746	1,236,736	301,631	129,699	431,330	46,980	72,041	119,021	546	338	445

Source: *Census of Maharashtra, 1991 and 2001*

males and females. However, it is difficult to comment either on the quality of such non-agricultural employment or the industry where such employment has been created.

Moreover, the reduction in level of employment in agriculture is also accompanied by a tendency for available employment to become marginal in nature. Comparing data from 2001 with 1991, it is seen clearly from Table 20 that there is an absolute decline in the number of main workers on the one hand and a nearly fivefold increase of marginal workers on the other. While main workers among females in rural Wardha have fallen down by 23 percent, it has registered a moderate increase of 5 percent among males. As regards marginal workers, their numbers have increased at phenomenally high rates among males as well as females, in rural as well as urban parts of Wardha District over 1991–2001. Work participation rate (WPR), the number of workers per 1000 population, has fallen in rural Wardha from 503 in 1991 to 493 in 2001, considering male and female workers together. This fall is essentially related to a decline in work participation rate among females. While males have registered an increase in WPR, this increase is related to an increase in marginal workers in rural Wardha. The Wardha District thus presents a picture where marginalisation of workforce is taking place alongside a decline in employment in agriculture over the 1990s. The observed changes in employment pattern are not unrelated to the changes in land use and cropping pattern in the district. A tendency to keep land out of cultivation, indicated by a decline in net sown area and an increase in total fallow lands, a shift away from cotton alongside an increase in area under soyabean would have the tendency to lower employment opportunities in agriculture. Cultivation of soyabean is much less labour-intensive compared to cotton, in particular, for women labourers.

Total employment created under the employment guarantee scheme (EGS) has also been dwindling in Wardha District over 1990–91 to 1999–2000, contrary to the experience of the state. Number of days of employment created for women has marginally increased in Wardha District while it has nearly doubled in the state as a whole, as per data in Table 21.

1.9. Concluding Observations

Wardha District, which is largely an agrarian economy, is experiencing a situation where agriculture is on the decline. Gross area under cultivation has been shrinking over the years while area that is left fallow has been increasing. There has been an increasing tendency for farmers to keep land out of cultivation and by 2004–05 the

Table 21 Persondays created under EGS, Wardha District and Maharashtra

	Persondays (in lakh) 1990–1991		Persondays (in lakh) 1999–2000	
	Total	Women	Total	Women
Wardha	11.14	5.11	8.83	5.30
Maharashtra	898.94	277.44	949.39	543.64

Source: *GoM, 2002*

extent of total fallows in the district was of the order of 85,000 Ha, that is, 13 percent of geographical area of the district. Agriculture in Wardha District relies almost entirely on the south–west monsoon and *kharif* is the most important agricultural season. While the south–west monsoon which is the lifeline of agriculture in the district has registered a mild decline over the years, the nature of development in the irrigation regime is not such as to compensate the deficiencies in rainfall. It is observed that the extent of irrigation is as low as 7 percent of net sown area in the early 2000s.

As regards the cropping pattern in Wardha District, cotton and sorghum were the major crops of the district till the introduction of soyabean in the late 1980s. Area under soya bean has been increasing rapidly at the expense of all other crops, including cotton and sorghum. Reduction in area under sorghum has resulted in a substantial fall in food grains production in the district while production of soyabean has increased substantially. Instability of yield of all crops is much higher in Wardha District compared to all of the state of Maharashtra as well as all of India. This suggests that the risk in cultivation is relatively much higher in the district.

The nature of changes in Wardha District has lead to a decline in employment in the agricultural sector as well as marginalisation of workforce over the 1990s. Further, there has been an increase in fragmentation of land holdings in the district. In 1970–71 just about one-fourth of all holdings were marginal or small while by 2000–01 more than half the holdings were classified as marginal or small. The enormous increase in fragmentation of holdings implies that the current crisis in agriculture falls heavily on the marginal and small holders whose ability to bear risks would be minimal. It is therefore imperative that measures to stabilise agriculture are undertaken on a war footing in Wardha District. We have noted earlier that the physical conditions that prevail in the district—in particular, the soil characteristics and rainfall pattern—result in a significant extent of run-off of rain water and erosion of top soil, warranting serious efforts in soil- and water-

conservation activities. However, our analysis clearly points out a decline in soil- and water-conservation activities with the restructuring of the agricultural department and the introduction of the Single Window System since 1998. Moreover, while expansion of irrigation would help in reducing the fluctuations in yield levels and bring about some stability in agricultural growth, it is seen that there is a sharp gap between irrigation potential planned for the district and actual irrigation achievement of the district. These issues need attention if the general decline in agriculture in the district is to be altered.

Section 2

Perspectives from the Field

This section provides a summary of the findings of our field study conducted in two villages: Lonsawali in Wardha Taluk and Kosurla in Hinghanghat Taluk, both in Wardha District. While Lonsawali village was chosen on purpose, Kosurla was selected randomly.[26] Intensive, qualitative interviews were carried out with farmers in the two villages in order to understand the constraints faced by them in adoption of technology and problems encountered by them in the process of cultivation in general. Group discussions with farmers were held in both the villages and this was followed by intensive qualitative interviews with few individual farmers.[27]

2.1. A Brief Outline of Lonsawali and Kosurla

Lonsawali village is located nearly 25 km from the district headquarters of Wardha. The revenue village of Lonsawali comprises two hamlets: Lonsawali and Shekapur. As per the Census of 2001, there were 319 households with a population of 1,434 in the revenue village of Lonsawali. The Village Panchayat of Lonsawali represents Lonsawali, Shekapur, and Dorli, and the panchayat office is located in Lonsawali. The village of Kosurla is about 34 km from Wardha town. In 2001, Kosurla had 164 households with a population of 776 persons.

The predominant land tenure system that prevailed in Wardha District was the Zamindari system. In both the villages, the former zamindar families remain as one of the biggest land holding families. In Lonsawali, the erstwhile zamindar's family continues to own the biggest land holding in the village, possessing more than 100 acres even by 2008. However, most of their land is either left barren or given out

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26 (a) MSSRF has established a Village Knowledge Centre in Lonsawali and has collected basic data on land holdings in the village. This database helped in our survey of farmers. In addition to this MSSRF's presence helped in building a rapport with the farmers.
(b) The eight taluks of Wardha District may be grouped to form three regions on the basis of certain basic characteristics that define the nature of their agricultural economy. The factors that were considered include proportion of area under forests, irrigation ratio, cropping pattern, extent of fallow land, soil characteristics, pattern of land holding, population density etc. The contiguous taluks of Wardha, Seloo, and Deoli form one region; Hinganghat and Samudrapur form another; while the northern taluks of Ashti, Arvi, and Karanja form yet another region. While Kosurla was chosen using random numbers from among the villages of Hinganghat and Samudrapur, it is unfortunate that we could not study the Ashti, Arvi, and Karanja region.

27 Survey of farmers was carried out in February 2008 in Lonsawali and in May 2008 in Kosurla.

on tenancy. In Kosurla, the former zamindar's family held more than 200 acres even as late as 1970. Subsequently, the land was partitioned among the zamindar's heirs, and they remain the big land holding families of Kosurla Village.

In Lonsawali, data collected by the Village Knowledge Centre of MSSRF in 2006–07, indicates that slightly more than one-fourth of households, 26.97 percent, in the village are landless households. Among those who report land ownership, a little more than 50 percent are either marginal or small farmers holding less than 5 acres. Small farmers are the predominant category, accounting for 44 percent, while marginal farmers, holding less than 2.5 acres, account for 8 percent of all farmers. Farmers with semi-medium holdings of size 5–10 acres form 29 percent of all farmers, while those having medium-to-large holdings, above 10 acres, constitute 19 percent of the total.[28] In Kosurla, while we were not fortunate to have a detailed data base, the information we gathered suggests that the pattern of land ownership that prevails here today is not very different from that of Lonsawali: it is said that about one-fourth of the families do not own land and that the landed families are divided more or less equally if they are classified as those owning below 5 acre and those, above 5 acre.

Lonsawali received electricity connection for agricultural purposes around 1969–70. The Land Development Bank started sanctioning loans for well digging purposes since 1958 in Wardha District. Making use of this loan facility, with the onset of village electrification, a few farmers went in for wells connected with electric motors. According to the village administrative officer, in 2003–04, there were 116 wells in the field of which about 90 had electric motors. In 2008, there were two submersible motors in the village and all the rest were 3-HP, nonsubmersible motors. Water is usually at a depth of 40–50 feet, and considering that the capacity of suction pipe is only 25 feet the motors are kept within the well, adjacent to the wall of the well. During monsoon, when the water level in the well rises, the motor is pulled upwards and often kept outside the well on a temporary structure. It is said that nearly half the wells in the village are dry and not in use. Of the gross cropped area of 948.6 Ha in 2006–07, 148 Ha, or 15 percent, is irrigated by wells. Of the irrigated area, only 22 acres receive irrigation throughout the year while the rest have irrigation only during the monsoon season. That is, while all wells have

28 Compared with Table 10, it is clear that the land holding pattern in the district and Lonsawali are more or less similar, though the percentage of marginal holdings is greater in the district than in the village. However, the district data refer to operational holdings while the village data refer to ownership holdings.

water during the *kharif*, only a few wells continue to have enough water for a *rabi* crop. It is said that in the last ten years no new wells have been dug in the village as it has been difficult to get loans for this purpose.[29] However, in 2008, about twenty-five farmers in Lonsawali have a sprinkler system.

In Kosurla, electricity for agricultural purposes was received much later, that is, in 1980–82. In 2008, there were about ten wells in the village but none seem to be in use. In Kosurla there is a problem in digging wells as they have a tendency to cave in. The caving in of wells is a problem associated with the soil structure and texture. Most of the wells that were dug in heavy clay soils seemed to have caved in after digging to some depth. In such places, wells can be taken only if supporting pillars are provided. This is highly cost intensive which makes it impossible for a small farmer with heavy clay soil type in his field to dig wells.

In Lonsawali, cotton and sorghum were the traditional crops of the village, and they were essentially rainfed. The sorghum variety that was used was called *desi gavrani* and this was sown in June and harvested in January. In 1964 the first sorghum hybrid CSH1 was released in the country and from about 1969-70 farmers started cultivating hybrids. Over the years sorghum varieties have gone out of circulation and only sorghum hybrids are cultivated in the village.[30] As regards cotton, the varieties that were grown were (L47 and L973), till the long staple cotton hybrid (H4) was introduced in the village in 1968. Traditionally, red gram was always grown as an intercrop with cotton, and cotton was sown in June and harvested in February. For about two to three years, H4 cotton was popular in the village and then farmers shifted to MCU 5. This variety was also not popular for long as it was affected by red leaf curl and farmers shifted to Ankur 651 and then to H10. Since then, a large number of cotton hybrids and varieties has been released by the public research system as well as the private companies and these were patronised by the farmers. During the late 1990s, with the introduction of soyabean in the village, a large number of farmers shifted at least part of their cotton/sorghum area to soyabean. In 2005, with aggressive marketing of Bt cotton by seed companies, many farmers started cultivating Bt cotton; However, there were different types

29 In 2008, it was estimated that it would cost approximately Rs.1.5 lakh to dig a well and get the electricity connection.

30 It is said that seeds of the sorghum variety, gavrani , is preserved in the seed bank in the Marathwada Agricultural University.

Table 22 Cropping Pattern in Lonsawali and Kosurla, 2006–07

Crops	Area under cultivation (in hectare)		Percentage of area under cultivation	
	Lonsawali	**Kosurla**	**Lonsawali**	**Kosurla**
Sorghum	26.9	19.82	2.84	6.32
Wheat	64.8	1.2	6.83	0.38
Red gram	88.6	30.73	9.34	9.8
Bengal gram	25.8	8.8	2.72	2.81
Black gram	3.4		0.36	0
Vegetables	35.4	Nil	3.73	0
Fruits	5.4		0.57	
Soyabean	160.2	143.18	16.89	45.67
Sesame	3.2		0.34	0
Cotton	506.7	109.75	53.42	35.01
Others	28.2	0	2.97	
GCA	948.6	313.48	100	100

Source: *Collected from Village Administrative Officer, Lonsawali and Kosurla, in 2008*

of Bt cotton seeds that were available in the market: legal Bt cotton seeds that were authorised for sale as well as illegal Bt cotton seeds or general Bt cotton.[31] In 2008, the charm of Bt cotton seems to have faded among farmers in Lonsawali. Hybrid cotton is popular among farmers and the seeds are purchased in shops either in Waifad (4.5 km) or Pulgaon (7–8 km) or Wardha (25 km).

The cropping pattern that prevailed in Kosurla, till the introduction of soyabean in the village in 1998, was one of cotton and sorghum intercropped with red gram during the *kharif* season and wheat, gram and oil seed during the *rabi* season. Kosurla was one of the '*rabi*' villages where on waterlogged[32] lands dry *rabi* crops were cultivated. The proportion of waterlogged lands were relatively higher in Kosurla and during monsoon these lands were flooded routinely, and therefore one could cultivate these lands only during *rabi* season. These lands are left fallow during the *kharif* season and are allowed to absorb the rain water during the south west monsoon and after the cessation of rains, dry wheat or gram or oil seeds were cultivated. The crop was grown using the moisture retained by the soil. After 1998, with the introduction of soyabean in the village, the practice of cultivating

31 By 'general Bt cotton' farmers refer to seeds that are produced by companies that do not have a license to produce Bt seeds. General Bt seeds are sold by private traders without bills being issued to farmers. At times even when farmers retain their Bt cotton seeds and sow it in the next season they refer to it as general Bt.

32 Waterlogged lands are referred to as *pan basan* locally.

dry *rabi* crops disappeared. There are several reasons attributed for the decline of dry *rabi* crops. First, dry *rabi* crop requires extensive land preparation with two to three harrowing/ploughing. The land being marshy is not workable with a tractor and needs bullock and manual labour to cultivate. Shortage of animal and manual labour as well as the sheer drudgery involved in preparing the waterlogged area for the dry *rabi* season makes soyabean, which is cultivated during the *kharif* season, a more viable option. Second, unlike the cotton crop that is highly susceptible to flooding at all stages, soyabean can moderately withstand water logging conditions when the crop is in its vegetative phase. The peak flooding period of July–August in Wardha District coincides with the vegetative growth phase of soybean. By resorting to soyabean cultivation, the farmers are able to reap at least some suboptimal yield when they take up soyabean. Third, considering that the prevalent rate for soyabean is quite remunerative, the farmers are able to absorb the losses even if the field gets flooded and there is a consequent crop loss. Fourth, soyabean is a cash crop which is sold in the market and is helpful in meeting the cash needs of farmers while dry *rabi* crops such as wheat or gram were often retained only for home consumption.

Analysing the data for the year 2006–07 for Lonsawali and Kosurla, it is clear that *kharif* is the principal agricultural season in the villages, as shown in Table 22. While cotton is the major crop accounting for 53.42 percent of gross cropped area in Lonsawali, soyabean is the major crop accounting for 45.67 percent of gross cropped area in Kosurla. In both the villages, cotton and soyabean together account for 70 percent to 80 percent of total area under crops. As red gram is intercropped with cotton as well as soyabean, it figures as the third most important crop in both the villages. The intercrop ratio varies across the two villages. In Lonsawali, the prevalent practice is six rows of soyabean or cotton for one row of red gram while in Kosurla the ratio varied from 6:1 to 10:1. While both the villages were traditionally sorghum-growing areas, in 2006–07, the area cultivated with sorghum is very minimal in the villages. In both the villages, a drastic decline in area under sorghum was reported. Farmers are increasingly moving away from cultivation of sorghum for various reasons: it is more remunerative to grow crops such as soyabean or cotton intercropped with red gram; when a shift away from sorghum takes place in an area, those who continue to grow sorghum become the target of attack by wild life and birds. This results in the intensity of loss to be relatively higher for the farmers who grow sorghum and results in them slowly moving away from sorghum cultivation. Third, in Kosurla incidence of a perinicious weed, *striga*, which grows in sorghum field and competes with the crop, has also been

cited. All in all, there is a shift away from what was once the staple diet of the villagers. The *rabi* crops, wheat and gram are grown under irrigated conditions in Lonsawali while in Kosurla, wheat and gram are dry crops. In Kosurla, dry wheat and gram cultivated in the *rabi* season account for about 3 percent of gross cropped area while in Lonsawali, *rabi* crops account for 9 percent to 10 percent.

Some of the major cultivation practices with regard to land preparation, sowing operations, application of fertilisers and pesticides as well as practices with regard to procurement of inputs, sale of produce etc. vary very little within the village as well as across the two villages. Let us discuss some salient aspects of these practices.

- For the *kharif* season, land preparation usually starts in the month of April. Farm yard manure which largely comprises of animal dung is applied to the field in April and is ploughed into the field in the month of May.[33] The quantum of farm yard manure applied varies from farmer to farmer as it is related to the number of animals he owns. However, our estimate is that on an average one tractor trolley (approximately 5 tonnes) of farm yard manure per acre was applied. Farmers tend to alternate their plots for application of farm yard manure when supply is not adequate to cover their entire land holding. After receiving the first showers of rain, in June, the field is given two to three rounds of harrowing. By and large, farmers use country ploughs and bullocks for ploughing and harrowing while some large farmers do use tractors.
- In Lonsawali as well as Kosurla the practice of making compost is not prevalent. We found one farmer in each village who had just begun the process of making a compost pit.[34] The farm yard manure in both the villages are preserved either in open pits (in Kosurla) or uncovered heaps (in Lonsawali). This leads to volatalisation losses of nitrogen, which is the main macro nutrient in the animal dung. When dung is left on the soil surface, some of the nitrogen is eventually converted to ammonia and nitrogen gas, and passes into the atmosphere. However, application of farm yard manure helps in improving soil texture even if there has been a loss of nutritive value.
- In Kosurla the practice of penning appears to be relatively more prevalent. Sheep and goats from as far away as Gujarat and from the neighbouring

33 Among the farmers we interviewed nine out of ten in Kosurla and seven out of nine in Lonsawali own either cows or bullocks or buffaloes.

34 The compost pit is an item offered under the Prime Minister's relief package.

Yavatamal District are penned on the fields. The dung these sheep and goats leave in the field dries up, checking the ammonification loss of nitrogen and working this back to the field after receiving first rains helps utilise its manurial value. Farmers alternate the location for penning every year. This is usually done during the period from January to April or May, when there are no crops on the field. Charges paid to the shepherd are in the range of Rs.1,000–1,500 for one night. In Lonsawali, one of the big farmers has leased out nearly sixty acres of his barren land for goat grazing. The lessee grazes nearly 600 to 700 goats during June to November on this land and in return pays twenty-eight trolleys of goat dung. If the lessee is unable to provide twenty-eight trolleys of dung then for every trolley less than the agreed number of twenty-eight, he compensates by paying Rs.500.

- Collective grazing of cattle is organised in both the villages. A cowherd tends around thirty to forty animals, which may be cows as well as buffaloes, belonging to different farmers in the village. He collects the animals every morning around 11 a.m. and takes them to a common grazing land for grazing. He is paid Rs.40–50 per cow per month and Rs.100 per buffalo. Bullocks are not sent for grazing.
- Sowing of seeds is usually done after the receipt of first showers.[35] Sowing is done by female labourers using the traditional method of opening furrows with an implement called *phandi* (wooden/iron) and line-sowing of seeds by dropping seeds through a bamboo or metal funnel. This method is followed for soyabean, cotton, red gram, and sorghum. Seeds are bought in the market in neighbouring towns or big villages from private shops for all crops except red gram. Usually retained seeds are used for red gram.[36] Over the last two years, soyabean seeds are being given on subsidy through the Department of Agriculture under the Prime Minister's Relief Package. In the perception of farmers this has been a very useful and timely intervention. Seeds that are popular among farmers are Ankur 651, for cotton hybrid; Eagle seeds and JS 335, for soyabean; and Maruthi for red gram.
- As regards chemical fertilisers, supplies are bought from private shops that operate in the neighbouring big villages or towns. In the case of soyabean, in

35 In Wardha region, sowing is usually done between 12 noon and 4 p.m.. Sowing is usually done in the secondweek of June.

36 Red gram seeds are generally replaced by farmers once in two to three years by resorting to seed purchase from the market.

most cases a mixed fertiliser is applied, as for instance, 26:26:10 and 18:18:10, instead of the recommended straight fertilisers such as single super phosphate, muriate of potash, urea, and sulphur. Even when the recommended straight fertiliser, for instance, single super phosphate, is used, it is not supplemented with muriate of potash, urea, and sulphur. So, in effect, there results an overdose of phosphorous fertiliser, with less or no potash, nitrogen, or sulphur supplements which are very essential for soybean. The method of fertiliser application that is practised deviates from the scientific recommendation given on this. The practice is to apply seeds and fertiliser at the same time using *phandi* while the recommendation is that fertiliser be first applied and then covered with soil before seeds are sown. Optimum nutrient-distribution and uptake will be obtained if the recommended practice is followed.

With regard to cotton, the quantum of fertiliser applied is lower than the recommended dosage in most cases. Sometimes nonapplication of one or more of the basic nutrients also occurs, potash being the nutrient missed in more than one instance. Again, with regard to cotton, the method of application of fertilisers is not as per recommendations either. One-time application of fertilisers is practised by farmers instead of the recommended split doses at critical stages, that is, at sowing, square formation, and peak flowering stages.

- Pests and diseases were reported mostly in cotton and red gram. Incidence of pests was relatively less in soyabean. Common pests cited in cotton are bollworms and sucking pests while on red gram it was pod borer. Red leaf curl, a physiological disease was widely reported in Lonsawali. The recommendation for red leaf curl is to spray magnesium sulphate, when it is due to magnesium deficiency, or nitrogen, when it is due to nitrogen deficiency. In the perception of farmers Endosulfan is to be used against pod borer and Metasystox(® against red leaf curl for cotton, and Avant is used against pod borer in red gram. However, while spraying the pesticide, farmers tend to mix different groups of pesticides (Metasystox® and Endosulfan). Mixing and spraying of different group of pesticides, in the event of extreme incompatibility, may lead to scorching and drying of the plant.
- In general, weed management is done manually. Hand weeding and harrowing is done in all crops. However, some farmers do use weedicides like WhipSuper®, Pursuit®, TargaSuper®, and Kloben® in soyabean to control both broad and narrow-leaved weeds. While the dosage of weedicide used is usually lower

than the recommended norm, the preparation of weedicide mixture and time of spraying is generally as per the recommendation.[37]

- Other than cotton which is hand picked, all other crops are harvested by cutting the stalk and bundling the same. Threshers are used to separate the grain/pod from the stalk. The stalk is crushed into husk by the thresher and this is used as cattle feed. In cotton there are generally three to four pickings. Cotton stalks are either burnt on the field or used as fuel wood. Red gram and cotton stalks are also used for bunding and fencing.
- Agricultural produce is usually sold either on the auctioning floor of Agricultural Produce Marketing Committee, or to private traders who come to the doorsteps of farmers or to traders in neighbouring big villages or towns. While bigger farmers whose holding capacity is relatively higher hold on to their stock till the appropriate price is offered, the smaller farmers dispose off their produce as soon as the harvest is over.
- There is a total lack of guidance or advice from the scientific community/ extension officers to the farmers. Farmers' source of information is only the private traders and other farmers.

2.2. Major Issues in Lonsawali and Kosurla

Our detailed discussions with farmers bring out a range of issues—economic, sociopolitical, and climatic factors—that act as constraints to crop production and productivity.

Tables 23–24 are based on the detailed interviews we had with few farmers in Lonsawali and Kosurla.[38] As noted earlier, the cropping pattern in Lonsawali is more diversified than in Kosurla and the bigger farmers in both the villages have a more diversified cropping pattern. Proportion of farmers who own a pair of bullock is quite high across both the villages and across all size class of farmers. This is expected as bullocks are integral to the agricultural operations in Wardha. Tenancy is quite prevalent and six out of nineteen farmers whom we interviewed in the villages have leased in land.

37 For instance, while the recommended dose of WhipSuper is 300 ml per acre the amount of WhipSuper applied by one farmer we met in Kosurla is 50 ml per spray. He gives two rounds of spray, accounting for 100 ml per acre which is just one-third of the recommended dosage.

38 A checklist of issues that were discussed with farmers is presented in Annexure 1.

Table 23 Salient Features of Respondents, Lonsawali, 2008

Respondents	Size of Operational Holding (in acre)	No. of Wells Owned	No. of Electric Motor Pumps	Crops Cultivated
1.	2.5	Nil	Nil	Soyabean, red gram, and bengal gram
2.	3	1	1	Soyabean and red gram
3.	4.5	1	1	Cotton, red gram, sorghum, soyabean, wheat, and vegetables
4.	5	1	1	Cotton, soyabean, red gram, sorghum, wheat, and bengal gram
5.	6*	Nil	Nil	Cotton, soyabean, and red gram.
6.	9*	1	1	Cotton, soyabean, red gram. and Sugarcane
7.	17	2	1	Cotton, soyabean, red gram, sorghum, sugarcane, and wheat
8.	18	2	2	Cotton, soyabean, red gram, wheat, gram, sugarcane, and orange
9.	45	2	2	Cotton, soyabean, red gram sorghum, wheat, and sugarcane

Note: *1. * land taken on lease under a system of tenure called theka. Respondent 5 has leased in 3 acres, while Respondent 6 has leased in 5 acres in 2007–08*

Source: *Field Survey, Lonsawali, March 2008*

There are two systems of tenancy that are prevalent in the villages: *batai* and *theka. Batai* is more popular in Lonsawali while *theka* is more common in Kosurla. *Batai* involves an arrangement of cost- and produce-sharing between the land owner and the lessee while *theka* involves the payment of a fixed amount by the lessee to the land owner.[39] While *batai* is supposed to be sharing of expenses on 50–50 basis, often the lessee is not in a position to make any initial investments and the landlord bears the cultivation expenses and collects an interest, which is invariably high, from the lessee. In such cases, depending on the rate of interest charged, the share of the land owner is greater than 50 percent. Four out of nineteen farmers we interviewed have benefited from the Maharashtra Agricultural Lands (Ceiling on Holdings) Act that came into force in 1962 and they have received 2–3 acres from the government.[40]

39 The prevailing rate for theka is around Rs.1,500–2,000/acre/annum.

40 Respondents 1 and 2 in Lonsawali and Respondents 2 and 3 in Kosurla.

Table 24 Salient Features of Respondents, Kosurla, 2008

Respondents	Operational Holding	No. of Wells Owned	No. of Electric Motor Pumps	Crops Cultivated
1.	3.5	Nil	Nil	Soyabean, cotton, And red gram
2.	4*	Nil	Nil	Cotton amd red gram
3.	4.75*	Nil	Nil	Soyabean, cotton, and red gram
4.	6*	Nil	Nil	Soyabean and red gram.
5.	8	Nil	Nil	Soyabean, Cotton, and red gram.
6.	8*	Nil	Nil	Soyabean, Cotton, and red gram..
7.	22	1	1	Soyabean, cotton, and Red gram
8.	28*	1	1	Soyabean, cotton, red gram, bengal gram, wheat, and sweet lime.
9.	36	2	2	Soyabean and red gram

Note: *1. * Land taken on lease under a system of tenure called theka. Respondent 2 has leased in 2 acres, Respondent 8 has leased in 6 acres, Respondent 3 has leased in 2.75 acres, and Respondent 4 has leased in 3 acres.*

Source: *Field Survey Kosurla, May 2008*

Tables 25 and 26 clearly indicate that farmers do not follow the norms recommended by the scientists. Irrespective of the size of their land holding or ability to buy fertilisers in the market, the farmers do not adhere to the recommended dosage of fertiliser. The problem is not only whether or not the right quantity is applied, but it is also whether or not the correct combination of nutrients is applied. This problem of not adhering to the recommended norms appears to be pervasive, cutting across different sections of farmers. In the case of soyabean, even when the recommended straight fertiliser, single super phosphate, is used it is not supplemented with muriate of potash, urea, and sulphur. So, in effect, there results an overdose of phosphorous fertiliser, with less or no potash, nitrogen, or sulphur supplements which are very essential for soyabean. We had discussed earlier that since a large extent of soils in Wardha are calcareous and alkaline, the problem of phosphorous

Table 25 Details of Fertiliser Applied for Soyabean, 2007–08

Village Name	Respondents	Size of Operational Holding (2007–08)	Combination of Fertiliser Applied	Quantity of Fertiliser Applied (in kg/acre)			
Lonsawali		**(in acre)**		**Nitrogen**	**Phosphorous**	**Potassium**	**Sulphur**
	1	2.5	Mixed and Urea	16.4 (205)	7.2 (90)	4 (25)	Nil
	2	3	Mixed and Urea	5.94 (74)	5.94 (74)	3.3 (21)	Nil
	3	4.5	Diammonium phosphate and urea	32 (400)	10 (125)	Nil	Nil
	5	6	Mixed	5.94 (74)	5.94 (74)	3.3 (21)	Nil
	6	9	Single super phosphate	Nil	8 (100)	Nil	5.5 (69)
	8	18	Mixed	6 (75)	16 (200)	8 (50)	Nil
Kosurla							
	1	3.5	Single super phosphate	Nil	9.12 (114)	Nil	6.27 (78)
	4	6	Single super phosphate	Nil	8 (100)	Nil	5.5 (69)
	5	8	Mixed	9 (113)	9 (113)	5 (31)	Nil
	6	8	Single super phosphate and Mixed	3 (38)	8.3 (104)	1.66 (10)	3.66 (46)
	7	22	Mixed	10.4 (130)	10.4 (130)	4 (25)	Nil
	8	28	Mixed	8.6 (108)	8.6 (108)	Nil	Nil
	9	36	Single super phosphate	Nil	8 (100)	Nil	5.5 (69)

Notes: *1. The recommended dose of fertiliser nitrogen, phosphorous, potassium, and sulphur for rain-fed soyabean: 8:8:16:8 kg/acre or 20:20:40:20 kg/ha.*

2. Figures in parentheses give the index with respect to recommended dosages equating 8 kg of nitrogen, phosphorous, and sulphur, and 16 kg of potassium to 100.

3. Respondents 4, 7, and 9 of Lonsawali village have not been included for lack of complete information.

4. Respondent 3 of Kosurla village was not included for lack of information; Respondent 2 of Kosurla village was not included as he has not applied any fertiliser to his field.

Source: *Field Survey at Lonsawali March 2008, and Kosurla May 2008*

Table 26 Details of Fertilizer Applied for Cotton, 2007–08

Village Name	Respondents	Size of Operational Holding (2007–08)	Combination of Fertiliser Applied	Quantity of Fertiliser Applied (in kg/acre)		
		In acres		Nitrogen	Phosphorous	Potassium
Lonsawali	1	2.5	Mixed and Urea	32 (100)	9 (56)	5 (31)
	3	4.5	Diammonium phosphate	9 (28)	10 (63)	Nil
	5	6	Mixed and Urea	16.36 (51)	9 (56)	5 (31)
	6	9	Mixed and Urea	35 (109)	32 (200)	16 (100)
	7*	17	Mixed and Magnesium sulphate	34 (106)	29 (181)	21 (131)
	8	18	Mixed	54 (169)	54 (338)	30 (188)
Kosurla						
	1	3.5	Mixed	14.82 (46)	14.82 (93)	5.7 (36)
	2	4	Mixed and Urea	11.44 (36)	10.88 (68)	5.44 (34)
	5	8	Mixed and Urea	49 (153)	13 (81)	5 (31)
	6	8	Mixed	13 (41)	13 (81)	5 (31)
	7	22	Mixed and Urea	24.02 (75)	8.7 (54)	3.33 (21)
	8	28	Diammonium phosphate	63 (197)	70 (438)	Nil

Notes: *1. * In addition to the macro nutrients like nitrogen, phosphorus, and potassium, this farmer has also applied 2.4 kg of magnesium and 1.95 kg of sulphur per acre to cotton.*

2. The recommended dose of fertiliser for rain-fed cotton N:P:K = 32:16:16 kg/acre. Figures in parentheses give the index with respect to recommended dosage equating 32 kg of nitrogen and 16 kg of phosphorous and potassium to 100.

3. Respondent 2 of Lonsawali has not taken cotton so has not been included in the table. Respondents 4 and 9 of the same village have also not been included in the table as no information came forth from them with regard to fertiliser application.

4. Respondents 4 and 9 of Kosurla village have not been included as they have not taken cotton during the kharif of 2007–08. Respondent 3 of the same village has not applied any fertiliser to cotton.

Source: *Field Survery at Lonsawali March 2008 and Kosurla May 2008*

fixation is inherent to these soils and therefore even the excess phosphorous will not be effectively utilised by the plants in the absence of ameliorative measures. With regard to cotton, nonapplication of potash is a problem.

Another important reason why farmers are unable to follow the recommendations given by scientists as regards the quantum and combination of fertilisers is to do with the farmers' ability to purchase fertilisers in the market as well as the availability of various kinds of fertilisers in the market. Fertilisers are often bought on credit from private shop keepers, and the farmers are forced to take whatever fertiliser they are supplied with. Further, shortage of chemical fertiliser during sowing seasons is a recurrent problem faced by farmers across the country.

One-time application of fertilisers is practised by farmers instead of the recommended split doses at critical stages—at sowing, at square formation and at peak flowering stage in the case of cotton—and these practices would have implications for crop yield.

As regards pesticide, it is clear that Endosulfan is the most popular pesticide and it is one that is even used against red leaf disease. This is an erroneous practice and one that will have no effect in controlling the disease. This is because red leaf curl is not the result of a pest attack. Red leaf curl is the symptom of a physiological disease which occurs due to nutrient deficiency, and the correct control measure is spraying of the deficient nutrient. Mixing of different groups of pesticides is also another incorrect practice which is common across farmers. Even where certain groups of pesticide can be mixed, unless the dilution rate is as per the recommendation the mixture can result in detrimental effects.

Our observations on farmers' practices with regard to pesticide application do suggest that there is a problem of lack of awareness of correct practices among farmers, as illustrated using Tables 27 and 28.

Yield of cotton, red gram, and soyabean, during the *kharif* season of 2007–08, as reported by farmers is provided in Table 29. By and large, all farmers have reported a higher yield of cotton compared to the district average while that is not the case with soyabean. The progressive farmers we met—Respondent 8 in Lonsawali and Respondent 8 in Kosurla—have reported yield that are higher than the district yield with regard to cotton and soyabean. There is very high intra-village variation in reported yields, a factor that is largely related to quality of soil in Lonsawali and the problem of flooding of fields and lack of drainage in Kosurla. The majority soil

Table 27 Pesticides Used by Respondents in Soyabean Cultivation, 2007-08

Village Name	Respondents	Size of Operational Holding (2007–08) (in acre)	Name of the Pesticides
Lonsawali	1	2.5	None.
	2	3	None.
	3	4.5	None.
	4	5	Endosulfan
	5	6	None.
	6	9	None
	7	17	None.
	8	18	Endosulfan and Pursuit
Kosurla			
	1	3.5	None.
	3	4.75	None.
	4	6	Pursuit and copper powder
	5	8	Endosulfan ,Metasystox® Copper Powder.
	6	8	None.
	7	22	Pursuit®
	8	28	Whip super®, Kloben®, Endosulfan/Roger®, thiomethoxam.
	9	36	Pusuit and Targa super®. Avant® and a mixture of Biozyme and Endosulfan used on red gram.

Notes: *1. Avant is the only pesticide used for red gram which is intercropped with soyabean. One of the farmers, Respondent 9 in Kosurla, uses Avant and a mixture of Biozyme and Endusulfan on red gram.*
2 Respondent 9 of Lonsawali has not been included in the table, as no information was available on pesticide usage on his field.
3. Respondent 2 in Kosurla has not been included as he lost his entire soyabean crop to flooding, and we do not have complete information on the pesticides he used for soyabean.
Source: *Field Survey Lonsawali, March 2008 and Kosurla , May 2008*

type in Lonsawali is light black soil which is very low in organic carbon content, has low cation-exchange capacity, and very poor water-holding capacity.

2.3. Concluding Observations

Our study of Lonsawali and Kosurla clearly indicate the need to undertake soil- and water-conservation activities in order to minimise crop-loss incurred by farmers. All the ten farmers we interviewed in Kosurla and three out of ten farmers in Lonsawali had encountered problems of waterlogging and lack of drainage leading subsequently to crop-loss. Further, the quality of soil, particularly in Lonsawali,

Table 28 Pesticides Used by Respondents in Cotton Cultivation, 2007–08

Village Name	Respondents	Size of Operational Holding (2007–08) (in acre)	Name of the Pesticides
Lonsawali	1	2.5	Endosulfan and Monoseal
	2	3	None
	3	4.5	Endosulfan and Monocrotophos
	5	6	Endosulfan
	6	9	Endosulfan and Monocrotophos
	7	17	Magnesium sulphate, Confidor, Aggressor, Spruthi tonic
	8	18	Confidor, Endosulfan, and Avant
Kosurla			
	1	3.5	Endosulfan and Confidor
	2	4	Endosulfan
	3	4.75	Endosulfan
	5	8	Endosulfan ,Metasystox® Copper Powder.
	6	8	Endosulfan and Metasystox ®
	7	22	Endosulfan, Metasystox®, Ecalyx, Quinalphose

Notes: *1. Avant is the only pesticide used for red gram which is intercropped with cotton. One of the farmers, Respondent 2 in Kosurla, uses Endosulfan on red gram in addition to cotton, and Respondent 8 in Lonsawali uses Avant on both cotton and red gram.*
2. Respondents 4 and 9 of Lonsawali village have not been included for lack of complete information.
3. Respondents 4 and 9 of of Kosurla have not been included since they have not taken cotton in their field.

Source: *Field Survey Lonsawali, March 2008 and Kosurla , May 2008*

is poor and requires soil fertility enhancing measures. Need for soil- and water-conservation measures have increased further with the tendency of farmers to convert waterlogged areas where dry-*rabi* crops were grown earlier into *kharif* cultivation. Desilting of waterways close to the fields as well as initiation of other appropriate measures, it appears, would go a long way in minimising the loss incurred by farmers.

Our analysis of cultivation practices adopted by farmers indicates that farmers do not get any help or guidance from the state agricultural extension machinery. Advice regarding crop practices is received by farmers only from private shop-owners dealing with agricultural inputs. There are several areas where farmers require advice: land preparation, selection of seeds, timing of sowing, type and quantum

Table 29 Yield of Major Crops in Lonsawali and Kosurla

Name of the Village	Respondents	Yield of Crops (kg per acre)		
		Cotton	Soyabean	Red gram
Lonsawali	1	104 (100)	200 (35)	120 (24)
	2	NA	260 (43)	2
	3	20 (19)	300 (50)	33 (7)
	4	750 (721)	800 (133)	100 (20)
	6	400 (365)	457 (76)	300 (60)
	7	480 (462)	500 (83)	175 (35)
	8	300 (288)	800 (133)	100 (20)
Kosurla	1	280 (269)	570 (95)	57 (11)
	2	160 (154)		120 (24)
	3	200 (192)	280 (47)	72 (14)
	4		580 (97)	160 (32)
	5	350 (337)	340 (57)	110 (22)
	6	100 (96)	300 (50)	117 (23)
	7	517 (497)	359 (60)	25 (5)
	8	243 (234)	700 (117)	64 (13)
	9	–	527 (88)	100 (20)

Note: *Figures within parentheses are indices with respect to average yield of Wardha District in 2007–08*
Yield in kg per acre of cotton is 104, soyabean 600 and red gram 500 in the district.
Source: *Field Survey Lonsawali, March 2008 and Kosurla , May 2008*

of fertiliser to be used, identification of pests, decision on appropriate pesticide etc. Total lack of advice on any of these aspects result in faulty and inappropriate use of techniques such as application of Endosulfan to arrest red leaf curl or sowing retained seeds of hybrid cotton etc. by the farmers so that the efforts taken by them often do not bring desired results. Even the method of conservation of farmyard manure leaves much to be desired, and there is plenty of scope for simple scientific interventions that would help farmers in retaining the nutrient value of farmyard manure. Moreover, in an area where soils have so many inherent deficiencies, a proactive role by the state in arranging for systematic soil testing and provision of advice on that basis would have helped farmers in choosing the appropriate mix of fertilisers.

Lands that are close to the mountain ranges, in particular, Lonsawali, face the risk of crop-loss incurred by wild animal attack. Wild animals such as blue bull and wild boar come during the nights and either eat the crops or trample and destroy them. These animals come in groups of ten or fifteen but run away if loud noises

are made. Some farmers have erected shelters that stand on stilts in their fields and spend the nights in these shelters with a hope of chasing away the animals by making loud noises

Apart from bringing out the importance of soil and water conservation activities and the need to revive and strengthen the agricultural extension machinery, our study of the two villages also corroborates some of the other findings of secondary data analysis pertaining to Wardha District. For instance, decline in area under cotton, sorghum wheat, and gram and increase in area under soyabean observed in the district as a whole is happening in our study villages too. While an important finding of our analysis of land-use pattern of Wardha District, namely, decline in net sown area and increase in fallow, needs to be studied more carefully at the village level, our preliminary analysis indicates that farmers with large land holdings have left part of their cultivable land fallow for various reasons.

Section 3

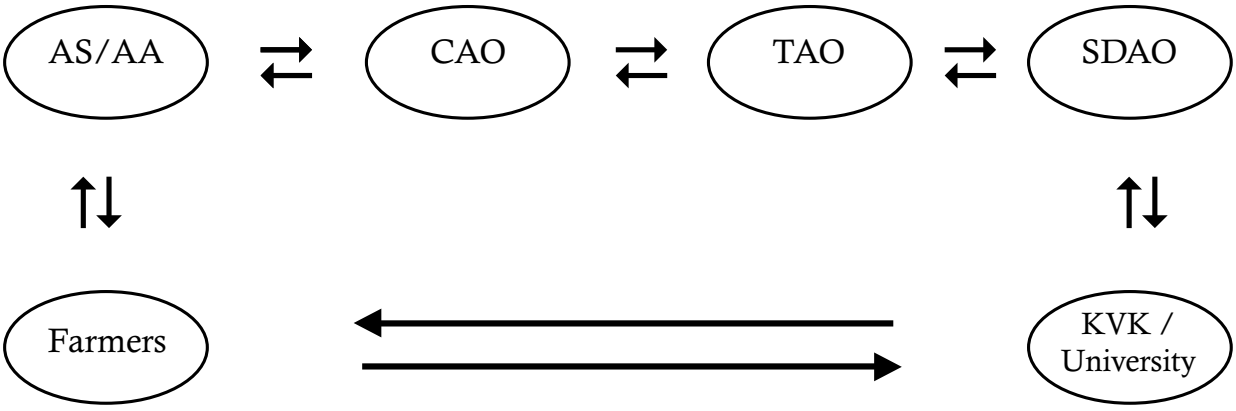
Agricultural Extension and Research

3.1 Agricultural Extension[41]

The agricultural extension system plays a crucial role in facilitating the various decisions farmers make during a crop cycle. The pathways of flow of information from scientists to farmers and vice versa, in the state of Maharashtra, are broadly as shown in Figure 9.

As discussed earlier (Section 1.7 and Tables 14 and 15), the organisational structure of the Department of Agriculture in Maharashtra has been revamped and a single window system is in vogue since 1998. In the section that follows we shall elaborate the implication of the changes in the organisational structure of the department to agricultural extension activities.

Figure 9 : Pathways of Flow of Farmers' Queries and Scientists' Solutions in the Extension System



Note: *List of abbreviations*

AS/AA	:	*Agricultural supervisors/assistants*
CAO	:	*Circle agricultural officers*
TAO	:	*Taluk agricultural officer (after the single window system)*
SDAO	:	*Sub-divisional agricultural officer*
KVK	:	*Krishi Vigyan Kendra.*

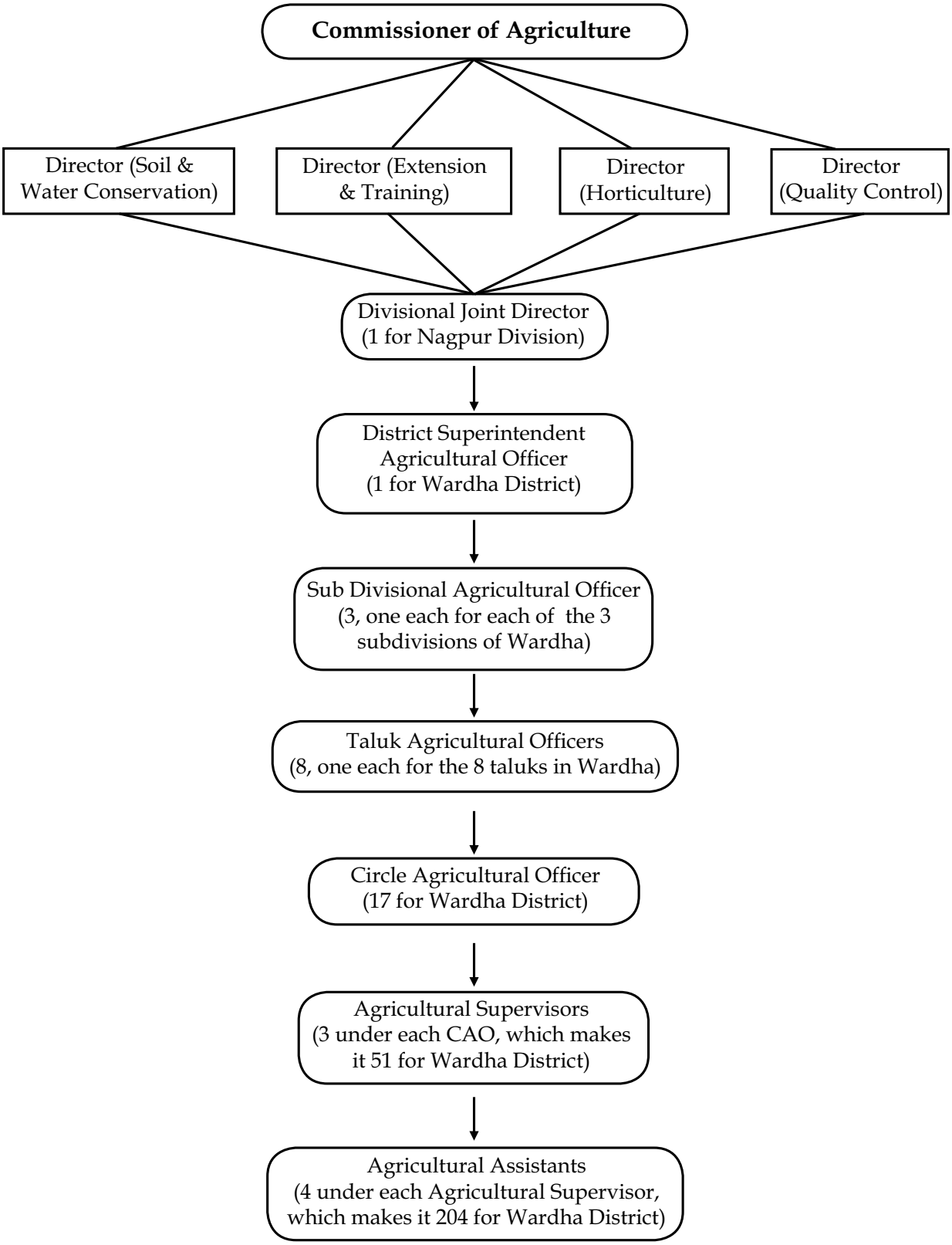
41 This section is based on the interaction with the staff in the Department of Agriculture, Wardha District.

3.1.1. Structure and Functioning of the Agricultural Extension System Prior to the Single Window System

Prior to the single window system, agricultural extension activities were managed by a Director of Extension at the state level below the Commissioner of Agriculture. There was a Divisional Joint Director Agricultural Extension (DJD (AE)) one for each division namely Aurangabad, Amaravati, Konkan, Nagpur, Nashik, and Pune. Under each of these divisional joint directors there was one Principal Agricultural Officer (PAO), for each district in the division. For Nagpur division there were around six PAOs, one each for Bhandara, Chandrapur, Gadchiroli, Gondia, Nagpur, and Wardha districts. At the sub-divisional level, there was the Sub-divisional Agricultural Officer (SDAO) for each of the sub-divisions in a district. Wardha District comprises three sub-divisions, namely, Arvi, Wardha, and Hinghanghat. But the Extension Department had only two sub-divisional agricultural officers in Wardha district namely in Wardha and Hinghanghat sub-divisions. At the sub-divisional level each officer had the services of four subject matter specialists (SMS). The subject matter specialists were from diverse fields like Agronomy, Horticulture, Entomology, and Pathology and would provide relevant advice in their respective areas of specialisation. At the circle level, there were thirteen agricultural officers in Wardha District. These officers had no separate office space and they would mostly sit in the office of the Gram Panchayat or the Farmers' Marketing Cooperative Societies, and hence were easily accessible to farmers. At the village level, each circle agricultural officer had a maximum of eight Agricultural Supervisors/Assistants working under them. Totally, there were around 104 agricultural supervisors/assistants in Wardha District exclusively to carry out agricultural extension work at the village level. On average, each of them interacted with eight contact farmers who in turn disseminated the agricultural advice to other farmers.

The Circle Agricultural Officer (CAO) would have the complete list of villages and contact farmers that each Agricultural Supervisor/Assistant was supposed to handle. The days of the visit of the Agricultural Supervisor/Assistant to each of the villages of which he is in charge is fixed, and the work of the Agricultural Supervisor/Assistant is monitored and cross-checked by the circle officer, based on this list. The extension work that was carried out mainly dealt with cultivation practices such as suggestion of sowing time and spraying time; suggestions on tackling pest and disease problems; and suggestions on input use, for example, seed variety to be used, the fertiliser dosage to be given, the pesticides to be sprayed etc.

Figure 10: Structure of Field Staff under Single Window System



The Agricultural Supervisors/Assistants also facilitated soil sample testing of the farmers' field. In addition to this, the Agricultural Supervisors/Assistants would also monitor the adoptive trials of the State Agricultural Universities (SAUs)[42] carried out through the contact farmers. The Agricultural Supervisors/Assistants were given a permanent travel allowance (PTA) of Rs.350/month and the CAO was given a travel allowance of Rs.500/month for their field visits.[43]

Every Monday, a meeting of the CAO and the Agricultural Supervisors/Assistants was held, and in this meeting the Agricultural Supervisors/Assistants would discuss those field-level problems faced by the farmers to which they were not equipped to give a readymade solution. The CAO would educate them on the guidelines of any new schemes that had come for implementation, or give updates on the new technologies available in farming. The CAO would also assign the new schemes to be implemented and other work to be carried out by each of the Agricultural Supervisors/Assistants for the week. The CAO apprises the SDAO about the field-level problems to which the Agricultural Supervisors/Assistants were unable to provide a solution.

A fortnight after this, a workshop would be held at the State Government Farm which is popularly referred to as the Taluk cum Demonstration Trial. It is at this Taluk cum Demonstration Trials that new varieties of PKVK, Akola, and the Maharashtra State Seed Corporation Ltd were raised on trial before their official release in the district. The fortnightly workshop would be attended by the sub-divisional agricultural officers, subject-matter specialists, circle agricultural officers, the agricultural supervisors /assistants, scientists from the State Agricultural University, and the experts from the Krishi Vigyan Kendra (KVK). In this meeting, the SMS and the scientists would give solutions for the problems raised by the field staff. If necessary, the scientists and SMS would visit the villages along with the field staff and suggest solutions. The University scientists even gave their adoptive trials to be implemented by the agricultural assistants through their contact farmers.

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42 The Directorate of Extension Education of SAUs plans, organises, and coordinates extension activities through the Farm Advisory Service, Farm Training Service, and Farm Information and Communication Service. The Farm Advisory Service is responsible for transfer of technology by organising monthly zonal workshops for field extension workers and to discuss problems faced by field staff and offer possible solutions. The SAU assigns a fixed team of scientists to each district to provide consultation service for the Department.

43 The allowance is with reference to the period that immediately precedes the introduction of Single Window System in 1998.

In sum, the agricultural extension system that prevailed till 1998 entailed a very close interaction between the extension workers at the village level and the farmers.

3.1.2. Structure and Functioning of Agricultural Extension System: Post Single Window System

As discussed earlier, the introduction of a Single Window System in 1998 in the department of agriculture meant that the three major wings of the agricultural department, namely, soil and water conservation, agricultural extension and horticulture, were merged. This merging happened only at the level of field staff, while the office staff continued to work as independent wings. The flowchart, in Figure 10, describes the structure under the single window system.

Under this system, staff members were expected to carry on all the activities of all wings and no longer were there specialised staff to carry out specific activities. Every staff member in the agricultural department was expected to do every activity ranging from soil and water conservation to horticulture and agricultural extension. Another change in the organisational structure is the creation of the posts of taluk agricultural officers (TAO) at the taluk level and the removal of the posts of subject-matter specialists at the sub-divisional level. In the new structure, the subject-matter specialists were absorbed as taluk agricultural officers. This change in the structure of the agricultural department has important implications for the quality of extension work that could be carried out. The subject-matter specialists who were exclusively providing extension support in their respective subjects no longer have the responsibility to do so. Moreover, the agricultural supervisors/assistants who are responsible for village-level agricultural extension have the additional responsibility of implementing various government schemes and subsidies. As a result agricultural supervisors/assistants spend their working hours pushing these schemes, and has practically no time or incentive to carry out any agricultural extension work. In addition to this, while reporting on the progress of their extension work, the agricultural department field staff are required to make separate reports for the different wings of the agricultural department: soil and water conservation, extension, and horticulture. These requirements have increased the burden of paper work and there is very little time available for the field staff to carry out agricultural extension activities in the villages.

Another major change is with regard to the travel-allowance settlement for field-based work. Prior to single window system agricultural supervisors/assistants were given a permanent travel allowance of Rs.350/month and the circle agricultural

officer was given a travel allowance of Rs.500/month for their field visits. With the introduction of single window system, the permanent travel allowance given to the circle officer and village-level agricultural assistants and supervisors has been discontinued. This has been replaced by a system that entails reimbursement of a specific allotted amount of travel claims against submission of bills. The system of travel claim settlement is seen to be very cumbersome as it involves delay in reimbursement. In effect, this results in fewer visits to villages by the field staff. Further, while the Department of Agriculture, Wardha District has an allocation of nineteen vehicles (jeeps), only ten were available by late 2008. Only taluk-level officers and their superiors are eligible to use the Department jeeps. Neither the circle agricultural officer nor the agricultural supervisors/assistants who work at the village level are provided any kind of transport facility. The other major change is with regard to abandoning the concept of contact farmer which had an important role in technology dissemination at the village level.

3.2. Agricultural Research

Contribution of the State Agricultural University to Agricultural Development in the Vidarbha Region of Maharashtra:

Dr. Panjabrao Deshmukh Krishi Vidyapeeth, headquartered at Akola was established on 20 October 1969. The jurisdiction of the 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 along with breeder and foundation seed programme.

A central research station is situated at the main campus which undertakes research on the principal crops of the region, namely, cotton, sorghum, oilseeds, and pulses. The University has developed and released about eleven varieties of cotton from 1975 to 2006, DHY-286, AKH-8401, AKA-7, AKA-8, and PKV-DH-1, to name a few, and four hybrids of cotton, PKVHy-2, PKV Hy-3, PKV Hy-4, and PKV-Hy-5 between 1981 and 2002. From 1988 to 2006, one improved variety of sorghum, and seven hybrids of sorghum, CSH-14, SPH-388, SPH-840, CSH 19R, and SPV-669, have been developed and released for commercial cultivation. Four red gram varieties and three soyabean varieties (two with collaborative research with BARC, Trombay, namely TAMS-38, TAMS-98-21) and six gram varieties have been released by the University. A large number of varieties have been developed and released in paddy, wheat, maize, pulses, and oilseeds.

Box 1: Insecticide Resistance Management: A Model of Successful Research–Extension Linkage in Technology Delivery to Cotton Farmers of Vidarbha Region

Pest and disease attack are two of the major constraining factors of cotton production. Cotton is affected by about 166 different species of insect pests at various stages of its growth right from germination till harvesting. The cotton boll worm, *Helicoverpa armigera*, the pink boll worm, *Pectinophora gossypiella,* white fly *Bemisia tabaci,* and Jassids, *Empoasca devastans* cause economic damage to the crop.

Cotton farmers usually resort to chemical control of pests by spraying insecticides. Farmers indiscriminately use systemic insecticides to control the sucking pests, and boll worm control is attempted with all groups of insecticide. Overuse and misuse of insecticides result in grave problems like secondary pest outbreaks of white fly and aphids; development of resistance to insecticides/ pesticides by pests, as was exhibited by *Helicoverpa armigera;,* and also ecological, environmental, and health hazards. The overuse of insecticides on the one hand result in increasing the cost of cultivation of cotton, and on the other the ineffectiveness of these insecticides to control the target pests, leading to crop losses.

Cotton pest management was at crossroads and the farmers suffered from the twin tragedy of increased cost of cultivation on the one hand and complete crop failure to reduced output on the other. The situation called for the adoption of a unique method of pest control which advocated the use of insecticides in a manner that is effective for insect pest management and at the same time is environmentally compatible too. The most immediate and logical step towards this was to address the issue of insecticide resistance and stop the indiscriminate use of insecticides. Taking into consideration all these issues, the Central Institute for Cotton Research (CICR), Nagpur, an Indian Council of Agricultural Research Institution, took a lead and introduced the technology of Insecticide Resistance Management (IRM) in cotton.

Insecticide Resistance Management (IRM) in Wardha

IRM was first introduced in Wardha district in the year 1998, for a period of three years from 1998–2001. The disseminating agency of the technology was the Grameen Tantra Niketan, a Community Polytechnic based at Pipri, Wardha with the collaboration and technical guidance of CICR Nagpur. The programme covered around 1200–1500 ha of cotton area of 650 farmers for three years from 1998-2001. Karanji-Bhoge, Karanji-Kaji, Dindoda, Tuljapur, Nagapur, Takali-

Kite, Digras, Zadegaon, and Belgaon constitute the IRM villages in Wardha. The dissemination of the technology was carried out as a farmers' participatory programme in nine villages of Wardha district. The farmers were assisted in cotton pest management throughout the cropping season by conducting regular meetings, imparting knowledge on IRM strategies and insecticide use. There was an effort to include the whole farm family in the individual farm level implementation of the technology. Participation of children was ensured by roping in the schools, and the participation of women in the programme was ensured through SHGs.

Table 30 Impact of the Programme in Wardha District (2002–03 to 2006–07)

Sl No.	Details	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
1.	No. of taluks	2	2	6	5	4
2.	No of villages	11	21	25	41	68
3.	No of farmers	120	221	1351	2370	2203
4.	Area in ha	53	94	994	2490	3048
5.	Percentage reduction in spray	57	71	61	75	79
6.	Per ha saving spraying cost over non IRM villages	NA	292	1810	1341	1080

Rationale of IRM Technology

About 1326 species of insects have been recorded on cotton. These include harmful ones such as insect pests and beneficial ones, as for example, the natural enemies that feed on the insect pests and keep their population below economic threshold levels under pesticide-free situations. IRM aims to control the pest population by protecting the beneficial insects that feed on them, and also by minimal use of insecticides, at times when the harmful insect population crosses the economic threshold level (ETL). IRM also modified the scouting technique to make it more farmer-friendly. Instead of going by the count of the insect population IRM arrives at ETL by scouting for the symptoms of pest attack on the plant population. In this method, levels of 50 percent infested plants during peak square phase and levels of 90 percent to 100 percent infested plants during the peak boll formation phase are considered as ETL for the use of the conventional insecticides.

Source: *Narula A.M; K.R.Kranthi; S.K.Banerjee et al. 2001*
Sharma, Atul 2008

Under its breeder and foundation seed programme, the University supplies breeder seeds to Maharashtra Hybrid Seed Corporation as well as to other private seed companies to facilitate large-scale production of foundation and certified seeds. Over the period 2004 to 2007, on average 667 quintals of breeder seed and 282 quintals of foundation seed of soyabean were produced per *kharif* season by the University. As regards cotton, 82 quintals of breeder seed and 229 quintals of foundation seed of improved cotton and 6 quintals of breeder seed and 72 quintals of foundation seed of hybrid cotton were produced over 2004-2007 per *kharif* season.

The University offers a host of products and services to farmers in Vidarbha. Seeds, grafts, biofertilisers, and biopesticides are some of the commodities supplied by the University to farmers. The University also provides a range of services: laboratory services which provide scope to test soil, water, biofertiliser etc; agricultural extension services; and consultancy services on, say, food processing or watershed development or irrigation development etc. The University also gives recommendations on thematic areas like integrated nutrient management, integrated pest management, soil and water conservation etc. for the different crops grown in Vidarbha. In addition to this, the University also provides very detailed recommendations—the package of practices—for the major crops of the region cotton, soyabean, and tur as well as other minor crops. The agricultural engineering department of the University has developed a large number of useful farm machineries.

In the wake of the agrarian crisis in the Vidarbha region, the University has implemented in the year 2006, a programme titled, 'Hope Generation Programme' in the eleven districts of Vidarbha region of Maharashtra with the intention of boosting the farmers self-confidence. In the first phase of the programme, the Directorate of Extension of the University, organised a large number of scooter and motorcycle rallies in Vidarbha. In the second phase of the programme, seminars and exhibitions were also organised for the farmers in the region. The seminars were attended by experienced farmers, social workers, journalists and media-persons, and specialists in the field of agriculture and other allied fields. The state-level mega exhibition called 'AGROTECH -2006' was organised by PDKV, Akola. Farmer–scientist interactions were also organised. The farmers and the scientists discussed problems and difficulties in cotton soyabean, pulses, oilseeds, horticulture, processing, and post-harvest technologies. The University felicitated thirty-five progressive farmers in this occasion. The University has also formed

a committee to study the socioeconomic status, causes of suicide of farmers, and remedies thereon. The committee has submitted its findings to the University. Through this programme, the University scientists came in direct contact with 14 lakh farmers of Vidarbha region. Besides this, scientists were able to reach farmers through radio and television talks, and publication of books and literatures. The University has conducted as part of this programme 175 radio talks, 82 TV talks, published 17 books, 122 extension literature, 533 popular articles, and 152 newsletters. Shown in Box 1 is a brief note on insecticide resistance management.

3.3. Concluding Observation

The state-run Agricultural University in Vidarbha has created a huge knowledge bank of tremendous amount of region-specific and crop-specific recommendations over the years. Given that the University does not have a mandate to be directly engaged in farmer extension activities, it is necessary that concerted efforts are taken to transfer the relevant knowledge to farmers. There is an urgent need for a better research–extension linkage in the region. Mere revamping of the Agricultural Department to the single window system has not helped in improving the agricultural extension services available to farmers and has in fact diluted and weakened the nature of services available**.** Even significant initiatives such as the 'Insecticide Resistance Management' in cotton that goes a long way in reducing the cost of cultivation do not get adopted on a much wider scale. It is therefore necessary to provide for a better 'extension officer-farmer ratio' in the region.

Section 4
Recommendations

A large number of studies have analysed the problems encountered by farmers in the agricultural distress hotspots of the country. Various dimensions of the problem-economic, social and psychological- have been studied and policy interventions have been suggested. Our attempt, as discussed earlier, is to focus on technological constraints faced by farmers in the district of Wardha and our recommendations relate largely to this aspect.[44]

4.1. Long-term Measures

4.1.1. Adoption of a System that Conserves Soil and Water Resources

A farming system that aims at reducing runoff thereby maximising water storage in the soil and minimising soil erosion is the need of the hour in the district. Soil loss due to erosion is estimated to be quite high in Wardha District. About 90 percent of the geographical area of Wardha District is subjected to a level of soil erosion that is beyond the permissible limit. After accounting for the maximum permissible limit of soil loss, of 10 tonnes per hectare per year, the extent of soil loss in the district due to erosion is estimated to be of the order of 19.6 lakh tonnes per annum. Soil erosion results not only in soil degradation and reduction of soil depth in areas where erosion occurs but also results in silting of water bodies. Further, on integrating the effective rainfall of the district with the water holding capacity of the soils, the runoff is estimated to be quite substantial—3550 cubic metre of rain water per hectare per annum—in Wardha District. The rainfall pattern during south–west monsoon, the lifeline of agriculture in Wardha District, over the years 1966–2006, shows a declining trend. Moreover, in the district as a whole there has been a shift away from cultivation of dry-*rabi* crops such as wheat and gram to cultivation of soyabean and tur in *kharif* season. Dry *rabi* crops in Wardha were usually grown on waterlogged areas after the cessation of rains and using the moisture in the soils. With the introduction of soyabean, farmers have been cultivating soyabean, in *kharif*, even on lands that are prone to flooding. Extensive loss of standing crops often occurs when fields get flooded and waterlogged. It is therefore necessary that suitable soil and water conservation measures that would help in recharging should be undertaken.

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44 A major lacuna in our study is the absence of any attempt to relate the policies associated with economic reforms to the current crisis in agriculture in Wardha.

An analysis of soil characteristics of Wardha District reveals that the soils of Wardha suffer from inherent chemical, physical, and microbiological drawbacks that call for appropriate ameliorative measures to ensure better crop productivity. There has been an increasing tendency for farmers to keep land out of cultivation. in the district. The enormous extent of land that remains uncultivated and kept fallow has serious implications for soil erosion. Fallow lands are more prone to erosion losses due to runoff. Land is often kept out of cultivation due to (a) low levels of productivity of land, (b) inability of farmers to invest on land, say to remove boulders or to clear bushes or weeds, and (c) inability of farmers to stay in the villages and undertake cultivation. Funding for development of such lands is a possible step that may help in bringing land under cultivation. Other measures such as growing of green manure or other plants need to be encouraged by the Department of Agriculture by giving incentives to farmers. Such measures would not only contribute towards sustainable agricultural practices but also help in addressing the problem of increasing fallow lands.

Wardha District suffers from a paradox of scarcity among plenty as far as water, one of the most important resources for sustainable agricultural growth, is concerned. Wardha indicates an assured rainfall pattern with an annual mean rainfall of 1041.1 mm, which is on par with the national average of 1170 mm. But when one looks at the spatial distribution, this district receives almost 85 percent of this rainfall during the four months—June to September—the south west monsoon season. In this context lack of an adequate number of water conservation structures have resulted in crop failures due to flooding and water logging of fields during the *kharif* season on the one hand and lack of availability of water for cultivation during the *rabi* season. Moreover, the extent of area under irrigation is closely related to the rainfall pattern which means that whenever rains fail availability of irrigation also suffers. This is yet another reason why water conservation activities that would help in ground water recharging should be undertaken in Wardha District.

4.1.2. Completion of Pending Irrigation Projects

In Wardha District, the extent of area irrigated as a percent of net sown area is very low. Just about 7 percent of net sown area receives irrigation in 2001–02. While number of major, medium, and minor irrigation projects have been planned in Wardha District, it is alarming to find a huge gap between irrigation potential planned and irrigation created. Only one-fourth of surface irrigation potential that has been planned has actually been created. Further, of the irrigation capacity

created only one-third is actually utilised. The abysmal performance on the surface irrigation front is combined with stagnancy in well irrigation. Not only is the extent of area under irrigation low but the growth in irrigated area has been very minimal over the years. It is therefore absolutely essential to concentrate on expansion of irrigation. This is further necessary given that fluctuation of crop yields is relatively larger in Wardha District for all the four important crops,: soyabean, cotton, red gram, sorghum. Availability of irrigation would help in stabilising crop yields.

4.1.3. Adoption of an integrated crop-livestock farming system approach

Soyabean has become the single, most-important crop in the district of Wardha, replacing another major cash crop of the region, viz. cotton. In order to make the shift to soyabean sustainable for the farmers, economically and ecologically, it is important to adopt an integrated soyabean-livestock farming system approach. Livestock has always played an integral role in the agricultural system of Wardha District. A large number of agricultural operations continue to depend on animal power in Wardha District and further livestock is an excellent income supplement with cash flows on a daily or weekly basis. A shift to an integrated crop–livestock approach would ensure continued feed supply for the animals and thereby arrest the declining trend in the livestock population. Soyabean husk is a nutritive animal feed.

Another advantage of integrated crop–livestock approach would be the availability of farm yard manure. Application of farm yard manure for enriching the soil is an age-old practice in India, and its importance is being strongly recommended by the proponents of organic farming in the recent years. According to the Livestock Census, Wardha District records an absolute decline in bovine population. In 1997, 5.8 lakh bovines were counted in Wardha District, and it declined to 4.05 lakhs in 2003. Assuming that 80 percent of farm yard manure comprises animal dung, the decline in animal population is a serious concern. Assuming that a bovine produces 5.5 kg of animal dung per day and that 80 percent of farm yard manure is animal dung, our calculation indicates that there is an enormous short supply of animal population to meet the demand of 7.5 tonnes of farm yard manure per hectare per annum. For the year 2003, only one-third of the dung requirement can be met by the available animal population. Considering the shortage of animal population and the tendency for animal population to decline over 1997–2003, it is imperative that support is provided by the government to rear bullocks and cows in order that a crop-cum-livestock integrated approach may be practiced in Wardha District.

Given that vast areas are left fallow by the farmers, the government can take the initiative to identify the fallow lands and organise cultivation of fodder crops and green manure crops.

4.1.4. Restructure Agricultural Services

a. Agricultural Extension

There is an almost complete absence of extension services with regard to advice or guidance on agricultural practices. Several instances were noticed where proper technical advice would have either prevented or reduced crop loss incurred by farmers:

- Cultivation of Bt cotton crop using retained seeds;
- Mixing and spraying of different groups of pesticide, a common practice followed by farmers, will result in physical, chemical, or phytotoxic incompatibility when the mixture is not prepared as per the recommended dilution rate and will lead to detrimental effects such as scorching and drying of plants and building up of pesticide resistance by target pests. Farmers need proper technical advice on these issues.
- The use of pesticides for a physiological disease like red leaf curl was noticed. But red leaf disease is a physiological disease which is the manifestation of nutrient deficiency and this can be corrected only by spraying the deficient nutrient. While there seems to be varying claims of the cause of the red leaf disease even among the scientific community, it is important that farmers receive proper guidance.
- It was observed that farmers use much less than the required quantity of fertilisers and do not often use the correct mix of fertilisers indicating the need for appropriative advice.

Thus, several examples can be given where lack of proper knowledge leads to incorrect cultivation practices resulting in lower yields and crop loss.

There is an urgent need to have a more effective agricultural extension system. Staff members working in the agricultural extension wing are over-burdened with clerical work and have little time to visit farmers' fields and guide farmers in agricultural practices. Nonrecruitment of staff and restructuring of staff positions in the recent decade has weakened the services of agricultural extension wing further. The only source of advice to farmers is the private input dealers. An extension

system that is much more dynamic and mobile is urgently needed. Allocation of separate staff for soil and water conservation activities and for general agricultural extension activities should be reintroduced. Extension service should also make sure that agricultural machineries developed in the universities and national institutes reach the farmers.

b. Input Supply

Using good-quality inputs is a fundamental requirement for reaping a good harvest and the importance of timely availability of quality inputs for agricultural development need not be stressed. Making available soyabean seeds to farmers at subsidised rate through the agricultural department, as part of the Prime Minister's National Relief Fund, has been an extremely useful intervention. On the same lines, if farmers can be given an assurance of supply of seeds, fertilisers, and pesticides, as well as non-chemical inputs such as bio-fertilisers and bio-pesticides, it would go a long way to revive agriculture in the district. The point made earlier regarding augmenting supply of farm yard manure and green manure need to be taken note of in this context. Scarcity of urea in Vidarbha region, for the *kharif* season of 2008, has been widely reported in the media. The present status of agriculture warrants a complete revamping of the agricultural extension system combined with a commitment from the government for supply of appropriate inputs at subsidised rates to farmers.

4.1.5. Crop Insurance

As regards crop insurance, a number of studies have recorded the abysmally low number of farmers who use this facility. In the existing scheme of Crop Insurance, when a farmer suffers crop loss he becomes eligible to get compensation only when his crop loss coincides with a shortfall in yield at the taluk level. That is, while insurance premium is collected on an individual basis, the loss is compensated only when the loss is widespread and reflects on the taluk level yield. This suggests that when a farmer suffers from crop loss because of flooding of his field or due to wild life menace or problems of pests and diseases of crops that are not widespread, he can have no hope of receiving any compensation. Therefore, a comprehensive crop insurance scheme that compensates a farmer for his crop loss irrespective of whether or not there is a general crop failure has to be conceived and implemented. In this context it is important to note, the significant intervention made by the Government of Andhra Pradesh with respect to crop insurance in the state. The village, instead of taluk, is taken as the 'Insurance Unit' since 2005 *kharif* in Andhra

Pradesh. This change in the unit of insurance has benefited a large number of farmers in Andhra Pradesh.

4.2. Short-term Measures

4.2.1. Provision of Soil Health Cards

Knowledge on the health of the soil in their fields is extremely crucial for farmers to apply appropriate quantity of organic and chemical fertilisers. Soil variability within the village and across villages is relatively high in Wardha District. Further, large extent of soils in Wardha District have several inherent deficiencies such as low level of availability of macro- and micronutrients; problems of phosphorous fixation, soil erodability; etc. Therefore, the required combination of fertilisers would also vary from field to field. It is very important that every farmer is provided a soil health card specific to his land in order to facilitate balanced nutrient application to the soil. In order to do this, it is absolutely essential to carry out soil testing. On the basis of the results of a soil test, farmers should be advised suitably. The exact advice may range from simple measures such as ploughing back crop residues or adding more organic matter to the soil to more complicated measures such as applying gypsum to address the problem of alkalinity etc. The Government, in addition to investing in adequate number of soil-testing laboratories and upgrading the existing soil testing laboratories, should also invest in mobile soil testing laboratories. These interventions would enhance the awareness among the farmers of their land-specific physical, chemical and microbiological properties of soil. This would enable farmers to adopt appropriate corrective measures to improve soil fertility and thereby increase crop productivity on their land.

4.2.2. Water-Harvesting Measures

Number of examples for successful community managed water harvesting mechanisms is available within the state of Maharashtra**.** Water-Conservation and harvesting initiatives taken by social activists such as Anna Hazare and Poppat Pawar in different parts of Maharashtra have brought about fundamental changes in their areas of intervention. Considering the enormous possibilities for conserving rain water in Wardha District, it is important to have a mission-mode approach towards water-conservation programmes. A farmer-to-farmer learning system can be emphasised and farmers from different villages may be taken on a field visit to the sites that have developed model water-harvesting structures in order to create awareness.

4.2.3. Adoption of Varieties/Hybrids released by Public Research Institutes

The Central Institute for Cotton Research, Nagpur the leading regional research station established by ICAR has developed a Bt cotton variety. This variety has received the approval of Genetic Engineering Approval Committee (GEAC) for commercial release. This variety of Bt cotton, Bikaneri Narma (BN-Bt) was developed by transferring the Cry1Ac event into the elite Indian G.hirsutum genotype, Bikaneri Narma. The release of this Bt variety would go a long way in cutting down on the cost of cultivation of cotton by reducing the seed cost as farmers can use retained seeds.

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has released red gram hybrids with a potential yield level of 3–4 tonnes per hectare. These hybrids- ICPH 3467 and ICPH 3340 of Maruti group and ICPH 3371 and ICPH 3491 of Asha group – have been successfully adopted in rainfed regions of Tamil Nadu where MSSRF has a presence. Adoption of these hybrids can be promoted considering the improvement in yield. As a measure to ensure supply of good-quality hybrid seeds, community-based seed production may be encouraged. Seed production activities may be promoted by self-help groups (SHGs) of women and men farmers. Production of seeds locally, say, by SHGs and development of seed technology at the community level would be an important initiative that would bring down farmers' dependence on the market and thereby reduce their risk and vulnerability. Thus, tapping technologies on the shelf for increasing productivity, profitability, and sustainability of the farming system of Wardha District should be aimed at.

4.2.4. Decentralised Support System

Considering that most problems have a local flair and have their specificities, it is important that problems are analysed and handled at the local level. Young men and women in villages can be trained to provide simple technologies needed by the farmers. There is lack of skilled manpower to provide simple soil and water conservation measures such as, say, bunding the fields. Barefoot practitioners who can be trained to provide simple technologies relating to soil and water conservation, preparation and preservation of farm yard manure, composting etc. would be a great help to farmers. Local agricultural colleges can offer certificate courses on simple farm technologies for the local youth. The certificate holders can then be recruited by the agricultural extension services of the state government. This step would go a long way in increasing the extent of adoption of simple technologies by farmers.

4.2.5. Village-Level Mini Agromet Observatory

Considering the decreasing trend of south west monsoon rain fall in Wardha District, farmers must be educated to adopt weather based farming decision in terms of crop planning and crop management of the sown crop. Though in India, IMD gives integrated weather forecast at district level it can not be applied at the village level. Hence a mini village-level agromet observatory may be established in Lonsawali where MSSRF has initiated a Village Knowledge Centre. The weather data collected through the agromet observatory could be related to observations made on field crop growth and many location specific thumb rules could be developed for taking weather-based farm decisions at the village level. This activity is being done in two villages, one each from Rajasthan and Andhra Pradesh, under the project Vulnerability Assessment and Enhancing the Adaptive Capacity of the Communities in Semi-Arid areas of India, by the MSSRF.

4.3. Other Issues

4.3.1. Wildlife Menace

The plight of the farmers due to destruction of crops by wild animals, such as blue bull and wild boar, is enormous in Wardha District. Farmers whose lands are close to the mountain ranges are especially at risk of loosing their crop because of wild animals. Intrusion of wild animals is often given as a reason for decline of sorghum in Wardha, as sorghum attracts wild life much more than other crops. This is a delicate issue that concerns the interests of farmers and wildlife. It is necessary that departments of agriculture, forestry, and environment come to a consensus on how to tackle the issue of destruction of crops by wild life.

4.3.2. Gender Mainstreaming of Programmes

Agricultural distress in the district of Wardha has an important dimension related to the issue of land rights to women. High levels of suicides among farmers (essentially men), continue to be reported in the district with an implication for the surviving widows and their families. To address these issues Nine Point Charter for Mahila Kisans was developed by MSSRF and adopted during the 95th Indian Science Congress in 2008. The nine-point charter is of relevance in the context of Wardha District and would help address the special needs of women farmers who are left behind. Specifically, the interventions can be in the following spheres:

- Title to Land: Joint pattas are absolutely essential for mahila kisans to get access to Kisan Credit Cards and institutional credit.

- Right to Credit: Both to individuals and to women self-help groups.

The following recommendations of the National Commission on Farmers to ensure better access to land for women may also be taken note of:

- Policy pronouncements that would facilitate direct transfer of government land to women.
- Improving inheritance rights of women.

All these measures, if implemented with a mission-mode approach, would go a long way in arresting the tendency to keep land fallow, in minimising crop loss, and making agriculture a viable activity in Wardha District. Funds available under various government programmes such as Rashtriya Krishi Vikas Yojana, Food Security Mission, Horticultural Mission etc. may be tapped to improve the agricultural situation in Wardha District.

When you observe a Wardha farmer who borrows money and cultivates for incurring either a negative balance or little profit, year after year, you are struck by the insight of Pearl S. Buck in her short story "The Refugee".

In her short story she describes a conversation between an urbanite and a Chinese peasant. The peasant is forced to leave his land which gets flooded by the river, moves into the town, and much to the surprise of the urbanite, he holds on to his silver in order to buy seeds rather than spend it on food though he was visibly hungry. The attitude of the peasant is beautifully captured by Pearl Buck as is evident from the following quotation:

'Sir, we have no seed left, even. We have eaten our seed. I told them, we cannot eat the seed. But they were young and hungry and they ate it... That [the silver] is for seed. As soon as I saw it, I knew I would buy seed with it. They ate up all the seed, and with what shall all the land be sown again?... Well, I know you cannot understand. But if you had land you would know it must be put to seed again or there will be starvation yet another year...'

The succinct description of the mindset of a Chinese peasant fits the Wardha farmer as well.

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Annexure

Checklist of Issues Addressed During Interviews with Farmers in Villages in Wardha District

- **Basic Details of Households**
- **Details of Land Ownership/ Operational Holdings**
- **Livestock Details**
  - No of bullocks/cows/buffaloes/calves.
  - Details of livestock maintenance
  - Source of livestock feed (husk/crop residue/straw/natural grazing)
  - Method of animal dung collection and storage.
  - Details on milk production and usage/sale of milk.
- **Details of Farm Implements and Machines Owned**
- **Crop Details**
  - Cropping pattern
  - Acreage under each crop
- **Cultivation Practice / Agronomic Practice Under Major Crops**
  - **Land Preparation**
    - Time of land preparation (month , before/after the receipt of showers) Method of land preparation (number / depth of ploughing and no of harrowing)

      Power used for ploughing (bullock/tractor)

      Amount and method of FYM application
  - **Sowing**
    - Variety of seed sown
    - Time of sowing (after/before first shower)
    - Method of sowing (*phandi*/seed drill/hand)

- Seed rate
- Spacing.

- **Intercropping**
  - Crop taken as intercrop.
  - Seed rate
  - Intercrop ratio (6:2/ 8:2/ others)
- **Nutrient Management**
  - Name of fertilisers.
  - Quantity of fertilisers.
  - Method of application.
  - Time of application.
- **Weed Management**
  - Type of weed management (manual/chemical**)**
  - Number of harrowing done before/after weeding operation.
  - Name of weedicide/herbicide. (in the case of chemical weeding)
  - Quantity of herbicide used
  - Time of application
  - Dilution ratio
  - Method of application
- **Pest and Disease Management**
  - Name of pesticide used
  - The disease/pest for which it was used
  - Quantity of pesticide used
  - Dilution rate
  - Number of rounds of pesticide spray
  - Time of application of the pesticide spray

- **Irrigation Details**
  - Time/stage of growth of plant when irrigation given
  - Number of wettings given
  - Interval between two wettings
- **Harvesting**
  - Time of harvesting
  - Method of harvesting
  - Use of machinery in harvesting
  - Total number of pickings (in the case of cotton)
  - Post-harvest handling of produce (transport and storage from the field)
  - Yield of the main produce/acre
  - Time of harvesting of the intercrop
  - Yield of the intercrop

- Marketing
  - Details of price discovery by the farmer (fellow farmers/ newspapers/ APMC markets)
  - Details of the decisionmaking process for selling
  - The quantity to be sold
  - The process of choosing the buyer for the produce
  - Deciding the place of transaction (selling to private trader outside the village/APMC market/selling to private trader who comes to the village to collect the produce)
  - Quantity of intercrop set aside as marketable surplus
  - Price at which the produce is sold
  - Price at which the intercrop produce is sold

- **Farmers' perception of the level of agricultural extension activity in the villages**
- **Benefits accrued by the farmer from the Government Packages/Schemes**
  - The kind of benefit accrued (subsidised seeds/compost pit/cart etc.)

Designing Rural Technology Delivery Systems for Mitigating Agricultural Distress:

A study of Wardha District

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