AGRICULTURAL SITUATION IN INDIA

APRIL, 2013

PUBLICATION DIVISION
DIRECTORATE OF ECONOMICS AND STATISTICS
DEPARTMENT OF AGRICULTURE AND CO-OPERATION
MINISTRY OF AGRICULTURE
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Publication Division

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Agricultural Situation in India

VOL. LXX **APRIL, 2013** **No. 1**

CONTENTS

PART I

Officials of the Publication Division, Directorate of Economics and Statistics, Department of Agriculture and Co-operation, New Delhi associated in preparation of this publication :

D. K. Gaur—*Technical Asstt.*

Uma Rani —*Technical Asstt.* (*Printing*)

The Journal is brought out by the Directorate of Economics and Statistics, Ministry of Agriculture. It aims at presenting a factual and integrated picture of the food and agricultural situation in India on month to month basis. The views expressed, if any, are not necessarily those of the Government of India.

NOTE TO CONTRIBUTORS

Articles on the State of Indian Agriculture and allied sectors are accepted for publication in the Directorate of Economics & Statistics, Department of Agriculture & Cooperation monthly Journal "Agricultural Situation in India". The Journal intends to provide a forum for scholarly work and also to promote technical competence for research in agricultural and allied subjects. The articles, not exceeding five thousand words, may be sent Soft Copy in MS Word and Hard Copy duplicate, typed in double space on one side of fullscape paper in Times New Roman font size 12, addressed to the Economic & Statistical Adviser, Room No.145, Krishi Bhawan, New Delhi-11 0001, alongwith a declaration by the author(s) that the article has neither been published nor submitted for publication elsewhere. The author(s) should furnish their e-mail address, Phone No. and their permanent address only on the forwarding letter so as to maintain anonymity of the author while seeking comments of the referees on the suitability of the article for publication.

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Abbreviations used

N.A. —Not Available.
N.Q. —Not Quoted.
N.T. —No Transactions.
N.S. —No Supply/No Stock.
R. —Revised.
M.C. —Market Closed.
N.R. —Not Reported.
Neg. —Negligible.
Kg. —Kilogram.
Q. —Quintal.
(P) —Provisional.
Plus (+) indicates surplus or increase.
Minus (–) indicates deficit or decrease.

A. General Survey

(i) Trends in Foodgrain Prices:

During the month of February, 2013 the All India Index Number of Wholesale Price (2004-05=100) of Foodgrains declined by 0.23 per cent from 217.2 in February, 2013 to 216.7 in March 2013.

The Wholesale Price Index Number of Cereals showed an increase of 0.47 per cent from 212.4 to 213.4 whereas of Pulses showed a decline of 2.96 per cent from 239.8 to 232.7.

The Wholesale Price Index Number of Wheat declined by 0.29 per cent from 206.9 to 206.3 while that of Rice increased by of 0.58 per cent from 205.6 to 206.8 during the same period.

(ii) Weather. Rainfall and Reservoir situation during March. 2013.

As per IMD's long range forecasts for the South-West Monsoon 2013, monsoon rainfall for the country as a whole is most likely to be Normal (96-104% of Long Period Average (LPA). Quantitatively, the monsoon seasonal rainfall is likely to be 98% of the LPA with a model error of ± 5%.

Cumulative Pre-Monsoon (March to May) Rainfall for the country as a whole during the period 01st March to 01st May, 2013 is 35% less than LPA. Rainfall in the four broad geographical divisions of the country during the above period was (-)49% in North West India, 8% in Central India, (-)13% in South Peninsula and (-) 40% in East & North East India. Out of a total of 36 meteorological subdivisions, 15 subdivisions constituting 49% of the total area of the country received excess/normal rainfall, 21 subdivisions constituting 51 % of the total area of the country received deficient/scanty rainfall and 01 met subdivision constituting 1 % of the total area of the country received no rainfall.

Central Water Commission monitors 84 major reservoirs in the country which have a total live capacity of 154.42 BCM at Full Reservoir Level (FRL). Current live storage in these reservoirs as on 02nd May, 2013 was 40.51 BCM as against 41.17 BCM on 02.05.2012(1ast year) and 33.28 BCM of normal storage (average storage of the last 10 years). Current year's storage is 98% of the last year's and 122% of the normal storage.

As per the second Advance Estimates of 2012-13 released on 8th February, 2013, around 101% of the normal area under Rabi crops have been sown. Area sown under all crops taken together is around 615.51 lakh ha. as compared to 605.75 lakh ha. during 2011-12(Final Estimate). Area coverage was higher by 2.0 lakh ha. under Jowar, 1.1 lakh ha. under Barley, 6.3 lakh ha. under Gram, 3.0 lakh ha. under Rapeseed & Mustard and 1.0 lakh ha. under Groundnut. Area coverage was lower by 4.3 lakh ha. under Wheat, 1.0 lakh ha. under Rice and 1.3 lakh ha. under Maize.

A statement indicating comparative position of area coverage under major Rabi crops during 2012-13 (Second Advance Estimate 2012-13) and the last year is given in the Annexure

ALL INDIA CROP SITUATION - RABI (2012-13)

Crop Name	Normal Area	Area sown reported (In lakh hectares)			
		2nd Adv. Est. 2012-13	% of Normal	Final Est. 2011-12	Difference
Wheat	282.62	294.34	104.1	298.65	-4.3
Rice	44.99	37.88	84.2	38.83	-1.0
Jowar	44.99	38.22	85.0	36.25	2.0
Maize	11.36	12.75	112.2	14.01	-1.3
Barley	6.57	7.55	115.0	6.43	1.1
Total Coarse Cereals	62.92	58.52	93.0	56.69	1.8
Total Cereals	390.53	390.74	100.1	394.17	.3.4
Gram	80.57	89.25	110.8	82.99	6.3
Urad	7.46	8.62	115.5	8.57	0.1

ALL INDIA CROP SITUATION - RABI (2012-13)—*Contd.*

Crop Name	Normal Area	Area sown reported (In lakh hectares)			
		2nd Adv. Est 2012-13	% of Normal	Final Est 2011-12	Difference
Moong	6.40	8.57	134.0	7.78	0.8
Total Pulses	127.46	142.20	111.6	132.72	9.5
Total Foodgrains	517.99	532.94	102.9	526.89	6.0
Rapeseed & Mustard	62.80	61.97	98.7	58.94	3.0
Groundnut	8.87	10.43	117.6	9.48	1.0
Safflower	3.05	1.57	51.5	2.50	-0.9
Sunflower	10.26	5.56	54.2	4.72	0.8
Linseed	4.03	3.04	75.4	3.23	-0.2
Total Oilseed (Nine)	91.56	82.57	90.2	78.86	3.7
All- Crops	**609.55**	**615.51**	**101.0**	**605.75**	**9.8**

Agriculture

All India production of foodgrain : As per the 3rd advance estimates released byMinistry of Agriculture on 3.5.2013, production of foodgrains during' 2012-13 is estimated at 255.36 million tonnes compared to 259.32 million tonnes (Final advance estimates) in 2011-12.

Procurement : Procurement of rice as on 1st March, 2013 was 27.30 million tonnes of Rabi Marketing Season as against 26.12 million tonnes procured last year in the corresponding period respectively. This represents an increase of 4.52 per cent. Wheat procurement during Rabi Marketing Season 2012-13 is 38.15 million tonnes as compared to 28.15 million tonnes during the corresponding period last year.

TABLE 1— PROCUREMENT IN MILLION TONNES

	2009-10	2010-11	2011-12	2012-13
Rice	32.03	34.20	34.93	28.64*
Wheat	25.38	22.51	28.34	38.15*
Total	**57.41**	**56.71**	**63.27**	**66.79**

* Position as on 19-3-2013

Off-take : Off-take of rice during the month of February, 2013 was 29.23 1akh tonnes. This comprises 20.67 lakh tonnes under TPDS and 8.56 lakh tonnes under other schemes during February 2013. In respect of wheat, the total off take was 34.63 lakh tonnes comprising of 17.31 lakh tonnes under TPDS and 17.32 lakh tonnes under other schemes.

Stocks : Stocks of foodgrains (rice and wheat) held by FCI as on April 1, 2013 were 59.68 million tonnes, which is higher by 11.97 per cent over the level of 53.30 million tonnes as on April 1, 2012.

TABLE 2—OFF-TAKE AND STOCKS OF FOODGRAINS (MILLION TONNES)

	Off-take			Stocks	
	2010-11	2011-12(P)	2012-13(P) (up to Jan. 2013)	April. 1, 2012	April. 1, 2013
Rice	29.76	32.10	29.53	33.35	35.47
Wheat	21.92	22.98	21.48	19.95	24.20
Total	**51.68**	**55.08**	**51.01**	**53.30**	**59.67**

P=Provisional.

Growth of Economy :—

As per the Advance Estimates of the Central Statistics Office (CSO), the growth in Gross Domestic Product (GDP) at factor cost at constant (2004-05 prices) is estimated at 5.0 per cent in 2012-13 with agriculture, industry and services registering growth rates of 1.8 per cent, 3.1 per cent and 6.6 per cent respectively. As per the First Revised Estimates, the growth in GDP at factor cost at constant (2004-05) prices is estimated at 6.2 per cent in 2011-12. At disaggregated level, this (First Revised 2011-12) comprises growth of 3.6 per cent in agriculture and allied activities, 3.5 per cent in industry and 8.2 per cent in services. The growth in GDP is placed at 4.5 per cent in the third quarter of 2012-13.

TABLE 3— GROWTH OF GDP AT FACTOR COST BY ECONOMIC ACTIVITY

(at 2004-05 Prices)

Sector	Growth			Percentage Share in GDP		
	2010-11	2011-12 IR	2012-13 AE	2010-11	2011-12 IR	2012-13 AE
1. Agriculture, forestry and fishing	7.9	3.6	1.8	14.5	14.1	13.7
2. Industry	**9.2**	**3.5**	**3.1**	**28.2**	**27.5**	**27.0**
a. Mining and quarrying	4.9	-0.6	0.4	2.2	2.1	2.0
b. Manufacturing	9.7	2.7	1.9	16.2	15.7	15.2
c. Electricity, gas and water supply	5.2	6.5	4.9	1.9	1.9	1.9
d. Construction	10.2	5.6	5.9	7.9	7.9	7.9
3. Services	**9.8**	**8.2**	**6.6**	**57.3**	**58.4**	**59.3**
a. Trade, hotels, transport and communication	12.3	7.0	5.2	27.3	27.5	27.5
b. Financing, insurance, real estate and business services	10.1	11.7	8.6	17.2	18.1	18.7
c. Community, social and personal services	4.3	6.0	6.8	12.8	12.8	13.0
4. GDP at factor cost	**9.3**	**6.2**	**5.0**	**100.0**	**100.0**	**100.0**

(IR): 1st Revised Estimates; AE: Advance Estimates

TABLE 4—QUARTERLY ESTIMATE OF GDP (Year-on-year in per cent)

Sector	2011-12			2012-13		
	Q1	Q2	Q3	Q1	Q2	Q3
1. Agriculture, forestry & fishing	5.4	3.2	4.1	2.9	1.2	1.1
Industry	5.7	3.8	2.6	3.6	2.7	3.3
2. Mining & quarrying	–0.4	–5.3	–2.6	0.1	1.9	–1.4
3. Manufacturing	7.4	3.1	0.7	0.2	0.8	2.5
4. Electricity, gas & water supply	6.6	8.4	7.7	6.3	3.4	4.5
5. Construction	3.8	6.5	6.9	10.9	6.7	5.8
Services	8.9	8.5	8.3	7.0	7.2	6.1
6. Trade, hotels, transport & communication	9.5	7.0	6.9	4.0	5.5	5.1
7. Financing, insurance, real estate & bus. Services	11.6	12.3	11.4	10.8	9.4	7.9
8. Community, social & personal services	3.5	6.5	6.8	7.9	7.5	5.4
9. GDP at factor cost (total 1 to 8)	**7.5**	**6.5**	**6.0**	**5.5**	**5.3**	**4.5**

Source: CSO

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Farm Size and Agricultural Productivity : A Study of Low Hill Zone of Himachal Pradesh

A.D.N. Bajpai* Sikander Kumar** and Rakesh Singh***

Abstract

The relationship between size of holding and productivity has been the subject of study since the results of farm management investigations. The present paper also makes an attempt to examine the relationship between operational holding on the one hand and gross value of output and value of major inputs used in the production of selected field crops on the other. In addition to this, net returns across different farm sizes have also been examined. The results obtained from the study pointed out that there exists an inverse relationship between the operational holding and productivity on maize crop, whereas, constant productivity relationship was observed on paddy and wheat crops. When all these crops were taken together, inverse relationship between the two holds true. In respect of profitability, only small farmers are able to convert their output advantages into net profitability by taking all these crops together. The important policy implications of the analysis is that consolidation of land holdings, formulation and effective implementation of a development strategy and management of basic economic holding in the study area will undoubtly of primary importance to boost agricultural production, productivity and profitability thereby enhancing the productive employment and well-being of the farm families.

I

Introduction

The population of our country is increasing at a rapid rate leading to decline in land-man ratio and expansionary demand for foodgrain production. In order to fulfill the growing demand, it has been argued that small farms are more efficient in producing most of the agricultural commodities; therefore, land distribution in favour of marginal and small farms is an attractive policy instrument for raising production, improving rural employment and equality of income distribution. No doubt, over the past few years in our country, substantial progress has been made in respect of the performance of agricultural system which relies more on abolition of intermediaries, ownership rights, security of tenants and ceiling of land holdings. But in order to formulate the proper policy regarding land reforms, it is equally important to know the exact relationship between farm size and productivity in Indian farming. The new agricultural strategy called the High Yielding Variety Programme (HYVP), introduced in the mid-sixties in our country has caused considerable changes in the trend of area, production and productivity. Though this strategy is confined to a few crops and not with the same vigour in all parts of the country, it favour large farm bias, however upto a limited extent. It is argued that new agricultural strategy has displaced the importance of family labour which was considered to be the main determinant of inverse relationship between farm size and productivity. The use of chemical fertilizers, HYV seeds, irrigation facilities along with other infrastructural facilities, process of liberalization, change in tenancy relations, replacement of share tenancy with fixed rent tenancy etc., have profound implications in favour of large farm bias. It is in this background, the present study was undertaken to examine whether farm size is an important factor to determine productivity and profitability? An attempt has also been made to find out the relationship between farm size and inputs use in selected crops across different categories of farms in the low hill region of Himachal Pradesh.

II

Data Base and Methodology

For the purpose of collecting data, the entire State was divided into three agro-climatic zones viz. low-hill, mid-hill and high-hill zones based on the height above the mean sea level. By considering the similar agro-climatic conditions having good production potential, fertile soil, good roads and communication network, production of major foodgrain crops viz. maize, paddy and wheat etc., low-hill zone has been purposively selected out of which two blocks namely Una and Ghumarwin have been selected from two districts viz., Una and Hamirpur respectively by random mechanism. Una block represented the most progressive and leading area in adoption of improved farm technology whereas, Nadaun block represented a mixture of both traditional and improved farm technology. After that, three panchayats from each block and three villages

* Professor of Economics and Vice-Chancellor, Himachal Pradesh University, Shimla - 171005.

** Professor and Director CCS, Department of Economics, Himachal Pradesh University, Shimla - 171005.

*** Assistant Professor, Swami Vivekanand Government Degree College, Ghumarwin, Bilaspur, H.P. - 174021.

from each panchayat, thus a total of 18 villages have been selected with the help of multi-stage random sampling. As the selection of household is an ultimate unit of enquiry, all the households against each selected village were categorized into three size- classes viz., marginal farmers having land less than one hectare, small farmers having land 1-2 hectares and medium farmers having land more than two hectares. The data which we have used in this exercise were collected by survey method with the help of well-structured schedule from 200 farms consisting of 98 marginal, 62 small and 40 medium selected randomly on the basis of probability proportional to the number of farms in each size class pertaining to the year 2011-12. Due to non-availability of data on some minor crops such as pulses, mustard, gram etc. we have concentrated in our analysis the size productivity relation of the major foodgrain crops viz., maize, paddy, wheat and when all these crops were taken together. The most of earlier studies have taken into account the gross value of output of all the crops grown as a measure of productivity but for the present study it was also considered appropriate to analyse the productivity of individual crop against holding size. The relationship between the two was worked out by fitting the log-linear equation with net operated area as endogenous and gross value of individual crops as exogenous variable as well as when all the crops (maize+ paddy+ wheat) were considered together. More specifically, the following log-linear equation was fitted to the data:

$$Y = aX_1^{b1}e^u$$

In the log-form,

$$\text{Log } Y = \log a + b_1 \log X_1 + u$$

Where,

Y = Per Hectare value of output of respective crop (Rs)

X_1 = Size of operational holding under respective crop (hectares)

b_1 = Elasticity coefficient

u = Error term

a = Intercept term

In order to test the statistical validity of the relationship between farm size and productivity, we have made the following hypothesis:

1. The null hypothesis, H_0 = There exists no relationship between farm size and productivity as b_1 not statistically significant.
2. The alternative hypothesis, H_1 = There exists positive relationship between farm size and productivity as b_1 positive and statistically significant.
3. The alternative hypothesis, H_2 = There exists inverse relationship between farm size and productivity as b_1 negative and statistically significant.

In addition to this, the difference in the means of gross value productivity of different crops and mean inputs use between different categories of farms was tested with the help of appropriate statistical tools. The effect of farm size on inputs use was estimated with the help of following regression equations:

$$\text{Log } H = \log a + b_1 \log X_1 + u \text{ ———— (i)}$$

$$\text{Log } M = \log a + b_1 \log X_1 + u \text{ ————(ii)}$$

$$\text{Log BTC} = \log a + b_1 \log X_1 + u \text{ ———(iii)}$$

Where,

H = Per hectare labour use and is sum of family and hired-in labour (standard mandays)

X_1 = Farm size

M = Value of manure & fertilizer per hectare

BTC = Bullock labour & tractor charges per hectare

b_1 = Regression coefficient

u = Error term

a = Intercept term

III

Literature Review

The debate on the possible relationship between farm size and productivity was started by A. K. Sen (1962) in India and later on joined by Khusro, A.P. Rao, Rudra, Hanumanta Rao, G.R. Saini and others. Majority of the studies pointed out that there exists an inverse relationship between the farm size and productivity. The findings of Directorate of Economics and Statistics (1955), Khusro (1964), Krishna (1964), Sharma (1971), Bardhan (1973), Bhardwaj (1974), Sankhayan (1978), Saini (1979), Sekar (1994), Heltberg (1996), Chatopadhyay & Sengupta (1997), Sharma & Sharma (2000) and Fan & Chankang (2003) are pioneering in this regard, though they offered different explanations in favour of inverse relationship. On the other hand, a few studies conducted by Singh & Patel (1973), Ghose (1979), Nagraja (1985) and Reddy (1993), showed that inverse relationship between the two has disappeared with the advent of new agricultural strategy which involves HYV seeds, chemical fertilizers, labour saving machinery, modern irrigation equipments etc. However, the studies made by Rao (1967), Rudra (1968), Rani (1971), Vaidya (1993) in case of wheat crop and Singh & Bal (1994) indicated that productivity remains constant irrespective of the difference in holding sizes. Further, Helfand (2003), found U shaped relationship between farm size and Productivity i.e. productivity first falls with the farm size and then rise with the size. In sum, the debate on this controversial issue continues to be a moot point in Indian agriculture.

IV

Results and Discussion

In this section, we shall examine the statistical basis of the inverse relationship between farm size and productivity and its connection with patterns of resource use on farms. Before going into the analysis of farm-size productivity relationship, it would be useful to have an idea of the basic characteristics of the study area across different farm size categories. These characteristics are presented in Table 1 in terms of family size, standard mandays, literacy percentage, sex-ratio, farm size, cropping intensity, average yield, per capita income, average propensity to consume etc., indicated that there are wide variations across different farm size categories.

TABLE 1—BASIC CHARACTERISTICS- SOME SELECTED INDICATORS

S. No.	Indicators	Size class			
		Marginal holdings	Small holding	Medium holding	Overall holding
1	Family size	5.76	6.09	7.05	6.12
2	Family work force (percent)	67.07	69.57	64.18	67.18
3	Total available mandays (per annum)	1146	1218	1365	1212
4	Literacy percentage	68.31	64.55	81.20	70.12
	(a) Male	79.13	69.37	86.09	77.58
	(b) Female	57.83	58.57	75.57	62.01
5	Sex-ratio (at 100 males)	103	80	86	92
6	Per capita income (Rs)	14902.31	20174.49	22443.31	18266.76
7	Average propensity to consume	0.77	0.61	0.63	0.68
8	Farm size (ha)	0.46	1.26	2.32	1.08
9	Cropping intensity (percent)	185.97	179.51	178.9	180.56
10	Ratio of hired labour to family labour	0.03	0.07	0.13	0.08
11	Irrigation (percent)	0.14	0.26	0.22	0.22
12	Tractor (No./Farm)	0.07	0.11	0.20	0.10
13	Thresher (No./Farm)	0.07	0.22	0.30	0.16
	Average Yield (qtl/ha)				
	Maize	23.80	19.88	15.79	19.15
	Paddy	32.87	26.22	21.86	25.91
	Wheat	18.0	15.54	14.53	15.66
	All crops (Maize + Paddy + Wheat)	23.02	19.34	16.56	19.04

Source: Field Survey, 2009-10

4.1 Farm size and Productivity: The gross returns of maize, paddy, wheat and all crops are given in Table 2. The data indicated that the gross returns from maize, paddy, wheat as well as all crops are significantly higher on marginal farms as compared to the small and medium farmers. Similarly, the gross returns were also higher on small farms as compared to medium farmers except in wheat crop. To examine the effect of farm size on productivity of different crops, log-linear regression was done. The results of regression analysis (Table 3) showed the negative effect of farm size on productivity in case of maize and when all the crops were taken together, however the effect was positive in case of Paddy and negative for wheat crop though insignificant. Thus, inverse relationship between farm size and productivity is a confirmed phenomenon in the area under study.

TABLE 2—FARM SIZE AND GROSS OUTPUT OF DIFFERENT CROPS

(Rs per hectare)

S. No.	Crops	Marginal holding		Small holding		Medium holding		't' value for difference		
		Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Marginal and Small	Marginal and Medium	Small and Medium
1.	Maize	16857.22	3697.54	15187.96	3373.98	12819.20	2407.74	2.34*	6.32*	4.84*
2.	Paddy	29107.25	10894.35	24381.53	5831.49	20623.25	5371.91	3.30*	4.57*	3.19*
3.	Wheat	18384.24	7323.27	16207.55	6531.38	14765.72	5488.88	1.89***	2.75*	1.15
4.	All Crops	20569.04	8988.57	18380.23	6728.62	16069.39	5685.41	2.72*	5.00*	5.99*

Source: Field Survey, 2009-10 ** and *** significant at 1 and 10 per cent level respectively*

TABLE 3—FARM SIZE AND PRODUCTIVITY RELATIONSHIP : RESULTS OF REGRESSION ANALYSIS

Sr. No.	Items	No. of observations	Constant log A	b_1 (coefficient)	level of Significance (b_1)	R^2
1.	Maize	187	4.1166*	-0.108* (.021)	.000	.127
2.	Paddy	154	4.3993*	0.051 (.034)	.142	.014
3.	Wheat	181	4.1844*	-0.0247 (.035)	.181	.003
4.	All Crops	522	4.2174*	-.0476** (.020)	.038	.010

Note:- Figures in the parentheses are standard error.

*Significant at 1 per cent level.

** Significant at 5 per cent level.

4.1 Farm size and Input use: For the purpose of analyzing the relationship between farm size and productivity, we have also tested the relationship between farm size and input use of some of the important inputs viz., human labour, bullock labour & Tractorization and manures & fertilizers, as it is presumed that higher productivity on small sized farms may be due to more intensive use of inputs, particularly mentioned above. The results are presented in Table 4. The table shows that marginal farms used significantly higher amount of respective input factors as compared to their counterparts in each crop as well as when all the crops were taken together. The difference in the inputs use between small and medium farmers, however not significant in most of the cases in these crops but when all the crops taken together, it was found significant (except human labour). The inverse relationship between farm size and inputs use can also be supported by the results of regression analysis. Table 5 revealed that coefficients are dominated by significantly negative signs for all the respective factor inputs in each crop as well as when all the crops were taken together. It is indicative of the fact that farm size has negative impact on the use of inputs.

TABLE 4—INPUT USE ON DIFFERENT CATEGORIES OF FARMS

S. No.	Inputs	Marginal holding		Small holding		Medium holding		't' value for difference		
		Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Marginal and Small	Marginal and Medium	Small and Medium
	Input use in Maize crop									
1.	Human labour (days/ha)	20293	90.12	147.65	62.57	141.19	29.96	4.12*	4.20*	0.60
2.	Bullock labour and Tractorization (Rs/ha)	3465.64	1306.02	2725.81	1060.92	2508.12	373.92	3.64*	4.87*	1.23
3.	Manure and Fertilizer (Rs/ha)	2728.41	1225.49	2001.86	936.50	1666.52	735.06	3.88*	5.07*	1.90***
	Input use in Paddy crop									
4.	Human labour (days/ha)	220.67	72.98	163.78	43.54	155.68	28.0	5.01*	5.37*	1.01
5.	Bullock labour and Tractorization (Rs/ha)	3813.78	1281.96	3119.61	805.11	2595.21	861.42	3.43*	5.28*	3.02*
6.	Manure and Fertilizer (Rs/ha)	2711.37	1351.95	1989.32	742.91	1924.65	802.54	3.54*	3.31*	0.40
	Input use in Wheat crop									
7.	Human labour (days/ha)	139.89	73.17	108.77	18.88	97.06	17.15	3.24*	3.64*	3.15*
8.	Bullock labour and Tractorization (Rs/ha)	3106.78	1319.24	2648.95	569.12	2738.41	170.21	2.55*	1.88***	-0.96
9.	Manure and Fertilizer (Rs/ha)	2792.71	1061.56	1811.39	1012.04	1517.94	659.36	5.73*	7.02*	1.61
	Input use in All crops									
10.	Human labour (days/ha)	183.20	81.57	139.07	53.15	131.31	38.34	6.27*	6.61*	1.37
11.	Bullock labour and Tractorization (Rs/ha)	3416.41	1367.75	2820.53	875.03	2613.91	572.49	5.07*	6.16*	2.27**
12	Manure and Fertilizer (Rs/ha)	2748.80	1195.72	1931.32	909.94	1703.03	747.74	7.61*	8.77*	2.26**

Source: Field Survey, 2009-10*,** and *** significant 1,5 and 10 per cent level respectively

TABLE 5—INPUT USE AND FARM SIZE: RESULTS OF REGRESSION ANALYSIS

S. No.	Inputs/Crops	Maize			Paddy			Wheat			All Crops		
		Log A	b_1 (coefficient)	R^2	Log A	b_1 (coefficient)	R^2	Log A	b_1 (coefficient)	R^2	Log A	b_1 (coefficient)	R^2
1.	Human labour (Man days)	2.042 (0.009)	-0.398* (0.013)	0.83 (0.01)	2.104	-0.344* (0.017	0.73	1.997 (0.006)	-0.452* (0.013)	0.86	2.032 (0.005)	-0.421* (0.008)	0.82
2	Bullock labour & Tractorization	3.321 (0.016)	-0.294* (0.025)	0.42	3.406 (0.014)	-0.247* (0.024)	0.42	3.407 (0.012)	-0.0099 (0.024)	0.08	3.386 (0.008)	-0.209* (0.014)	0.28
3	Manure & Fertilizers	3.18 (0.034)	-0.202* (0.052)	0.073	3.186 (0.031)	-0.226* (0.052)	0.11	3.176 (0.021)	-0.332* (0.043)	0.24	3.180 (0.016)	-0.244* (0.027)	0.13

*Note: Figures in the parentheses are standard error, *significant at 1 per cent level*

4.3 Farm size and Profitability: In the present analysis, profitability is defined as the value of net returns which is obtained by deducing the total cost (all cash & kind expenses incurred on material inputs, rental value of owned land, rent on owned fixed capital, imputed value of owned family labour etc.) from the gross returns. Net returns are presented in Table 6.

TABLE 6—NET RETURNS

(Rs/ha)

S. No.	Crops	Farm size			
		Marginal Farmers	Small Farmers	Medium Farmers	Overall Farmers
1.	Maize	(-) 7382.61	(-) 2941.98	(-) 3534.17	(-) 4260.54
2.	Paddy	1884.93	5796.37	3375.69	4487.20
3.	Wheat	(-) 2144.84	780.05	44.93	(-) 115.02
4.	All Crops	(-) 7643.39	3634.44	(-) 114.24	111.64

It can be observed from the table that net returns in terms of Rs/ha are very low due to the poor resource base, inadequate knowledge and lack of motivation. Further, the cultivation of these crops gave a good amount of loss except paddy crop. As between the farms in different size classes, only small farmers are able to convert their output advantageously into net profit, however it is negative in respect of maize but the loss of amount is less than their counterparts. The negative returns on maize crop may be attributed to the low value of crop yield whereas, low yield rate was responsible for the same on wheat crop. The cultivation of paddy crop requires good quality of muddy soil without any slope in the field. Therefore, farmers irrespective of any farm size category put better application of available resources for the cultivation of paddy crop, which is reflected in high yield rate as compared to maize and wheat crops. That is why, there are positive returns in paddy crop.

V

Concluding Observations

To sum up, the inverse relationship between the farm size and productivity was observed in maize crop whereas, constant productivity was observed in case of paddy and wheat crops. When all these crops were taken

together, inverse relationship between the two holds true. The results further explored that marginal farms used higher amount of human labour, bullock labour & Tractorization and manure & fertilizers as compared to higher farm size categories. The results of regression analysis also indicated about inverse relationship between farm size and input use in each crop as the regression coefficients are significantly negative. The existing inverse relationship between farm size and productivity is mainly due to the higher input intensity on lower size categories as compared to large size category. The marginal farms use more amount of labour per unit of land because of availability of cheap family labour. The situation arising from low opportunity cost of labour, the fact is that they use less of hired in labour as compared to their large counterparts. Similarly, the intensity of bullock labour & Tractorization was also found higher on smaller sized categories of farms due to willingness to get profit and higher availability of bullock labour per unit of land as compared to large farm size category. Further, land fertility was also higher on lower sized categories due to the higher availability of farmyard manure per unit of land for them. In other way, they have a large number of cattle per hectare. The situation becomes worse for larger farm size category as there was no market for farmyard manure. However, the introduction of chemical fertilizers was eroded the importance of farmyard manure, yet it is equally required for retaining and enhancing the soil fertility along with balanced fertilizer (N+P+K). In broader terms, the results obtained from the study support the hypothesis of inverse relationship between farm size and productivity however, in respect of individual crops, the effect of farm size on productivity was size neutral in case of paddy and wheat crops. As far as the net returns to farming are concerned, the marginal farmers are not able to convert their output advantages into higher net profits due to their higher total costs. In other way, the viability of marginal farmers in terms of net returns is not as strong as in the case of output. Similarly, medium farmers also not getting profits despite their low cost, mainly due to the low yield rates. On the other hand, small farmers are not only getting positive returns but also minimizing the amount of loss on maize crop as compared to their counterparts. Therefore, in the light of declining net returns from farming, especially of marginal and medium farms, the viability of farming needs to be improved. It necessitates for the consolidation of land holdings, management of basic & economic holding and introduction of an integrated development strategy encompassing both its production and marketing aspects to make the cultivation of these crops a competitive vis-à-vis profitable enterprise. For this, there is inevitable need to tone up, strengthen and modernize the extension network to transfer the production technology and technical know-how to the farmers in order to increase the risk bearing capacity. Keeping in view the local conditions, the development of high yielding variety seeds which must be stalk rot resistant, dwarf and early maturing with high yield potential alongwith low input-output ratios is also of primary importance. Besides, a multidimensional approach covering optimum farm plans, soil conservation, water harvesting, animal raising, effective crop insurance scheme etc, was badly needed to increase productive employment in agriculture which is believed to be the key of accelerated development thereby the well-being of farm families.

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BT Cotton – A Status Report

Mondira Bhattacharya and Ankita Goyal[1]

Introduction

Cotton is a leading commercial crop grown for its valuable fiber. Bt cotton is the first genetically modified crop to be used in India. Cotton cultivation in India is mainly dominated by Bt cotton hybrids, approved for commercial cultivation in the year 2002. Currently above 90 per cent of the Cotton area is under hybrid Bt cotton. While several studies have shown that farmers have benefitted from adopting Bt technology, others have also expressed concerns about its benefits over time. The debate continues even after a decade since the introduction of Bt cotton for commercial cultivation in India.

Critics of transgenic technology correlate Bt cotton cultivation on several fronts, namely, increasing pesticide use, rising cost of cultivation, low productivity, adverse impact of human and animal health and environment, farmer suicides across Cotton growing states of India, and monopoly of private sector seed companies like Monsanto[2] (Shah and Banerji (2002) Bhargava (2003 & 2009), Mitra & Shroff (2007), Bandopadhyay (2012), Gaurav and Mishra (2012)). Kuruganti (2009) and Stone (2012) argue that factors such as bringing new and fertile lands under cotton cultivation, shift from unirrigated to irrigated Cotton, good monsoons, low pest incidence, and increased use of chemical fertilisers have contributed to Cotton yield increases in some years in some states of the country and that the yield increase cannot be attributed to Bt cotton perse.

Amidst the criticism, there have also been a number of empirical studies which have shown reduction in pesticide usage and an increase in crop yield as a result of reduction in crop loss after the introduction of Bt cotton (Qaim and Zilberman (2003), Bennett et al (2004), Naik et al (2005), Pray et al (2005), Narayanmoorthy & Kalmakar (2006), Khadi (2007), Peshin *et.al*. **(**2007), Rao and Dev (2009) and Herring and Rao (2012). In a study by Karihaloo and Kumar (2009), environmental safety concerns of Bt technology was found to be negligible. Gruere et al. (2008), found that Bt cotton cultivation was neither a necessary nor a sufficient condition for the occurrence of farmer suicides. Gruere and Sun (2012), by their regression results showed that Bt cotton contributed significantly to cotton yield growth, with a total increase contribution of 19 percent over time between 1975 and 2010. But their results also showed that other key factors such as the use of fertilizers, hybrid seeds, human labour, pesticides, and especially the use of irrigation had significant effects on Cotton yields. Interestingly, there are two points where the researchers across disciplines converge their views on; namely high expenditure on the 'hybrid' Bt seed as it cannot be reused by farmers and also the question as to why public sector institutions are not developing and promoting indigenous hybrids and even varieties so as to give Monsanto's Bt gene a competition (Ramasundaram et al. (2011).

In the year 2011, India ranked number one in the world with 34.05 per cent Cotton area (12 Million Hectares) followed by China with 15.35 per cent area. However, despite high area, the proportion of Cotton production in India was lesser (21.54 per cent) than China (27.22 per cent). India's average yield is only 481 Kg. Lint/Hec compared to world average of 747.69 Kg. Lint/Hec and China's average of 1326 Kg. Lint/Hec. Moreover, in recent years Cotton yields have shown some stagnation necessitating an in-depth enquiry into the study of this crop.

Objectives

With this background the aim of this study was to understand India's Cotton production characteristics and trade, farm input use, cost of cultivation and net return analysis, factors affecting Cotton yields and the perception of farmers and agricultural labourers on the effect of incomes from Bt cotton on their livelihoods.

Methodology and Data Sources

The study was based on both secondary and primary sources of data. Secondary sources included Government of India publications such as Economic Survey, Ministry of Finance and data received from the Directorate of

[1] Associate Fellow and Senior Research Associate at the Council for Social Development, New Delhi. The views and opinions expressed in the paper are solely the those of the authors.

[2] The multinational seed company based in USA, that had developed the first generation genetically modified crop and hence had a patent for the Bt gene. In India the hybrid Bt seeds are produced by different private sector companies, that paid royalty to Monsanto

Economics and Statistics, Ministry of Agriculture, Government of India. Since the commercial cultivation of Bt cotton in India had started from 2002 in the central and southern states and from 2005 in the northern states, hence in this study the Post-Bt cotton period for the central and southern states have been taken from 2002 onwards, while for the northern states, it has been taken from 2005 onwards. Further, a field survey was conducted in selected districts of 9 major Cotton growing states namely, Fazilka and Bathinda in Punjab, Hissar and Sirsa in Haryana, Hanumangarh in Rajasthan, Surendranagar and Bhavnagar in Gujarat, Jalgaon and Yavatmal in Maharashtra, Dhar and Khargone in Madhya Pradesh, Dharwad in Karnataka, Adilabad and Warangal in Andhra Pradesh and Virudunagar in Tamil Nadu, for the agricultural year 2010-11. The study was based on a total sample size of 1050 farmers and 300 agricultural labourers across the country. It involved cross-sectional analysis of farming population for a single year and hence the information received was compared with data received from the above mentioned secondary data sources. Since it was difficult to compare a single year study with previous years using the same population dataset, hence, farmers' recall method was used during the interview. Further, a lot of information was based on farmers' perception regarding various issues.

Field Survey Demographics

From the field survey it was observed that, most Cotton growers surveyed across the country were small farmers (53.71 per cent) followed by medium (36.76 per cent) and then large farmers (9.52 per cent). Further, it was seen that all farmers (100 per cent) surveyed in the major Cotton growing states cultivated Bt cotton. However, only 2.38 per cent farmers from the districts of Sirsa in Haryana and Hanumangarh in Rajasthan also cultivated Non-Bt (Desi) cotton. The total Bt cotton area as a proportion of total Cotton area was 98.90 per cent. The proportionate share of Bt cotton was higher in all the states. Most farmers (72 per cent) mainly learnt of Bt cotton from co-farmers followed by seed dealers (22 per cent), extension workers (3 per cent) and lastly social media (3 per cent). However, an exception was seen in Rajasthan and Maharashtra, where seed dealers provided most information on Bt cotton. The all India yields of Bt cotton (raw) (23.17 Qtl/Hec) was slightly higher than those of Non-Bt (Desi) cotton (20.11 Qtl/Hec) for the agricultural year 2010-11. The survey districts that showed Bt cotton yields greater than the national average were Virudunagar in Tamilnadu (37.25 Qtl/Hec) followed by Surendranagar in Gujarat (33.42 Qtl/Hec), Warangal in Andhra Pradesh (33.15 Qtl/Hec) and Hanumangarh in Rajasthan (25.66 Qtl/Hec). Further, Bt cotton yields were found to be scale neutral. From the primary field survey it was also seen that Bt cotton was mostly cultivated under unirrigated or rainfed conditions in India (55.59 per cent). The rest 44.41 percent cotton area was irrigated. Both Bt cotton and Non-Bt (Desi) cotton was cultivated under irrigated conditions in the northern states of Punjab, Haryana and Rajasthan. In the rest of the central and southern regions covering the states of Gujarat, Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu, the share of unirrigated Cotton area was found to be higher, highest being in Madhya Pradesh (98.08 per cent).

Cotton Trade

The contribution of Cotton in India's agro-export both in quantity and value terms had plummeted during the nineties and grew significantly during the first decade of the new millennium. Its share in the value of exports from the country in recent years increased from 0.75 per cent in TE 2000 to 10.53 per cent in TE 2009. Further, it was seen that, the trend growth rate of Cotton exports was -24.6 per cent in quantity terms and -21.3 per cent in value terms in the Pre-Bt cotton period between 1990-91 and 2001-02. However these export growth trends increased significantly to above 75 per cent in the Post-Bt cotton period between 2002-03 and 2009-10 (Table 1). On the other hand Cotton import growth rates showed considerable decline in the Post Bt cotton period. Thus, the advent of Bt cotton changed India from a net importer into a net exporter of Cotton.

TABLE 1—TREND GROWTH RATES IN EXPORT AND IMPORT OF COTTON (%)

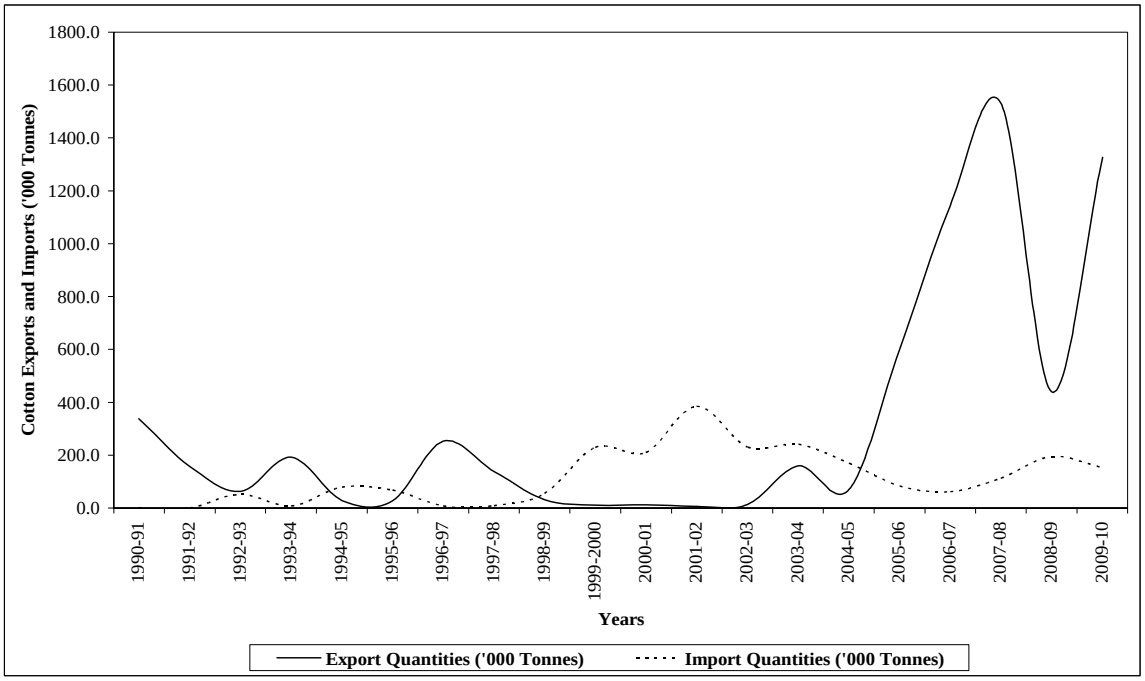
India	Pre-Bt cotton Period (1990-91 to 2001-02)	Post-Bt cotton Period (2002-03 to 2009-10)
Quantity of Exports (Tonnes)	-24.6	75.1
Value of Exports (1000 USD)	-21.3	80.9
Quantity of Imports (Tonnes)	64.3	-6.3
Value of Imports (1000 USD)	49.5	0.4

Source: Economic Survey, Ministry of Finance, GOI

[1] Triennium Ending

From Figure 1 it is seen that Cotton exports started to increase from 2002-03 and took off from 2005-06, but plummeted in 2008-09. This sudden decline in 2008-09 was because of lower production due to erratic rainfall coupled with high pest incidence that could have affected Cotton productivity. Apart from this, low international prices and depreciation of the rupee against the dollar also reduced exports in 2008-09. Cotton exports picked up once again in 2009-10.

Figure 1: Exports and Imports of Cotton Lint ('000 Tonnes)



Source: Economic Survey, Ministry of Finance, GOI

Cotton Production Characteristics

Area under Cotton in India grew at a trend growth rate of 1.89 per cent per annum between the years 1990-91 and 2011-12. On the other hand its production and yield grew at 4.53 and 2.59 per cent respectively (Table 2). However, ever since the cultivation of Bt cotton in India in 2002-03, Cotton area, production and yield grew at a trend growth rate of 4.91, 9.25 and 4.95 per cent respectively. This quantum leap in growth rates especially in the last decade suggests the huge influence of Bt cotton on farming choices in India. However, the Post-Bt cotton period also registered a marked increase in instability, measured through the coefficient of variation. In terms of area, the instability increased from 8.71 per cent in the Pre-Bt cotton period to 15.27 per cent in the Post-Bt cotton period. Similarly production instability increased from 18.74 to 25.35 per cent and yield instability increased from 13.09 to 15.57 per cent.

TABLE 2—GROWTH RATES IN AREA, PRODUCTION AND YIELDS OF COTTON

Time Period	Area	Production	Yield
	Trend Growth Rates Per Annum (%)		
Pre-Bt cotton Period (1990-2001)	1.89	4.53	2.59
Post-Bt cotton Period (2002-2011)	4.91	9.25	4.15

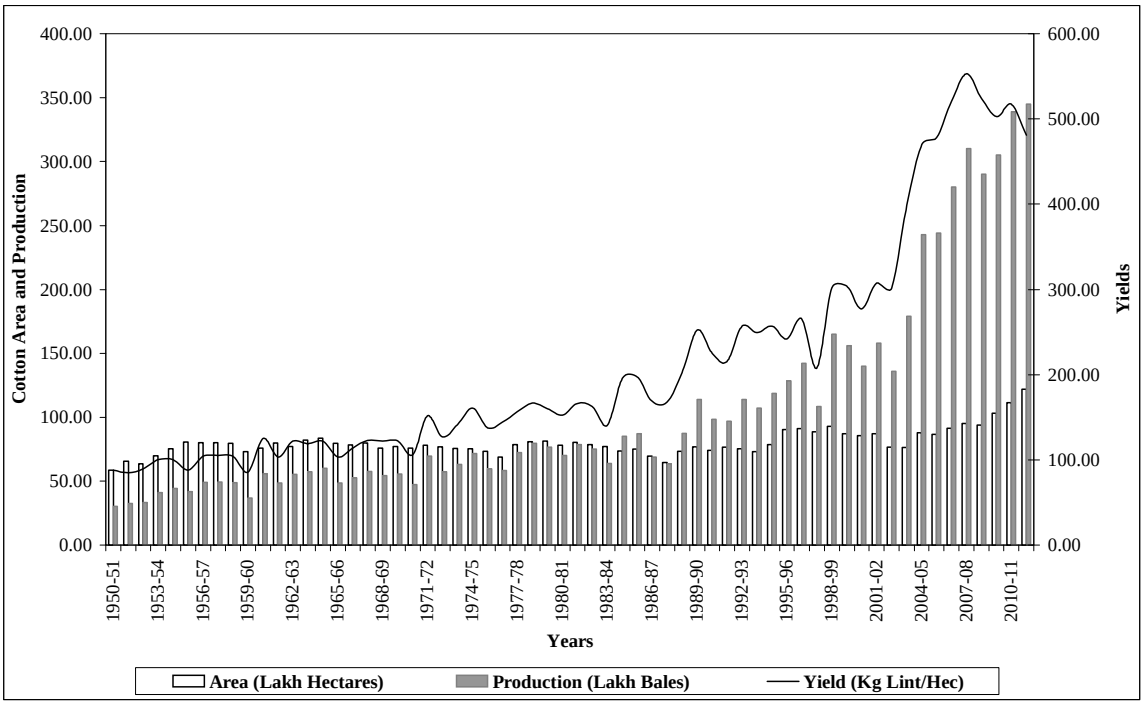
TABLE 2—GROWTH RATES IN AREA, PRODUCTION AND YIELDS OF COTTON—*Contd.*

Time Period	Area	Production	Yield
	Coefficient of Variation (%)		
Pre-Bt cotton Period (1990-2001)	8.71	18.74	13.09
Post-Bt cotton Period (2002-2011)	15.27	25.35	15.57

Source: Calculations based on data from Directorate of Economics and Statistics, Ministry of Agriculture, GOI

The average Cotton yields also showed stagnation and deceleration since 2008-09 onwards (Figure 2), presumably under the impact of marginal lands (shallow soils, rainfed areas) that were being brought under Cotton cultivation, erratic weather conditions and increased attacks by sucking pests not sufficiently controlled by insecticides or by the current Bt technologies.

Figure 2: All India Area, Production and Yields of Cotton



Source: Directorate of Economics and Statistics, Ministry of Agriculture, GOI

In TE 2011-12, while the average area under Cotton was highest in the states of Maharashtra (38 Lakh hectares), Gujarat (27.6 Lakh hectares) and Andhra Pradesh (17.07 Lakh hectares), the same states, especially Maharashtra, recorded low yields (Table 3). Some pockets in Maharashtra & Madhya Pradesh are mainly rain-fed with shallow soils and erratic rainfall patterns. Hence, they can be termed 'marginal lands' compared to other traditional cotton growing areas in the states. Hence, it can be inferred that overall Cotton yields in India have declined due to increase in Cotton area in such marginal lands[4].

[4]In this context it is important to mention that, according to a scientific study conducted by Blaise and Kranthi (2011), most of the Cotton grown in the country was rain-dependent and the crop experienced moisture stress. Furthermore, Cotton was grown on soils of varying depths, and it was observed that productivity was better on deep vertisols (black soil) compared to the shallow soils because the former has a better water-holding capacity. Such water stress could lead to (i) ineffective pest control; (ii) pest becoming resistant to the Bt toxin, and (iii) high pesticide use, in transgenic crops. Under rainfed conditions especially of central India, where rains ceased early in September, the crops grown in deep Vertisols were less likely to experience moisture stress than those grown on shallow soils. Secondly, it is also important to mention about the large number of Bt hybrid seeds that were being used indiscriminately by farmers without understanding the basic biological nature of the hybrid. This so called proliferation of hybrids was turning out to be a major menace in maintaining purity, arresting pest load and extending technologies (CICR report, 2001). The lack of knowledge of such scientific issues among farmers was resulting in soil toxicity and related health problems in certain years in some areas.

TABLE 3—RANKING OF STATES ACCORDING TO HIGHEST AVERAGE COTTON AREA AND YIELDS – TE (2009-11)

S. No.	States	Area (Lakh Hec.)	S. No.	States	Yields (Kg Lint/Hec)
1.	Maharashtra	38.00	1	Tamil Nadu	714.29
2.	Gujarat	27.60	2	Gujarat	648.46
3.	Andhra Pradesh	17.07	3	Andhra Pradesh	524.40
4.	Madhya Pradesh	6.50	4	Rajasthan	512.21
5.	Punjab	5.42	5	Haryana	504.98
6.	Haryana	5.19	6	Punjab	480.93
7.	Karnataka	4.47	7	Karnataka	433.87
8.	Rajasthan	4.09	8	Madhya Pradesh	429.36
9.	Tamil Nadu	1.19	9	Maharashtra	319.42

Source: Calculations based on data from Directorate of Economics and Statistics, Ministry of Agriculture, GOI

Farm Input use of Cotton in India

Pesticides

Regarding pest attacks[5], it was found that pesticide consumption in the country declined from an average of 0.28 Kg/Hec in the Pre-Bt cotton period (1996 to 2001) to 0.22 Kg/Hec in the Post-Bt cotton period (2002 to 2009), a decline of 23.45 per cent. The proportion of insecticide cost to the total cost of cultivation in the Cotton growing states showed a declining trend in the Post-Bt cotton period, but also showed a slight increase in the recent years of 2007-08 and 2008-09 due to increased damage by sucking pests, that are also responsible for declining yields. Hence, the decline in Cotton yields in recent years, can to some extent, be attributed to increased attacks by sucking pests not controlled by the current Bt technologies.

Fertilizers

Fertilizer consumption per hectare showed increasing trends especially since 2007-08. The average consumption of fertilizers in Cotton crop increased from 95 Kg/Hec in the Pre-Bt cotton period (1996-2001) to 120 Kg/Hec in the Post Bt cotton period (2002-2008), an increase of 26.72 per cent. Further, in the Pre-Bt cotton period, the growth rate of fertilizer consumption in Cotton was -1.54 percent which increased to 8.52 per cent in the Post–Bt cotton period. The highest growth rates in the Post – Bt cotton period were seen in the northern states (mainly irrigated) followed by the southern and central (rainfed states) in close succession. The proportion of fertilizer cost to total cost showed increasing trends in the Post-Bt cotton period.

Irrigation

The proportion of irrigated area under Cotton as a proportion of total Cotton area at the all India level remained at around 34 per cent since the last two decades and also declined to 28.89 per cent in 2011-12. The irrigated area under Cotton as a proportion of Gross Irrigated Area (GIA) was highest in the state of Gujarat (around 25 per cent), mainly because of development of several micro-irrigation systems there. The proportions were around 10 per cent in Punjab and Haryana and even lesser in the central and southern regions (around 5 per cent) over the years showing that Cotton was cultivated mainly under rainfed conditions in the major Cotton growing areas. This could also cause yield stagnations as Cotton crop requires irrigation. The average irrigation costs per hectare increased from Rs.355/Hec in the Pre-Bt cotton period (1996-2001) to Rs.813/Hec in the Post-Bt cotton period (2002-2008), in response to increased diesel costs. The trend growth rates in irrigation costs showed a major decline in all the Cotton growing states in the Post-Bt cotton period compared to the Pre-Bt cotton period. However, in Gujarat, irrigation costs grew at a high rate of 12.05 per cent in the Post-Bt cotton period. In terms of proportion of irrigation cost to total costs, major fluctuations were seen in all the states. The proportion of irrigation costs showed declining trends in the Post-Bt cotton period. However, since 2007-08, only the states of Gujarat, Haryana, Maharashtra, Rajasthan and Andhra Pradesh, showed increasing trends once again.

Seeds

The total seed usage of Cotton declined from 9.23 Kg/Hec in the Pre-Bt cotton period (1996-2001) to 6 Kg/

[5]The cotton crop accounts for a very high share (above 50 per cent) of pesticide consumption in India (Gandhi & Namboodiri, 2006).

Hec in the Post Bt cotton period (2002-2008). Seed usage of 15 to 25 kg per hectare and 10-18 kg per hectare were generally used for American cotton and Desi cotton respectively. The average seed usage in Bt cotton, from the field survey was found to be around 2 Kg/Hec. This figure was much less then the data on seed usage provided by the Ministry of Agriculture, Government of India. After Bt cotton cultivation from 2002-03 onwards, the number of Non-Bt varieties reduced and currently about 85 per cent of the Cotton area was under Bt cotton hybrids that required comparatively less seed usage per hectare. Over the years, the Government data also showed a decline in the total seed usage per hectare in all the states. Inspite of using relatively less seed, farmers were realizing higher yields and thereby higher net returns. The proportion of seed cost to total cost showed increasing trends in most states in the Post-Bt cotton period. The all India average seed costs increased from Rs.650/Kg in the year 2005-06 to Rs.1239/Kg in 2008-09.

In the context of seed, it is important to mention that, there were over a 1000 Bt hybrid seeds that were being used by farmers in the study region. According to a 2001 report of the Central Institute of Cotton Research (CICR), a public sector institute, such huge proliferation of hybrid seeds would result in complicated insect pest problems that would affect Cotton yields. In 2009 CICR, in collaboration with the University of Agricultural Sciences (UAS), Dharwad, developed a Bt cotton variety (Bikaneri Narma) and an indegenous Bt cotton hybrid (NHH-44Bt). The Bt variety developed was the only variety of Bt cotton in India. However, farmers in the survey region had not used these, because they did not have much knowledge about it.

As regards the proportion of farmers using Bt cotton seeds from different seed companies in the surveyed regions, it was found that a high proportion of farmers (25.14 per cent) used seeds of Nuziveedu Seeds Pvt Ltd, followed by Shriram Bioseeds Genetics (20.57 per cent), Rasi Seeds Pvt. Ltd (19.24 per cent), Ankur Seeds Pvt Ltd (17.24%), Bayer Bioscineces Pvt Ltd (14.95 per cent), Mahyco Ltd (13.62 per cent) and Monsanto Holdings Pvt Ltd (6.29 per cent).

Human Labour

Over the years, proportion of human labour cost to total cost of cultivation of Cotton was the highest. It ranged between 25 and 50 per cent in various states. The proportion of human labour cost to total cost showed increasing trends in the Post-Bt cotton period (2002-2008). Further, the human labour use had increased from 96 Mandays/Hec in the Pre-Bt cotton period to 104 Mandays/Hec in the Post-Bt cotton period. Decline in labour use was observed mainly in the states of Andhra Pradesh and Tamil Nadu. It was found that over the years 1 per cent increase in yields resulted in a 0.12 per cent increase in labour employment that was statistically significant at 5 per cent level of significance. It was also observed through the field survey that, the average daily wages of landless labourers increased by more than 80 per cent from the Pre - Bt cotton to the Post - Bt cotton period, for all kinds of farm operations, in all the surveyed regions. The percentage increase in female labour wages was around 10 times more than their male counterparts. It was seen that at the all India level labour wages were highest for post harvesting operations followed by picking. Farmers in the study region complained of labour shortage problems mainly due to MNREGA and said that the labour shortage has been pushing labour costs upwards.

Machine Labour

The average per hectare costs of machine labour increased from Rs.732.06/Hec in the Pre-Bt cotton period (1996-2001) to Rs.1408.07/Hec in the Post-Bt cotton period (2002-2008). Growth rates of machine labour costs showed substantial increase in the Post-Bt cotton period in the major cultivating states. The cost of machine labour as a proportion of total costs showed increasing trends in the Post-Bt cotton period, excepting in Gujarat where it declined in 2008-09.

Prices

As regards Cotton prices it was seen that average minimum support prices (MSP) of Cotton increased from Rs.1775/Quintal in 2002-03 to Rs.3050/Qtl in 2011-12. The farm harvest prices (FHP) of Cotton also showed an increase across all states in the Post-Bt cotton period. However, both the MSP and FHP showed high fluctuations indicating instability in Cotton prices over the years in all states. Further, the MSP of long staple length Cotton in the country in 2010-11 was Rs.3000/Qtl. The field survey showed that farmers in all the states sold Cotton above the MSP, the all India average being Rs.4377.43/Qtl, excepting in Tamil Nadu, where it was slightly less.

Economics of Cotton Cultivation in India

To understand the economics of Bt cotton production, an analysis of cost of cultivation was undertaken through a field survey for the agricultural year 2010-11. The total costs taken was the per hectare total working capital which included per hectare cost of seed, fertiliser, micronutrients, growth regulators, farm yard manure, pesticide, irrigation, farm mechanisation and human labour costs. It was seen that the total working capital costs of cultivating Bt cotton in India was Rs.29496.78/Hec (Table 4). The highest cost was seen in case of Gujarat (Rs.35184.30/Hec) followed by Andhra Pradesh (Rs.34135.19/Hec), Haryana (Rs.33303.83/Hec), Punjab (Rs.32177.017/Hec), Maharashtra (Rs.28675.39/Hec) and Madhya Pradesh (Rs.24748.77/Hec). Relatively

lower costs were seen for Karnataka (Rs.24320.42/Hec) and Rajasthan (Rs.22034.99/Hec). Gujarat reported higher costs because of higher costs for usage of fertilizer and farm yard manure, especially in the Bhavnagar district compared to other districts and states. Further it was observed that the per hectare cost of cultivation declined across farm size categories, suggesting economies of scale in input costs for large farmers.

Among individual farm input costs, average seed cost in the country was Rs.2834.25/Hec. Seed costs were found to be highest in Punjab (Rs.4077.35/Hec) and lowest in Madhya Pradesh (Rs.946.27/Hec) and Andhra Pradesh (Rs.965.43/Hec). The average fertilizer cost in the country was Rs.2337.28/Hec, with the highest in Tamil Nadu (Rs.4765.15/Hec) and the lowest in Madhya Pradesh (Rs.2768.57/Hec). The all India growth regulator cost was Rs.89/Hec, with the highest cost in Maharashtra (Rs.427.97/Hec) especially Yavatmal district (Rs.628.20/Hec) and the lowest in Haryana (Rs.19.22/Hec) and Madhya Pradesh (Rs.9.18/Hec). The average cost of farm yard manure was Rs.1226.40/Hec, with the highest in Maharashtra (Rs.3598.52/Hec) and lowest in Tamil Nadu (Rs.33.75/Hec). The average micronutrient cost in India was Rs.287.89/Hec, with the highest in Maharashtra (Rs.741.12/Hec) and lowest in Madhya Pradesh (Rs.5.09/Hec). The average pesticide cost in India was Rs.2627.30/Hec with the highest in Punjab (Rs.3996.40/Hec) and the lowest in Tamil Nadu (Rs.1899.53/Hec). The average irrigation cost in the country was Rs.1079.56/Hec, with the highest in Gujarat (Rs.3010.70/Hec) and the lowest in Karnataka (Rs.299.74/Hec) and Punjab (Rs.300.756/Hec). Compared to other input costs the costs of human labour were very high (Rs.15540.88/Hec). They were found to be the highest in the Sirsa district of Haryana (Rs. 23348.82/Hec) and Andhra Pradesh (Rs. 21553.79/Hec). The lowest human labour cost was seen in Rajasthan (11223.70/Hec).

Among the various costs, proportions were highest for human labour (52.69 per cent of total cost) followed by cost of fertilizers (10.84 per cent), seeds (9.61 per cent), pesticides (8.91 per cent) and mechanization (8.86 per cent).

TABLE 4—BT COTTON—COST OF CULTIVATION (RS/HEC)

Region	State	District	Farm Size Categories	Seed Cost (Rs/Ac)	Fertilizer Cost (Rs/Ac)	Growth Regulators cost (Rs/Ac)	FYM Cost (Rs/Ac)	Micronutrient Cost (Rs/Ac)	Pesticide Cost (Rs/Ac)	Irrigation Charges (Rs/Ac)	Mechanisation Cost (Rs/Ac)	Human Labour Cost (Rs/Ac)	Total cost (Rs/Ac)	Gross Returns (Rs/Ac)	Net Returns (Rs/Ac)
			Small	371023	3325.90	4239	95.68	514.46	3469.68	63629	5401.95	19554.40	36750.97	10083459	6408161
			Medium	4114.48	3586.84	1339	0.00	554.67	3730.91	226.04	504731	17470.84	34744.48	10280l.45	6805698
		Bhatinda	Large	2722.80	3700.97	0.00	0.00	340.86	4314.44	210.72	405l.71	16611.46	31952.91	91496.70	59543.74
			District Average	3822.56	3576.13	14.46	1l.27	512.40	3802.56	271.68	4914,33	17565.47	34490.87	100585.31	66094.44
		Punjab	Small	4240.53	2712.l2	11135	6'23.38	704.30	3826.44	611.54	5223.46	15999.99	34053.11	11533.67	77480.56
			Medium	433l.45	2744.91	295.40	219.02	807.54	4288.79	254.22	4078.96	11886.70	28906.99	121978.14	93071.15
		Fazilka	Large	4381.08	3082.43	267.03	287.05	710.29	4265.26	247.00	3807.54	11581.03	28628.70	115102.00	86473.30
			District Average	4324.47	282273	248.88	32265	761.00	4183.93	328.87	4255.66	12690.09	29938.28	118014.70	88076.42
	Puab	Average		4077.65	3193.21	133.60	169.53	638.75	3996.40	300.75	4579.56	15087.55	32177.01	109443,84	77266,83
			Small	3081.25	3352.97	0.00	0.00	58.75	2781.75	2729.55	2677.58	19217.26	33899.12	100532.17	66633.05
			Medium	3169.12	3439.26	0.00	155.02	141.69	3358.61	2237 .57	3100.96	15034.06	30636.89	115575.02	84938.13
Northern		Hissar	Large	3477.55	3252.85	0.00	295.43	31.63	2787.65	1581.55	3317.06	13817.73	2856l.45	120553.24	91991.79
Region			District Average	3269.66	3351.29	0.00	178.10	83.47	3027.80	2084.14	3100.21	15391.65	30486.31	114519.40	84033.09
		Haryana	Small	2996.58	1940.68	0.00	0.00	252.39	2226.29	2499.42	2626.66	23616.54	36158.57	91710.75	5552.18
			Medium	2773.43	2703.92	75.49	0.00	415.72	2705.47	2381.18	2441.89	23511.844	37008.95	104694.42	67685.47
		Sirsa	Large	2960.01	3456.62	46.02	414.22	530.36	3036.74	1410.93	2462.73	22977.79	37295.43	107053.79	69758.36
			District Average	2903.68	2759.95	43.56	149.36	410.97	2689.70	2064.69	2501.55	23348.82	36872.28	101881.24	65008.97
		Haryana	Merage	3108.19	3090.39	19.22	165.42	227.96	2878.63	2075.56	2836.08	18902.39	33303.83	108943.38	75639.54
			Small	1866.39	3162.90	0.00	0.00	442.54	1800.71	629.84	2998.68	13089.74	23990.81	131991.20	108000.39
		Hanumangrah	Medium	1767.95	3316.47	0.00	0.00	493.16	2275.41	556.42	2767.84	108l3.55	21990.81	137683.31	115692.50
			Large	1909.77	2286.45	182.96	0.00	698.l9	2025.77	453.65	2375.00	10461.26	20393.04	123587.09	103194.05
	Rajasthan														
			District Average	1824.24	3030.14	44.91	0.00	532.44	2110.57	547.21	2721.78	11223.70	22034.99	132981.41	l10946.42
		Rajasthan	Average	1824.24	3030.14	44.91	0.00	532.44	2110.57	547.21	272l.78	11223.70	22034.99	132981.41	l10946.42

TABLE 4—BT COTTON—COST OF CULTIVATION (RS/HEC)

Region	State	District	Farm Size Categories	Seed Cost (Rs/Ac)	Fertilizer Cost (Rs/Ac)	Growth Regulators (Rs/Ac)	FYM Cost (Rs/Ac)	Micronutrient Cost (Rs/Ac)	Pesticide Cost (Rs/Ac)	Irrigation Charges (Rs/Ac)	Mechanisation Cost (Rs/Ac)	Human Labour Cost (Rs/Ac)	Total cost (Rs/Ac)	Gross Returns (Rs/Ac)	Net Returns (Rs/Ac)
			Small	3816.43	4233.91	0.00	3267.S8	0.00	2216.50	3555.02	3502.29	18840.01	39431.80	105686.16	66254.36
			Medium	2539.80	4656.51	0.00	3201.45	0.00	2812.45	2879.42	2142.61	16359.83	35192.08	120195.51	85003.43
		Bhavnagar	Large	308836	4080.87	0.00	3841.82	0.00	2882.48	283223	3405.68	16347.10	36418.54	94518.31	58039.77
			District Average	2863.13	4466.87	0.00	3346.50	0.00	2729.89	2979.77	3005.59	16761.87	36153.61	112444.43	76290.82
	Gujarat		Small	4776.01	3278.61	0.00	2847.64	0.00	2932.81	3937.57	3658.38	17321.90	38752.91	139178.74	100425.83
		Surendra	Medium	2558.67	2706.10	0.00	1915.43	0.00	3061.05	2507.47	2054.92	16181.48	31585.13	134272.81	102687.68
		nagar	Large	2300.81	2593.50	0.00	568.10	0.00	275835	2699.58	1794,87	14807.65	27522.86	14912625	121603.39
			District Average	3331.06	2898.28	0.00	2044.94	0.00	2966.33	3062.11	2601.88	16668.61	33573.20	138412.19	104838.99
		Gujarat	Average	3038.90	3877.64	0.00	2857.58	0,00	2818. 71	3010.70	2853.94	16726.84	35184.30	122198.97	87014.67
			Small	2692.08	2558.95	0.00	3407.10	0,00	1829.15	1816.21	2090.82	17687.64	32081.94	69380.80	3729.86
			Medium	2666.14	3015.63	0.00	1139.62	24.18	1942.67	889.13	216526	15443.35	27285.98	63400.14	36114.16
		Dhar	Large	1935.06	3025.64	0.00	455.96	0.00	2309.11	529.68	895.20	14102.58	23253.22	60212.13	36958.91
			District Average	2272.64	2991.22	0.00	918.11	9.53	2133.34	755.36	1473.85	14865.12	25419.17	62067.33	36648.15
Central Region	Madhya Pradesh		Small	3323.42	2474.67	0.00	4370.00	0.00	1881.65	1805.73	2241.56	13772.42	29875.43	81000.96	51125.52
			Medium	2543.43	2713.55	48.14	1042.21	0.00	2478.60	961.09	1632.21	12452.93	23878.16	83989.48	60111.32
		Khargone	Large	2183.41	2361.70	0,00	1548.05	0.00	2212.33	168.34	1220.62	12966.75	23261.20	78442.72	55181.52
			District Average	2411.30	2513.64	19.70	1S40.55	0.00	2298.32	922.99	1461.18	12813.47	23981.15	80893.02	56911.87
		Madhya Pradesh	Average	2337.28	2768.57	9.18	1208.30	5.09	2210.25	833.51	1467.95	13908.64	24748.77	70843.90	46095.14
			Small	2717.49	2719.81	271.17	4010.38	872.92	1705.16	1385.54	2440.80	13296.43	29419.69	7427920	44859.51
			Medium	2982.75	2711.75	455.70	2409.90	569.16	2048,61	940.87	1952.14	13069.07	27139.94	62608.98	35469.04
		Jalgaon	Large	3509.06	1850.84	0.00	3294.13	0,00	1611.98	731.50	1844.58	10794.09	23636.18	49306.12	25669.94
			District Average	3091.71	2400.63	232.82	3225.32	455.46	1783.69	1001.66	2063.58	12310.44	26566.30	61360.23	34793.93
		Maharashtra													
			Small	2428.16	2979.24	349.19	4663.36	1047.22	2095.45	1116.10	1242.44	14701.06	30622.21	78675.20	48052.99
			Medium	2330.49	4114.30	1265.47	2446.34	1071.24	2828.68	556.66	1334.60	15203.59	31151.38	85626.41	54475.03
		Yavatmal	Large	2223.00	3501.07	421.80	4468.17	991.17	2676.45	507.30	1840.21	14195.04	30824.20	97532.81	66708.61
			District Average	2329.24	3476.19	628.10	3981.45	1034.23	2501.94	747.96	1477.41	14662.81	30839.43	87206.60	56367.1
		Maharashtra	Average	2715.88	2931.49	427.97	3598.52	741.12	2138.20	876.44	1774.26	13471.50	28675.39	74117.22	45441.83

TABLE 4—BT COTTON—COST OF CULTIVATION (RS/HEC)—*Contd.*

Region	State	District	Farm Size Categories	Seed Cost (Rs/Ac)	Fertilizer Cost (Rs/Ac)	Growth Regulators (Rs/Ac)	FYM Cost (Rs/Ac)	Micronutrient Cost (Rs/Ac)	Pesticide Cost (Rs/Ac)	Irrigation Charges (Rs/Ac)	Mechanisation Cost (Rs/Ac)	Human Labour Cost (Rs/Ac)	Total cost (Rs/Ac)	Gross Returns (Rs/Ac)	Net Returns (Rs/Ac)
			Small	230359	4232.65	0.00	0.00	182.05	2074.05	606.98	2812.51	19521.00	31712.84	72148.60	40415.76
			Medium	2488.72	396020	0.00	0.00	5033	1764.43	480.42	2724.10	22986.08	34454.29	75835.73	41381.44
		Adilabad	Large	2084.97	4162.68	0.00	0.00	363.24	2373.23	224.09	2324.71	21503.53	33036.44	69624.94	35588.50
			District	2378.17	4064.81	0.00	0.00	132.79	1939.47	477.05	2689.07	21817.75	33499.10	73905.37	40406.28
	Andhra		Average												
	Pradesh		Small	2511.64	3276.98	106.00	1308.08	422.98	3191.52	529.66	2945.96	22180.13	36472.95	137838.68	101365.74
			Medium	2244.44	3471.22	119.97	1888.63	428.13	2675.77	413.69	2781.69	21321.81	35345.35	164184.43	128839.08
		Warangal	Large	2113.22	3377.54	0.00	5488.89	1097.78	1697.99	180.49	2085.78	10808.61	26850.29	135026.67	108176.38
			District	2397.21	3345.64	102.24	1811.39	476.44	2914.99	466.45	2828.35	21037.26	35379.96	145887.32	110507.36
			Average												
		Andhra Pradesh	Average	2384.61	3821.59	34.58	612.60	249.01	2269.38	473.46	2736.17	21553.79	34135.19	98249.15	64113.96
Southern			Small	2764.64	3039.20	0.00	1487.51	77.19	2058.47	315.23	1892.34	14421.74	26056.32	86579.56	60523.25
Region															
			Medium	3098.82	3109.46	0.00	1296.75	0.00	2410.31	316.50	1690.77	11487.92	23410.52	112182.60	88772.07
		Darwad	Large	2429.86	294136	0.00	1080.63	0.00	1672.19	115.88	1216.15	6807.62	16263.69	159932.50	143668.81
	Karnataka														
			District	2858.16	3056.67	0.00	1386.29	43.23	2154.23	299.74	1765.68	12756.44	24320.42	101664.89	77344.47
			Average												
		Karnataka	Average	2858.16	3056.67	0.00	1386.29	43.23	2154.23	299.74	1765.68	12756.44	24320.42	101664.89	77344.47
			Small	2504.97	4870.77	0.00	0.00	0.00	1971.41	1454.52	3851.75	19481.66	34135.09	78116.82	43981.73
		Virudunagaar	Medium	2692.70	4585.68	0.00	91.11	0.00	1777.38	1289.99	3849.42	18476.41	32762.69	88002.86	55240.11
	Tamil		Large	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Nadu		District												
			Average	2574.52	4765.15	0.00	33.75	0.00	1899.53	1393.56	3850.89	19109.23	33626.64	81779.43	48152.79
		Tamil Nadu	Average	2574.52	4765.15	0.00	33.75	0.00	1899.53	1393.56	3850.89	19109.23	33626.64	81779.43	48152.79
			Small	2979.81	3261.21	80.60	1748.02	365.03	2391.50	1490.64	3008.93	17427.17	32752.92	96340.36	63587.44
			Medium	294839	3346.51	113.86	928.42	299.11	2779.23	1061.69	2877.12	15610.54	29964.86	100265.78	70300.92
		ALL INDIA	Large	2569.14	2939.08	59.54	1282.45	217.49	2577.47	814.97	1962.35	14110.94	26533.43	85949.37	59415.94
			All India	2834.25	3197.05	89.00	1226.40	287.89	2627.30	1079.56	2614.45	15540.88	29496.78	94804.60	65307.82
			Average												

Source: Primary Field Survey

The average value of output or gross returns from Bt cotton at the all India level was Rs.38382.43/Hec. The highest value of output was seen in the Hanumangarh district of Rajasthan (Rs.53838.63/Hec). This was followed by Gujarat (Rs. 49473.27/Hec) wherin the contribution of Surendranagar was Rs.49473.27/Hec. The gross returns from Warangal district of Andhra Pradesh was also very high (Rs. 59063.69/Hec), though the average of Andhra Pradesh was relatively low at Rs.39777/Hec. The lowest gross returns were seen for Maharashtra (Rs.30007/Hec) followed by Madhya Pradesh (Rs.28681.74/Hec). The per hectare value of output was scale neutral across farm size categories.

The ensuing net returns per hectare derived from the cost of cultivation analysis (total working capital) of Cotton was found to be positive in all the regions indicating profits to farmers from cultivation of Bt cotton. The average net returns from Bt cotton at the all India level was Rs.65307.82/Hec. The highest net return per hectare was seen in the Hanumangarh district of Rajasthan (Rs.110947 .46/Hec). This was followed by Gujarat (Rs.87014.67/Hec) wherein the contribution of Surendranagar was Rs.I04839.15/Hec. The net returns from Warangal district of Andhra Pradesh was also very high (Rs.ll 0507 .35/Hec), though the average of Andhra Pradesh was relatively low at Rs.64113.96/Hec. The lowest net returns were seen in Maharashtra (Rs.45441.82/ Hec) followed by Madhya Pradesh (Rs.46095/Hec). The per hectare net returns were scale neutral across farm size classes.

It was noticed from secondary data received from the Ministry of Agriculture that the average per hectare cost of cultivation increased by 67.68 per cent from the Pre-Bt (1996-2001) to the Post Bt- cotton period (2002-2009) (Table 5). The per hectare value of production also increased by 94.06 per cent during the same period. The average net returns per hectare increased significantly from the Pre to the Post-Bt cotton period by 375 per cent (Table 6). Thus, the percentage change in value of production and net returns per hectare from the Pre-Bt cotton to the Post Bt cotton period were high enough to offset the increase in per hectare cost of cultivation of Bt cotton in the major cultivating states in India. This showed that despite high cost of cultivation, farmers were deriving benefits from Bt cotton cultivation. However, amongst all states, the net return per hectare was seen to be the least in Maharashtra (Rs.1143/Hec).

TABLE 5—COST OF CULTIVATION (COST C2[6]) OF COTTON (RS/HEC)

States	Average Cost of Cultivation (Rs/Hec) Pre Bt cotton Period (1996-2001)	Post Bt cotton Period (2002-2008)	% Change	Growth Rates (%) 1996-2001	2002-2009	2006-07 to 2008-09 Average (Rs./Hec)
Andhra Pradesh	21825.94	35067.46	60.67	-1.91	5.88	40021.06
Gujarat	14839.28	27473.16	85.14	1.85	13.63	32799.56
Haryana	18716.10	33853.11	80.88	7.17	17.98	36224.79
Madhya Pradesh	9966.76	25680.99	157.67	-1.45	8.71	28878.96
Karnataka	10393.57	15045.83	44.76	4.67	10.73	18888.47
Maharashtra	13938.44	23314.51	67.27	7.15	6.17	26384.99
Punjab	24369.08	40508.69	66.23	10.97	14.04 .	42728.43
Rajasthan	14603.15	26210.32	79.48	4.08	18.97	29082.39
Tamil Nadu	26036.26	31467.35	20.86	7.38	1.76	32816.12
India	16348.70	27412.70	67.68	3.98	8.45	31980.53

Source: Calculations based on data from Directorate of Economics and Statistics, Ministry of Agriculture, GOI

[6] Cost C2 includes variable and fixed costs of cultivation

TABLE 6—AVERAGE NET RETURNS (RS/HEC.)

States	Pre Bt cotton Period (1996-2001)	Post Bt cotton Period (2002-2008)	% Change	2006-07 to 2008-09 Average (Rs/Hec)
Andhra Pradesh	827.20	5583.18	574.95	7788.22
Gujarat	2343.19	10070.04	329.76	12767.40
Haryana	893.25	5609.57	527.99	8499.93
Madhya Pradesh	-356.40	1202.47	437.39	5003.58
Karnataka	-483.19	3092.97	740.12	4468.53
Maharashtra	-800.05	-195.87	75.52	1142.73
Punjab	-2272.45	10374.81	556.55	11798.49
Rajasthan	5570.30	10672.20	91.59	11677.97
Tamil Nadu	-2972.97	-1762.89	40.70	3429.07
India	305.43	4960.72	374.95	7397.32

Source: Calculations based on data from Directorate of Economics and Statistics, Ministry of Agriculture, GOI

Factors Affecting Cotton Yields

The ordinary least squares (OLS) estimates of Bt cotton productivity (Cobb-Douglas) were used to see the impact of various input variables on per hectare gross value of output from Bt cotton. The regressions were based on primary survey data. The log linear transformation of this productivity function is stated as follows;

log Bt CGVO = log C + bi log NCA + b2 log HL + b3 log MH + b4 log S + b5 log F + b6log P+ b7 log GR+ b8log FYM+ b9log M +biO log I

Where,

Bt CGVO_hc = Gross Value of Output of Bt cotton (Rs/Hec), NCA = Net cultivated area (Hec), HL - hec = Human labour use (Rs/Hec), MH - hec = Mechanisation cost (Rs/Hec)

S_hec = Seed costs (Rs/Hec), F yec = Fertilizer costs (Rs/Hec), P _hec = Pesticide costs (Rs/Hec), GR - hec = Growth regulator costs (Rs/Hec), FYM - hec = Farm yard manure costs (Rs/Hec), M - hec = Micronutrient costs (Rs/Hec) and 1- hec =+ Irrigation costs (Rs/Hec)

TABLE 7—PRODUCTIVITY FUNCTION (COBB DOUGLAS METHOD)

Regions	States	Districts	R-Square	NCA	Seed Cost	Fertilizer Cost	Growth Regulators Cost	FYM Cost	Micrountr-ient Cost	Pesticide Cost	Irrigation Cost	Mechanisa-tion Cost	Labour Cost
		Batinda	034	-0.047	0.036	0.142	0.037***	0.017	0.013	0.082	-0.071	-0.026	0.054
	Punjab												
		Fazilka	0.27	0.0!2	0.805**	-0.044	-0.008	.0.017*	0.025*	0.046	-0.057	-0.051	0.023
Nothern		Hissar	034	-0.024	-0.116	0.080		0.003	0.017	0.286***	-0.001	0.065	-0.044
Region	Haryana												
		Sirsa	033	0.036	-0.045	0.169	0.005	0.000	0.023**	-0.116	-0.160	0.008	0.123*
	Rajasthan	Hanumangarh	0.25	-0.050	-0.229**	0.166***	0.069***		-0.006	0.010	0.041	-0.164**	-0026
		Bhavnagar	0.15	-0036	-0.001	-0.093		-0.008		0.041	-0.068	-0.087	0.259***
		Gujarat											
		Surendranagar	0.15	-0.023	.0308**	0.111		0.008		.0101	0.10	0.096	0.140
Central	Madhya	Dhar	0.12	0.124*	0.137	0.125		0.024	-0.023	-0.153	0.219**	0.036	.0024
Region	Pradesh	Khargone	0.25	-0.005	0.117	0.063	-0.051*	0.020		0.098	0.012	-0.060	-0.179
		Jalgaon	0.31	-0.131	0.023	0.133	0.034	0.001	0.005	-0.083	0.057	-0.190	.0.103
	Maharashtra												
		Yavatmal	018	0.142	0.041	0.053	0.014	0.016	0.008	-0.058	0.152	0.088	-0.092
	Andhra	Adilabad	0.14	0.062	.0156	-0.110			0.004	0.209**	.0.021	0.109	0.072
Southern	Pradesh	Warangal	0.24	0.164***	0.148	-0.127	0.024	0.025'*	-0.007	0.024	0.220**	-0.110	-0.021
Region	Karnataka	Dharwad	0.18	0107	-0.045	-0044		0.032'**	-0.041	.0.096	-0.178	0.069	-0.010
	Tamil Nadu	Virudunagar	0.24	0.114	0.150*	0.034		0.020		.0.077*	-0059	.0.414***	0.046
All India			0.11	.0.003	-0.03	0.08***	.0.02	0.001	0.021***	0.119***	0.035***	0.122***	-0.03

Source: Based on Primary Field Survey

Notes: *** statistically significant at 1 per cent, ** statistically significant at 5 per cent, * statistically significant at 10 per cent

At the very outset it is important to note that the R squares in each of the regressions presented in Table 7 are low because usually aggregate crop production functions (all crops in an agricultural year) are observed to be more neatly estimated and free from estimation distortions/abnormalities that at times accompany individual crop functions (in this case Bt cotton). This is due to the fact that the latter do not account for indirect production benefits. To illustrate, the externalities enjoyed by a crop because of the application of intensive inputs of plant nutrients in the preceding crop can only be accounted for in the aggregate crop production functions (Sharma 1992).

From the regression exercise it is seen that, at the all India level, per hectare cost of fertilizers, micronutrients, pesticides, irrigation and mechanization showed a positive and statistically significant relationship at 1 per cent level of significance with the productivity of Bt cotton. Net cultivated area, per hectare cost of seed, growth regulators and labour costs showed a negative though statistically non-significant relationship. A positive and statistically significant relationship was seen between farm size and Bt cotton productivity in the Warangal district of Andhra Pradesh and Dhar district of Madhya Pradesh. Bt cotton seed showed a negative but statistically non-significant relationship with productivity. This may be due to the fact that the huge proliferation in hybrid Bt seeds in the recent years was compromising on quality parameters. Hence, unavailability of high yielding quality of Bt cotton seeds seemed to be significantly affecting Bt cotton yields in some districts, especially Hanumangarh in Rajasthan and Surendranagar in Gujarat. Improper applications of growth regulators were significantly affecting Bt cotton yields in the Khargone district of Madhya Pradesh. Hence balanced application of growth regulators was needed in this region. Improper applications of farm yard manure were significantly affecting Bt cotton yields in the Fazilka district of Punjab. Hence balanced application of farm yard manure was needed in this district. Improper methods and techniques of mechanization in Bt cotton fields were significantly affecting Bt cotton yields in the Hanumangarh district of Rajasthan and Virudunagar district of Tamil Nadu. Hence mechanization techniques needed to be properly executed in these regions. For all other input variables such as per hectare cost of fertilizers, pesticides, micronutrients, irrigation and human labour the relationship was negative in certain regions but not statistically significant.

Farmers' Perception of Bt cotton

As regards perception of farmers on various issues of Bt cotton, it was seen from the field survey that, 95 per cent farmers said that Bt cotton yields were higher than Non-Bt cotton and 88 per cent said that returns were also higher. 85 per cent farmers said that the quantity of seed usage per hectare on Bt cotton was less than that used in Non-Bt cotton. However, 93 per cent farmers said that the expenditure on Bt cotton seeds was more than Non-Bt cotton. 4 per cent farmers said that they had faced problems of spurious seeds. Most of the states conformed to this, excepting Gujarat, wherein 21 per cent farmers said that they had faced such a problem. All proportions were very similar across all the surveyed districts and across different farm size categories. 85 per cent farmers did not plant 'refuge crops'[7] alongside their Bt cotton plots. This was because farmers aimed at getting higher yields and earn higher income on maximum areas. Further, the proportions were generally skewed towards large farmers in most of the surveyed districts. This meant that small farmers were taking more risk by devoting the entire area to Bt cotton in order to derive maximum benefits. A relatively higher proportion of farmers (54 per cent), reported greater fertilizer usage on Bt cotton compared to Non Bt cotton. At the all India level, 77 per cent farmers reported that the quantity of pesticide usage on Bt cotton had reduced over the years, and 79 per cent said that the expenditure on pesticide use for Bt cotton had also reduced. However, a relatively higher proportion of farmers (63 per cent) in the Hanumangarh district of Rajasthan, Yavatmal district of Maharashtra (90 per cent) and Virudunagar district of Tamil Nadu (79 per cent) reported an increase in pesticide usage and a commensurate increase in pesticide expenditure. As regards the role of Bt cotton in minimizing the attack of Bollworms, 90 per cent farmers claimed that Bt cotton had reduced the attack of Bollworms. Only in certain regions like Sirsa, Dharwad and Virudunagar, relatively higher proportion of farmers (30-40 per cent) reported that the attacks of Bollworm had increased. As regards irrigation expenditure, a relatively higher proportion of farmers (65 per cent) said that irrigation expenditure on Bt cotton was higher than Non-Bt cotton. In the states of Gujarat, Maharashtra and Andhra Pradesh, some farmers (less than 10 per cent) reported adverse effects of Bt Cotton on human and animal health, although they could not explicitly mention the why and how of it. Further, a small proportion of farmers (less than 10 per cent) in all the surveyed states reported negative effects of Bt cotton on soil quality on account of rising soil salinity and alkalinity.

On the issue of farmers' suicides, among the households surveyed, 5 per cent small farmers in Jalgaon and Yavatmal districts of Maharashtra and 3 per cent medium farmers in Adilabad district and 2 per cent small

[7] Fields with Bt crops are required to provide refuge areas to help control resistance. The refuge area supplies a source of wild type (non-mutant) insects to mate with possible resistant insects to produce nonresistant insects. Bt crops are planted with alternating rows of regular non-Bt crops. The insects that have developed resistance to Bt have more chances of mating with an insect that has not developed resistance to Bt. By the laws of genetics, the progenies produced will be insects that are not resistant to Bt.

farmers in the Warangal district of Andhra Pradesh reported farm related suicide within their families. Farmers in the central Indian region blamed the suicides mainly on low and erratic nature of rainfall as this was a rainfed region without much irrigation facilities, unavailability of timely credit and low and fluctuating Cotton prices over the years that made production risky in certain years. Further, the proportion of income from secondary or non-farm sources was found to be less than 1 per cent of farmers' incomes. As regards credit availability farmers reported that the transaction and borrowing costs associated with getting loans from institutional sources of credit was proving to be a cumbersome process especially for the small and medium farmers. Hence, these farmers depended more on non-institutional sources of credit such as money lenders, arhatiyas (middle men), relatives and friends wherein, transactions associated with getting loans was less cumbersome compared to getting loans from institutional sources, but inevitably riskier.

The field survey also documented farmers' and landless labourers' perceptions of increased returns from Bt cotton on their livelihoods. On an average 87 per cent farmers and landless labourers reported that, as a result of higher returns from Bt cotton, they invested in better quality education for their children, 80 per cent reported intake of high value and nutritious food, 75 per cent in recreation and social functions, 80 per cent on health of their family members and 70 per cent on health of livestock. At the same time the incomes were not high enough to afford a high standard/luxurious of living to the extent of buying huge property, excepting in the case of large farmers.

Conclusions and Policy Directions

In conclusion it can be said that the high proportion of Cotton area coverage by Bt cotton in India (above 90%) is an indication of the huge popularity that it enjoys in terms of higher returns. The advent of Bt cotton transformed India from a net importer into a net exporter of Cotton. Ever since its cultivation in India in 2002-03, Cotton area, production and yield increased substantially, however instability also increased and yields showed a decline since 2008-09 onwards. This was presumably under the impact of marginal lands (shallow soils, rainfed areas) being brought under Cotton cultivation, especially in the states of Maharashtra and Madhya Pradesh, erratic weather conditions and increased attacks by sucking pests not controlled by insecticides or by the current Bt technologies.

Pesticide consumption and seed use in Cotton declined in the post Bt cotton phase. However, fertilizer consumption and human labour use increased and the expenditure on inputs have also registered an increase. The minimum support price and the farm harvest price of Cotton increased over time, but also showed high fluctuations indicating instability in Cotton prices. Secondary data show that though cost of cultivation of Cotton increased in the post Bt cotton phase, its value of output and net returns also increased significantly, which shows that despite high cost of cultivation farmers were deriving benefits from Bt cotton cultivation in most states. The study shows that the overall economic impact of Bt cotton during the past 10 years has been quite encouraging. Also, by and large, the farmers expressed the view that the overall social impact has been positive.

However, there is a need to do further research in those regions where farmers reported an adverse impact of Bt Cotton on human and animal health and soil quality and where net returns were observed to be quite low such as in Maharashtra. Secondly, the socio-economic impact of Bt cotton has to be further examined through a thorough empirical analysis. Thirdly, since Bt cotton is affected by moisture stress hence, efficient use of scarce and costly irrigation water is of paramount importance in the Bt cotton crop system. Fourthly, a large number of Bt hybrids seem to be compromising quality parameters with the resultant shortage of good high yielding quality seeds. This kind of seed proliferation also complicates the insect pest problems. Hence seed companies should enlist few of their best Bt hybrids and promote them according to specific agro-ecological regions. Further, efforts made by the public sector in developing indigenous varieties and hybrids should be tested and widely promoted by the Government. A healthy competition of the public sector with private sector seed companies could give Monsanto's monopoly on the Bt gene a competition. Fifthly, farmers in the survey regions complained about low and fluctuating Cotton prices that make production risky. From a social point of view, it's a policy imperative to help Indian farmers such that they earn their living from growing Cotton, without having to take unacceptable risks. The Government should ensure that Cotton growers in all the regions earn reasonable profit in a stable manner by way of effective implementation of timely credit support and remunerative price support. Many of these lacunae could automatically get removed if extension services were revamped and supportive infrastructure services were strengthened and rendered more efficient.

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Government Spending and Agricultural Development in Indian Major States

K.Murugan*

Dr. K.Jothi Sivagnanam**

Introduction

Agriculture makes the largest contribution to economic growth in many developing countries. Growths in developing countries are dependent upon the nature and extent of agricultural development. There are functional relationships between agricultural development and government spending on this sector; and it is one of the important tools for promoting economic growth. Public expenditure on agricultural sector is directly influenced by the process of growth (Jothi Sivagnanam, 2006).

Government expenditure on productivity-enhancing investments such as agricultural development, irrigation, rural infrastructure and rural development have therefore to be targeted directly at the rural people. Further, it shows that the country has contributed to reduction in rural poverty while at the same time to reduction in growth in agricultural productivity [Fan and Throat (2000)]. The overall effectiveness of public expenditure in agriculture has however been raising farm productivity and lowering poverty (World Bank, 2004) and the need for public investment in agriculture, irrigation, credit availability, better marketing of agricultural products (Mahendra Dev, 2002).

Empirical Studies

Government spending on productivity investments such as agricultural research and development, irrigation, rural infrastructure and rural development. has positive effect on reductions of rural poverty and productivity. Additional expenditures on education has the largest impact on reduction of rural poverty and growth of agricultural productivity. The irrigation investments have much more favourable impacts in rain-fed areas as well as government additional spending on soils and water conservation, rural community development, and integrated rural development programmes with positive impacts on reduction of poverty and improvement in agricultural development (Fan, Hazell, and Thorat, 2000).The importance of agricultural investments and their impact on economic growth in the agricultural sector in the States of India since 1990 are done by Golait and Lokare (2008). The study shows that the share of agriculture is below the national average in the case of agriculturally important States such as Punjab, Uttar Pradesh, Gujarat, Bihar and Karnataka. Less capital formation, technology and the infrastructural development are effected the agricultural productivity in these States.

TABLE 1—Revenue Expenditure on Agricultural Sector to GSDP by Major States 1990-2010)

(At Current Prices)

States	1990-95	1995-00	2000-05	2005-10	ACGR *
High Income States	1.01	0.72	0.63	0.67	-2.04
Gujarat	0.80	0.54	0.55	0.56	-1.80
Haryana	1.10	0.73	0.56	0.77	-1.72
Maharashtra	1.41	1.03	0.88	0.85	-2.49
Punjab	0.75	0.59	0.52	0.50	-1.97
Middle Income States	1.38	1.00	0.72	0.84	-2.47
Andhra Pradesh	0.85	0.59	0.54	0.69	-0.99
Karnataka	1.36	1.26	1.06	1.55	0.65
Kerala	1.58	1.23	0.80	0.82	-3.20
Tamil Nadu	2.25	1.30	0.75	0.69	. -5.75

* Research Associate, Agro Economic Research Centre, University of Madras Chennai.

**Director, Agro Economic Research Centre, University of Madras Chennai.

TABLE 1—REVENUE EXPENDITURE ON AGRICULTURAL SECTOR TO GSDP BY MAJOR STATES 1990-2010)—*Contd.*

(At Current Prices)

States	1990-95	1995-00	2000-05	2005-10	ACGR *
West Bengal	0.87	0.60	0.47	0.43	-3.48
Low Income States	1.41	1.19	0.81	1.02	-1.60
Bihar	.1.22	1.25	0.58	0.79	-2.13
Madhya Pradesh	1.94	1.76	1.30	1.64	-0.82
Odisha	1.79	1.48	0.99	1.21	-1.93
Rajasthan	1.15	0.70	0.56	0.67	-2.66
Uttar Pradesh	0.93	0.78	0.64	0.77	-0.94
Major States	1.29	0.99	0.73	0.85	-2.06

Source: Reserve Bank of India, A Study of State Finance, (Various Issues) Budget of the State Governments .

NOTE: Annual Compound Growth Rate has been computed using the formula: $(Y_{t-1}$ Yt) ^(1/20)-1)*100 In this study, Y_{t-1}-2005-10 and Y_t is the year 1990-95.

Table 1 shows the average annual share of revenue expenditure on agricultural sector to the GSDP at current prices by the major States during 1990-95 to 2005-10. The low income States have allocated public expenditure on agricultural sector in a way that it has declined over the years by -1.60 per cent of annual growth rate with actual agricultural sector allocation reduced from 1.41 per cent in 1990-95 to 1.02 per cent in 2005-10, even as the allocation touched a deep low at 0.81 per cent to the GSDP in 2000-05. Government allocations have been reduced through neglect of the sector and migration of allocation from agriculture to industry.

It is a point of fact that the highest reduction of allocations to agricultural sector have been by the middle and higher income States which have recorded a negative growth of allocation at-2.47 per cent and -2.06 per cent over the years. The States of high income category have slashed their expenditure from 1.01 per cent in 1990-95 to 0.67 per cent in 2005-10. While, middle income states have also declined their expenditure from 1.38 per cent in 1900-95 to 0.84 per cent in 2005-10. The high income States have also been spending less than the share of the major states, all through the years even as the decline in public spending by the major States has amounted to-2.06 per cent, which is almost equal to that of the high income States. This low spending on agriculture may be attributed to the increased focus and investments on other sectors like the industry and services sector. It is rather strange that all States except Karnataka have shown declines in investments in agriculture with the highest decline (-5.75 per cent) from Tamil Nadu, followed by West Bengal (-3.48 per cent), Kerala (-3.20 per cent), Rajasthan (-2.66 per cent), Maharashtra (-2.49 per cent) and Bihar (-2.13 per cent).

Thus 13 major States of the Indian Union have had reduced allocation and therefore reduced spending on agriculture in the last 20 years, with the exception of Karnataka. Among the States with the least reduction are Madhya Pradesh (-0.82 per cent), Uttar Pradesh (-0.94 per cent) and Andhra Pradesh (-0.99 per cent). It is the high priorities given to other sectoral growth in these States that has led to greater neglect of agriculture. Low income states however have securing greater levels of investments in agriculture than either the middle income or high income States of the Union. In agriculture, due primarily to low productivity, continuing poverty and widening regional disparities, investments are a must and they must be made at a higher level than are being invested now. The main issues in agricultural sector, for that matter in other sectors, are the very low water rates, poor collection efficiency, high production costs and lack of maintenance of irrigation infrastructures. Concerted efforts need to be made to overcome these problems even as investments are to be increased to a level at which the sector could look up in the positive way.

Capital expenditure on agriculture by major States of India present a similar pattern, negative growth in most States in the last 20 years. Exceptions are Tamil Nadu (8.45 per cent), Uttar Pradesh (3.77 per cent) and Rajasthan (0.03 per cent) where capital investments have shown greater increases over the years (Table 2). However, the share of the capital expenditures in eleven States has been rather very small and declined one. Among the different level of States, annual compound growth rate of capital allocation to agriculture sector by middle income States have positive growing trends of 1.86 per cent, which has improved from 0.07 per cent in 1990-95 to 0.10 in 2005-10. While annual growth rate of government expenditure to agriculture sector of high and low income

states have decline trends. Among them, Maharashtra is the only one with relatively higher share of the GSDP but at levels not exceeding 0.22 per cent in both 1990-95 and 1995-2000. In the subsequent years, the average share has declined further to 0.15 per cent in 2000-05 and 0.14 per cent in 2005-10.

The Tamil Nadu Govemment has put in more public investment in irrigation and dams while the Uttar Pradesh Govemment has also put in on similar capital investments on irrigation, dams, power supply, fertilizers and seeds. Free power supply is another area on which several Govemments have invested money. Tamil Nadu and Andhra Pradesh are good examples of such investments.

TABLE 2—CAPITAL EXPENDITURE ON AGRICULTURAL SECTOR BY MAJOR STATES TO GSDP

States	1990-95	1995-00	2000-05	2005-10	ACGR*
High Income States	0.14	0.06	0.10	0.04	-5.61
Gujarat	0.17	0.12	0.10	0.08	-3.79
Haryana	0.10	0.05	0.06	-0.06	-0.04
Maharashtra	0.22	0.22	0.15	0.14	-2.26
Punjab	0.07	-0.14	0.09	0.02	-6.81
Middle Income States	0.07	0.06	0.04	0.10	1.86
Andhra Pradesh	0.02	0.02	0.04	0.01	-5.56
Karnataka	0.04	0.03	0.02	0.03	-1.82
Kerala	0.18	0.12	0.05	0.07	-4.59
Tamil Nadu	0.08	0.09	0.07	0.38	8.45
West Bengal	0.04	0.02	0.01	0.03	-1.17
Low Income States	0.09	0.10	0.11	0.07	-1.09
Bihar	0.07	0.02	0.02	0.03	-4.00
Madhya Pradesh	0.09	0.11	0.05	0.03	-4.66
Odisha	0.12	0.11	0.11	0.05	-4.35
Rajasthan	0.09	0.24	0.05	0.09	0.03
Uttar Pradesh	0.07	0.05	0.30	0.15	3.77
Major States	0.10	0.08	0.08	0.08	-1.11

Source: Reserve Bank of India, A Study of State Finance, (Various Issues) Budget of the State Governments

* NOTE: Annual Compound Growth Rate has been computed using the formula: $(Y_{t-1}/Y_t)\hat{}(1/20)-1)*100$

In this study, Y_{t-1} - 2005-10 and Y_t is the year 1990-95.

Agricultural Development

The growth of agricultural sector in India is certainly in shambles. Table 3 shows the annual growth rate of agricultural sector by the major States during 1996-97 to 2008-09. Exceptions apart, the annual compound growth rates of most States during the 15-year period have been in the negative, the lowest being -33.96 per cent in Gujarat while the highest has been recorded in West Bengal at -0.75 per cent. The only State with a positive growth rate is Madhya Pradesh, at 1.87 per cent. The annual compound growth rates during the 15-year period have shown large variations between the States as well as over time. States such as Gujarat (33.96 per cent), Bihar (33.36 per cent), Rajasthan (20.7 per cent) and Maharashtra (15.73 per cent) have shown promising annual growth rates during 1996-97 but they, along with several others, have shown negative annual growth rates in the next few years. In 2008-09, the only State with a considerably higher growth rate has been Bihar (14.65 per cent) while Gujarat, Maharashtra and Madhya Pradesh have recorded absolutely no growth (0.0 per cent), others have recorded either low growth rates (Rajasthan -4.28 per cent; Uttar Pradesh -4.26 per cent; Haryana -347 per cent; Punjab -3.41 per cent; and Odisha the lowest at 0.14 per cent) or negative growth rates (Karnataka at -5.76 per cent; Tamil

Nadu at-2.08 per cent; and West Bengal at-1.09 per cent).

The annual compound growth rates of the high income States of the Indian Union show that the growth rate has declined from a high of 16.80 per cent in 1996-97 to just 3.44 per cent in 2008-09, a difference of -13.36 per cent between the two years. The main reason'for such a state of affairs is the highest decline in Gujarat and no so high in Haryana, Maharashtra and Punjab. The case of Maharashtra for example is shocking because it has been growing at annual growth rate of 8.81 per cent in 2005-06 but three years down the line it has registered a zero growth. Even more shocking is the State of Gujarat with 22.31 per cent of growth during 2005-06 and zero 3 years down the line. Madhya Pradesh has also shown a similar spectacle of good now and zero three years later.

TABLE 3—ANNUAL GROWTH RATE OF AGRICULTURAL SECTOR BY MAIOR STATES : 1996-2008

States	1996-97	2000-01	2005-06	2008-09	Growth Rate
High Income States	16.80	-2.80	7.86	3.44	-13.36
Gujarat	33.96	-11.52	22.31	0	-33.96
Haryana	10.47	3.48	-1.68	3.47	-7.00
Maharashtra	15.73	-4.59	8.81	0	-6.92
Punjab	7.03	1.42	1.98	3.41	-3.62
Middle income States	4.23	2.42	5.85	-1.47	-4.01
Andhra Pradesh	6.15	13.16	8.84	1.2	-4.95
Kamataka	4.72	-6.87	4.07	-5.76	-10.48
Kerala	2.58	1.39	2.63	0.36	-2.22
Tamil Nadu	-0.76	4.77	11.67	-2.08	-1.32
West Bengal	0	-0.34	2.02	-1.09	-0.75
Low Income States	11.47	-0.95	0.11	5.83	-5.83
Bihar	33.36	34.4	-10.82	14.65	-18.71
Madhya Pradesh	5.63	-26.27	7.5	0	1.87
Odisha	-11.58	-7.4	3.39	0.14	11.72
Rajasthan	20.7	-6.13	-0.87	4.28	-16.42
Uttar Pradesh	9.24	0.67	1.34	4.26	-4.98
Major States	9.80	-0.27	4.37	1.63	-8.17
All India	9.92	-0.25	5.25	1.58	-8.34

Source: Central Statistical Organization (CSO), Ministry of Agriculture, Government of India Data book for DCH, 1st November, 2011.

On the other hand, the lowest growth rates in agricultural sector have been secured by the middle income States: -4.01 per cent between 1996-97 (4.23 per cent) and 2008-09 (-1.47 per cent). The main reasons for the lowest average rates are the poor performance of agriculture Karnataka (-5.76 per cent in 2008-09), Tamil Nadu (-2.08 per cent) and West Bengal (-1.09 per cent). The three States have also seen negative growth rates over the period of time: Karnataka (-10.48 per cent), Tamil Nadu (-1.32 per cent), West Bengal (-0.75 per cent). The motivation behind the three States as been that of a changed focus for industrial sector development. The agricultural sector investments, budget allocation, concentration have been reduced by the three States, also.

The overall picture of the agricultural sector among different States have been negative growth rates by almost all States in India, with the exception of Gujarat (11.65 per cent), Odisha (11.72 per cent), and Madhya Pradesh (1.87 per cent). Eleven states in India have tended to show negative growth trends in the agricultural sector due to a switch over to industrial sector. The farmers have migrated from rural areas to urban areas due to lack of agricultural job opportunities, low productivity, monsoon failures, low

investment, high cost of cultivation and lack of profit in the sector.

Results

The model examines the effect of agricultural expenditure on economic growth of the three income levels of states in India. Both the revenue and capital agricultural expenditure are analyzed. Model specification for regression is:

$$\text{In GSDP} = \alpha + \beta_1 \ln \text{RAE}_1 + \beta_2 1\text{n CAE}_2 + \beta_3 1\text{n FDI}_3 + \beta_4 1\text{n FG}_4 + \beta_5 \ln \text{OS}_5 + \beta_6 1\text{n LU}_6 + \beta_7 \ln \text{NSA}_7 + \beta_8 1\text{n PGR}_g + u$$

The dependent variable calculated as In GSDP expresses the logarithmic value of Gross State Domestic Product of the three different income levels of states of the Indian Union.The independent variable measured in term In RAE deals on the logarithmic value of Revenue Agricultural Expenditure, In CAE focuses on the logarithmic value of Capital Agricultural Expenditure, In FDI indicates to the logarithmic value of Foreign Direct Investment, ln FG refers to the logarithmic value of Food Grains. The In OS focuses on the logarithmic value of Oil Seeds of the states with three different income levels. The In LU focuses on the logarithmic value of Land Utilization and In NSA deals on the logarithmic value of Net Sown Area.

Table 4 presents the estimates of a regression analysis for agricultural expenditure and economic growth among the major States during 1990 to 2010. The results show that 01-per cent increase in revenue expenditure on agricultural sector in the low, middle and high income States leads to an increase of 0.77 per cent, 0.56 per cent and 0.45 per cent in the growth rates, respectively, for the low, middle and high income States (R Square value of 0.61, 0.71 and 0.63 per cent). The positive relation is significant at 1.0 per cent in all the States. The analysis has also found that there is significant relationship between government allocation to agricultural sector, land utilization and food grains in the low, middle and high income States. This indicates that land utilization and foodgrains stock in all the States of differential incomes have improved. In addition, population growth in the States of the three income levels are also positively related to the GSDP rates of the State economy. This also means that the low income States have contributed greatly to agricultural sector than those of the middle and high income States.

TABLE 4—IMPACT OF GOVERNMENT EXPENDITURE ON AGRICULTURE SECTOR TO GROWTH IN MAJOR STATES : 1990-2010 (DEPENDENT VARIABLE : LOG GSDP AT CURRENT PRICES)

Explanatory	Low Income States			Middle Income States			High Income States		
Variables	Coeffi	T	P	Coeffi	T	P	Coeffi	T	P
Intercept	5.81	4.90*	0.00	7.32	8.99*	0.00	5.99	5.25*	0.00
LN Rev Agriculture	0.77	12.55*	0.00	0.56	9,65*	0.00	0.45	6.06*	0.00
Ln Capital Agriculture	0.003	0.23	0.82	0.05	2.73*	0.01	-0.01	-0.75	0.46
Ln FD Investment	-0.03	-3.50*	0.001	-0.03	-2.57*	0.01	0.01	0.92	0.36
Ln Food Grains	0.25	2.59*	0.01	0.15	1.82***	0.07	0.24	2.41**	0.02
Ln Oil Seeds	-0.20	-5.53*	0.00	-0.02	-0.54	0.59	0.04	0.74	0.46
Ln Land Utilization	0.10	6.33*	0.00	0.16	4.74*	0.00	0.11	9.67*	0.00
Ln Net Sown Area	-0.09	-3.21*	0.002	-0.18	-2.88*	0.00	-0.12	-4.02*	0.00
Ln Population Rate	0.004	3.02*	0.003	0.01	5.82*	0.00	0.57	4.55*	0.00
Multiple R	0.65			0.75			0.66		
R Square	0.61			0.71			0.63		
Ad R Square	0.60			0.70			0.62		
Observations	100			100			80		
Number of States	5			5			4		

Source : Computed by Researcher, Note : * at I Per cent Level, ** at 5 Per cent Level, *** at 10 Per cent Level

It indicates that the States of Bihar, Odisha and Madhya Pradesh contribute highly to this sector. Also, after the economic reforms, expenditure on the agricultural sector has increased many folds. The number of Government schemes has increased as well towards improving agricultural development in the States of differential incomes. The schemes such as the National Horticultural Mission, National Rural Employment

Schemes have also contributed in this regard. A study of Shenggen Fan et al. (2000) on government spending on agriculture and irrigation has shown positive contributions to growth in agricultural productivity.

The coefficients estimated suggest that a I-per cent increase in capital allocation to agriculture sector results in an increase in the growth rate of GSDP by 0.05 per cent. The middle income States have had their agricultural spending increased, expressly in Andhra Pradesh, West Bengal and Tamil Nadu (Table 4).

On the other hand, the foreign direct investment of low and middle income States are negatively related to economic growth at 1.0 per cent level. This indicates that most agricultural investment has been observed in the high income States alone. The FDI could not support this group of States in terms of agricultural investment. Second, the estimation indicates that net sown area of low, middle and high income States is negatively related to the GSDP rates of the State economy at 1.0 per cent level. This is attributable to the fact that most of the time there is monsoon failure, and an irrigation gap; and hence the production cost is high among the different States of varying income levels, due to reduction in the net sown area in these States. Furthermore, there is also evidence that most of the cultivable lands have been converted to other purposes such as the industrial establishments, and real estates. Uncultivable land has increased in all the States of the differential incomes.

Conclusions

The low income States have allocated public expenditure on agricultural sector in a way that it has declined over the years by -1.60 per cent of annual growth rate with actual agricultural sector allocation reduced from 1.41 per cent in 1990-95 to 1.02 per cent in 2005-10, even as the allocation touched a deep low at 0.81 per cent to the GSDP in 2000-05. It is a point of fact that the highest reduction of allocations to agricultural sector have been by the middle and higher income States which have recorded a negative growth of allocation at -2.47 per cent and -2.06 per cent over the years. The States of high income category have slashed their expenditure from 1.01 per cent in 1990-95 to 0.67 per cent in 2005-10. While, middle income states have also declined their expenditure from 1.38 per cent in 1900-95 to 0.84 per cent in 2005-10.

Among the different level of States, annual compound growth rate of capital allocation to agriculture sector by middle income States have positive growing trends of 1.86 per cent, which has improved from 0.07 per cent in 1990-95 to 0.10 in 2005-10. While annual growth rate of government expenditure to agriculture sector of high and low income states have decline trends. Capital expenditure on agriculture by major States of India present a similar pattern, negative growth in most States in the last 20 years. Exceptions are Tamil Nadu (8.45 per cent), Uttar Pradesh (3.77 per cent) and Rajasthan (0.03 per cent) where capital investments have shown greater increases over the years. However, the share of the capital expenditures in eleven States has been rather very small and declined one.

The results show that aI-per cent increase in revenue expenditure on agricultural sector in the low, middle and high income States leads to an increase of 0.77 per cent, 0.56 per cent and 0.45 per cent in the growth rates, respectively, for the low, middle and high income States (R Square value of 0.61, 0.71 and 0.63 per cent). The positive relation is significant at 1.0 per cent in all the States. The analysis has also found that there is significant relationship between government allocation to agricultural sector, land utilization and food grains in the low, middle and high income States. This indicates that land utilization and food grains stock in all the States of differential incomes have improved. In addition, population growth in the States of the three income levels are also positively related to the GSDP rates of the State economy. This also means that the low income States have contributed greatly to agricultural sector than those of the middle and high income States.

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Assessment of Pre and Post Harvest Losses in Wheat and Paddy Crops in Punjab*

Importance of Paddy and wheat crops in Punjab

The green revolution brought significant changes in the cropping pattern of Punjab. The temporal analysis of cropping pattern in Punjab brings out the importance of wheat and paddy crops, selected for the present study. During 1970-71, about 40.49 per cent of the gross cropped area was under wheat which increased to 44.31 per cent in 2007-08 and since then hovered around 44.50 per cent. Rice, which occupied around 6.87 per cent of the gross cropped area in 1970-71, increased to over 33.15 per cent in 2007-08, and then rose further to around 35.85 per cent in 2010-11. The increase in wheat cultivation has been at the cost of gram, rapeseed and mustard, while that of rice has been obtained by shifting the area from maize, groundnut, millets and cotton. It can be concluded that imbalance in favour of two main cereals viz.rice and wheat in the cropping pattern has further sharpened despite all efforts on diversification of state agriculture. This happened because of better relative profitability of these crops with minimum production and marketing risk as compared to other crops.

Background of pre and post harvest losses

The emergence of monoculture of paddy and wheat has in a way have altered a multi commodity production system to a specialized system in the state. In the process, many traditionally cultivated crops (e.g. coarse cereals and small millets) either have lost their area or gone out of cultivation. But, these developments have entailed increased building up of pest and diseases, and consequent use of higher amount of pesticides to raise the crop productivity. The increased use of pesticides has also resulted in developing insects and disease resistance, which further led to reduction in crop yield.

Pre Harvest Losses: The estimation of crop loss due to pests and diseases is a complex subject. It is in fact, difficult to assess the loss caused by the individual pest as a particular crop may be infested by the pest complex in the farmers' field conditions. Further, extent of crop loss either physical or financial depends on the type of variety, stage of crop growth, pest population and weather conditions. Nevertheless, the crop loss estimates have been made and updated regularly at global level. The worldwide yield loss due to various types of pest was estimated at as: 37.4 per cent in rice, 28.2 per cent in wheat, 31.2 per cent in maize and 26.3 per cent in soybean (Oerke, 2007). At all India level, crop loss estimates due to insect pests have been provided by Dhaliwal *et al* (2010). According to this source, the crop loss was estimated at 25 per cent in rice and maize, 5 per cent in wheat, 15 per cent in pulses and 50 per cent in cotton. The crop loss has increased during post-green revolution period when compared to pre-green revolution period. The severity of pest problems has reportedly been changing with the developments in agricultural technology and modifications of agricultural practices.

Generally, crop loss is estimated as the difference between potential (attainable yield) and the actual yield. The potential yield is the yield that would have been obtained in the absence of pest under consideration. By multiplying the area with the estimated yield loss, total loss is obtained. To estimate the crop loss, most of the existing studies have adopted experimental treatment approach (with or without pest attack through artificial infestation) or fields with natural infestation wherein half of the field is protected against the pest while the other half is not. But, the results obtained from artificial infestation or natural infestation in the selected plots/ fields will not be appropriate for extrapolation over a geographical area (Groote, 2002). It is for the reason that the estimated crop losses under these conditions may not represent the actual field conditions of farmers. Alternatively, the estimates collected directly from the farmers through sample survey may be reliable and could be used for extrapolation in similar geographical settings. However, the farmers' estimates are likely to be subjective and these should be validated with expert estimates of the state department of agriculture.

Post Harvest Losses: Production in agriculture is seasonal and exposed to natural environment, but post-production operations play an important role in providing stability in the food supply chain. According to a World Bank (1999) study post harvest losses of foodgrains in India are 7-10 per cent of the total production from farm to market level and 4-5 percent at market and distribution level. Given the total production of around 240 million tonnes at present, the total losses work out around 15-25 million tonnes. With the given per capita cereal consumption requirement in India, the above grains lost would be sufficient to feed more than 10 crore people. Losses in food crops occur during harvesting, threshing, drying, storage, transportation, processing and marketing.

*A.E.R.C. Department of Economics and Sociology Punjab Agricultural University, Ludhiana.

In the field and during storage, the products are threatened by insects, rodents, birds and other pests. Moreover, the product may be spoiled by infection from fungi, yeasts or bacteria. Foodgrain stocks suffer qualitative and quantitative losses while in storage. The quantitative losses are generally caused by factors, such as incidence of insect infestation, rodents, birds and also due to physical changes in temperature, moisture content, etc. The qualitative loss is caused by reduction in nutritive value due to factors, such as attack of insect pest, physical changes in the grain and chemical changes in the fats, carbohydrates, protein and also by contamination of myco toxins, besides, residue, etc. The storage loss/gain is a very sensitive issue as it depends upon agro climatic conditions. In order to minimize the losses during storage it is important to know the optimum environment conditions for storage of the product, as well as the conditions under which insects/pests damage the produce.

According to FAO study, about 70 per cent of the farm produce is stored by farmers for their own consumption, seed, feed and other purposes in India. Farmers store grain in bulk using different types of storage structures made from locally available materials. For the better storage it is necessary to clean and dry the grain to increase its life during storage. In addition, storage structure, design and its construction also play a vital role in reducing or increasing the losses during storage. With the scientifically constructed storage, it is also essential that the grain being stored is also of good quality. At the village, generally harvesting is done at high moisture content and therefore before storing the same, it is necessary to obtain the desired moisture to obtain safe post storage grain. There are small storage structures at the farmer level and bulk storage of foodgrains. The major construction material for storage structures in rural areas at the farmer level are mud, bamboo, stone and plant materials. Generally, they are neither rodent proof, nor secure from fungal and insect attack. On average, out of total 6 per cent loss of food grains in such storage structures, about half is due to rodents and rest half is due to insects and fungi. The storage at the farmer level includes: coal tar drum bin, domestic Hapur bin, Chittore stone bin, double walled polyethylene lined bamboo bin, Pusa bin and so on. The bulk storage of food grains is done mainly by traders, cooperatives and government agencies like FCI, CWC, SWC and grain marketing cooperatives. There are many kinds of storage systems followed depending on the length of storage and the product to be stored. Some examples are cover and plinth storage, community storage structures, rural godowns and scientific warehouses.

Need for the present study

As per the available data, the crop losses caused by pests and diseases are huge. But, the knowledge on the crop loss at the farm level is very much limited. In addition to losses that occur during the growth period of the crop, there is a huge quantity of grains lost during the process of harvesting, threshing, transportation and storage. Therefore, the present study makes a comprehensive attempt to estimate the dimension of losses occurring during the pre and post harvest stages of paddy and wheat crops. For the pre harvest losses, generally animal pests (insects, mites, rodents, snails and birds), plant pathogens (bacteria, fungi, virus and nematodes) and weeds are collectively called as pests, which cause economic damage to crops. This broader definition of pests and diseases is followed in the present study. For estimating post harvest losses, there is a need to establish the extent of losses during storage under different agro climatic conditions. Causes of storage losses include sprouting, transpiration, respiration, rot due to mould and bacteria and attack by insects. Sprouting, transpiration and respiration are physiological activities that depend on the storage environment (mainly temperature and relative humidity). These physiological changes affect the internal composition of the grains all result in destruction of edible material and changes in nutritional quality. But it would be difficult to measure the loss due to physiological changes at the farm level. Nevertheless, an attempt would be made to estimate such losses based on the visual observations and according to farmers' estimates.

Objectives of the study

Keeping in view about this important subject, the objectives of the present research proposal are given below:

1. To estimate the physical and financial losses caused by pests and diseases in paddy and wheat at farm level
2. To examine the measures of pest and disease management to reduce the crop loss due to pests and diseases at farm level
3. To arrive at post harvest losses in paddy and wheat under different agro climatic conditions.
4. To identify factors responsible for such losses and suggest ways and means to reduce the extent of losses in different operations in order to increase national productivity.

Data base and methodology

The study has been based .on the farm level data collected from the two major paddy and wheat growing districts namely Ludhiana and Ferozepur of Punjab state. The crop production constraints particularly infestation by pests and diseases, and losses caused by them were worked out based on the estimates provided by the farmers. As not only pests and diseases cause crop damage when

their population reach beyond a threshold level, there are also other bio-economic factors like soil fertility, water scarcity, poor seed quality, high input costs and low output prices result in considerable financial loss to farmers. Thus, data on these bio-economic variables were also collected from the farmers. The post harvest losses during the process of harvesting, collection and threshing, transportation and storage were also quantified based on the estimates provided by the farmers. As storage material used by the farmers was not scientific, it was essential to identify the structure of storage at the farmers' level and enumerate the losses occurring in the process of storage at the farmer level.

To collect the primary data, a sample survey was conducted in Ludhiana and Ferozepur districts in the state for the reference period rabi 2010-11 (November to May) for wheat and kharif 2011-12 (June to October) for paddy crop. Ludhiana district represented the Central Plain region while Ferozepur district represented south - western region of the state. 'From each district, two villages with one nearby the market/mandi centre and one far off from the market centre were selected for canvassing the questionnaire. A random sample of 30 wheat and paddy growing farmers were selected from each village and thus constituting a total sample of 120 farmers for each crop in the state. To ensure proportionate representation to various farm size categories in the study sample, standard national level definition of operational holdings viz., marginal < 2.50 acres), small (2.51 to 5.00 acres), medium (5.01 to 10.00 acres) and large (> 10.01 acres) were applied. In addition to the primary data collected from the farmers, district office of the Department of Agriculture as well as experts of Punjab Agricultural University to compile the crop loss estimates (if any) for pre and post harvest losses were also consulted. Simple statistical tools were used to interpret the sample survey results.

Area, Production and Productivity of Wheat and Paddy in Punjab

District wise area, production and yield trends of wheat crop revealed that the area under wheat crop increased in district Hoshiarpur, Gurdaspur, Kapurthala and Sangrur districts from 1970-71 to 2009-10. On the other hand in district Jalandhar, Ludhiana, Ferozepur, Amritsar, Bathinda, Patiala, Rupnagar and Faridkot area under wheat crop increased initially but declined in last two decades. Almost two time increase in productivity under wheat crop was witnessed in all the districts during 1970-71 to 2009-10 and this also resulted in increased production over the last four decades in all the districts. In overall Punjab level, area under wheat crop increased from 22.99 lakh hectare in 1970-71 to 35.22 lakh hectare in 2009-10. Wheat productivity increased from 22.38 quintal per hectare in 1970-71 to 43.07 quintal per hectare in 2009-10 while the production increased from a mere 51.45 lakh metric tonnes in 1970-71 to 151.69 lakh metric tonnes in 2009-10. The growth in area under wheat crop in Jalandhar, Ludhiana, Amritsar, Gurdaspur, Kapurthala, Patiala, Sangrur, Rupnagar and Faridkot districts showed increasing trend in area in seventies and eighties while later on this trend declined. In overall, significantly positive growth in area was seen in Ludhiana, Ferozepur, Gurdaspur, Kapurthala and Sangrur districts while in Jalandhar and Faridkot districts area declined significantly. On the other hand, productivity increased significantly in all the districts during various decades and at overall level except in a few districts where it declined in some decades. This increased productivity resulted in increased production in almost all the districts except in a few ones. At Punjab level, growth in area under wheat crop was more in 1970-71 to 1979-80 period while in later decades growth was positive but less pronounced. Growth in productivity and production was more in 1970-71 to 1979-80 and 1980-81 to 1989-90 decades while in 1990-91 to 1999-2000 periods, growth in productivity and production was positive but less pronounced. There was a sharp jump in the area under rice crop in Jalandhar, Ludhiana, Bathinda and Sangrur districts of the state during the last four decades; however, area also increased in other districts namely Hoshiarpur, Ferozepur, Amritsar, Gurdaspur, Kapurthala, Patiala, Rupnagar and Faridkot but this increase was less prominent. There was almost three times increase in productivity of rice crop in Patiala, Sangrur and Bathinda districts while in other districts of the state the increase in productivity was nearly twice. At Punjab level, area under rice crop increased from3.90 lakh hectare in 1970-71 to 28.02 lakh hectares in 2009-10 while the corresponding increase in productivity in the same period was 17.65 quintal to 40.10 quintal per hectare and that of production from 6.88 lakh metric tonnes to 112.36 lakh metric tonnes. Growth in area was enormous under rice crop in Jalandhar, Ludhiana, Ferozepur, Amritsar, Gurdaspur, Kapurthala, Bathinda, Patiala and Sangrur districts during 1970-71 to 1979-80. However, during the subsequent decades, the growth in area under rice crop in almost all the districts of the state increased but at a lower rate. The productivity growth was also found to be higher during 1970-71 to 1979-80 decade in district Jalandhar, Ludhiana, Ferozepur, Amritsar, Gurdaspur, Kapurthala, Bathinda, Patiala and Sangrur. The growth in production was more pronounced in 1970-71 to 1979-80 periods as compared to the subsequent decades. In overall Punjab level, there was a significant growth in area, productivity and production under rice crop in the state, however, the quantum of increase was more in 1970-71 to 1979-80 period as compared to subsequent decades later on.

The cost of cultivation data for the year 1981-82 showed that cost C_2 in wheat crop was Rs. 3776.19 per hectare while cost A_2, worked out to be Rs. 2390.94 per hectare which was 63.31 per cent of cost C_2. After one

decade in the year 1991-92 the cost C_2 worked out to be Rs. 9274.96 per hectare while cost A_2 came out to be Rs. 5385.31 per hectare which was 58.06 per cent of cost C_2. Similarly, during the year 2001-02, Cost C_2 came out to be Rs.22930.99 per hectare while cost A_2 worked out to be Rs. 12368.22 per hectare which was 44.36 per cent of cost C_2. In the year 2008-09, cost C_2 worked out to be Rs. 35423.48 per hectare while Cost Al came out to be Rs. 14387.90 per hectare which was found to be 40.62 per cent of the Cost C_2. Thus, the share of cost A_2 in Cost C_2 had declined rapidly during the last three decades. The gross returns per hectare from wheat crop increased from Rs. 4682.78 in 1981-82 to Rs. 12446.17 in 1991.92,.Rs:31171.94 in 2001-02 and Rs. 48127.21 per hectare in 2008-09. Net returns per hectare at current prices increased from Rs.906.59 in 1981-82 to Rs. 3171.21 in 1991-92, Rs. 8240.95 in 2001-02 and Rs. 12703.73 per hectare in 2008-09. On the other hand, the net returns at constant prices increased from Rs. 906.59 per hectare in 1981-82 to Rs. 1559.82 in 1991-92, Rs. 2140.71 in 2001-02 and Rs. 2281.24 per hectare in 2008-09. Thus, there was 2.52 times increase in the profitability from wheat crop in the Punjab state from 1981-82 to 2008-09 at constant prices. The cost of cultivation of paddy revealed that during the year 1981-82, cost C_2 worked out to be Rs. 5473.89 per hectare while cost A_2 came out to be Rs. 3477.17 which was 63.52 per cent of the cost C_2. During the year 1991-92, the cost C_2 was found to be Rs. 10390.80 per hectare while cost A_2 worked out to be Rs. 6067.75 which was 58.39 per cent of the Cost C_2. Similarly, during the years 2001-02 and 2008-09, the cost C_2 was calculated at Rs. 22305.79 and Rs. 45291.24 per hectare respectively while the corresponding figures of cost A_2 for the same years worked out to be Rs. 11904.39 and Rs. 22510.13. The per cent share of cost A_2 in cost C_2 was found to be 53.37 per cent during the year 2001-02 while this share further declined to 49.70 per cent during the year 2008-09. The gross returns per hectare from paddy increased from Rs. 6605.49 per hectare in 1981-82 to Rs. 12922.08 in 1991-92, Rs. 30124.23 in 2001-02 and Rs. 66991.10 per hectare in 2008-09. Net returns per hectare from paddy cultivation at current prices increased from Rs.1131.60 in 1981-82 to Rs. 2531.28 in 1991-92, Rs. 7818.44 in 2001-02 and Rs. 21699.86 per hectare in 2008-09. On the contrary, the net returns at constant prices increased from Rs. 1131.60 per hectare in 1981-82 to Rs. 1245.06 in 1991-92, Rs. 2030.96 in 2001-02 and Rs. 3896.69 per hectare in 2008-09. Thus, there was 3.44 times increase in the profitability from paddy crop in the Punjab state from 1981-82 to 2008-09 at constant prices.

Assessment of Pre Harvest Losses of Wheat and Paddy Crops

The incidences of major pests and diseases in wheat crop have been shown in Table 1.1. Major pest in case of wheat crop was aphids with 97 per cent respondents reporting its severity of attack as not important with frequency of attack in every season and production loss less than 5 per cent. There were 3 per cent respondents reporting severity of aphids attack as important with production loss between 5 to 10 per cent. Major diseases affecting wheat crop were yellow or stripe rust and loose smut. The severity of yellow rust attack on wheat crop as reported by all the sample households was not important with 83 per cent revealing its frequency of attack once in three seasons, 17 per cent once in two seasons with production loss less than 5 per cent. The severity of loose smut attack on wheat crop was reported by all the respondent farmers with 32 per cent reporting its attack in every season, 40 per cent once in two seasons and 28 per cent once in three seasons with production loss less than 5 per cent. Major weeds affecting wheat productivity were broad leaf weeds and *phalaris minor.* The severity of broad leaf weeds was reported as not important by 98 per cent respondents and 2 per cent informed it as important with occurrence in every season reported by all the respondents. The production loss due to broad leaf weeds was informed by 98 per cent households as less than 5 per cent while 2 per cent revealed production loss between 5 to 10 per cent. The severity of *phlaris minor* as revealed by 82 per cent of

TABLE 1.1—INCIDENCE OF MAJOR PESTS AND DISEASE (PERCENTAGE OF HOUSEHOLDS)—WHEAT

Name of the pest/disease/weed	Rank of severity*			Frequency of attack**			Production loss***				
	1	2	3	1	2	3	1	2	3	4	5
Major Pests											
Aphids	—	3.0	97.0	100.0	—	—	97.0	3.0	—	—	—
Major Diseases											
Yellow or stripe rust	—	—	100.0	-	17.0	83.0	100.0	—	—	—	—
Loose smut		—	100.0	32.0	40.0	28.0	100.0	—	—	—	—

TABLE 1.1—INCIDENCE OF MAJOR PESTS AND DISEASE (PERCENTAGE OF HOUSEHOLDS)—WHEAT—*Contd.*

Name of the pest/disease/weed	Rank of severity*			Frequency of attack**			Production loss***				
	1	2	3	1	2	3	1	2	3	4	5
Major Weeds											
Broad leaf weeds	—	2.0	98.0	100.0	—	—	98.0	2.0	—	—	—
Phalaris minor	3.0	15.0	82.0	100.0	—	—	82.0	15.0	3.0	—	—

Note: * very important=l; important=2; not important=3

** Every season=l; once in two seasons=2; once in three seasons-3

*** <5%=1; 5-10%=2; 10-25%=3; 25-50%=4; >50%=5

the households was not important while 15 per cent reported its severity as important and 3 per cent as very important. The frequency of *phalaris minor* attack was reported by all the households every year with production loss less than 5 per cent revealed by 82 per cent, 5 to 10 per cent by 15 per cent and 10 to 25 per cent by 3 per cent of the sampled households. Hence the individual production loss due to incidence of major pests, diseases and weeds was found to be less than 5 per cent as informed by majority of the respondents.

The incidences of major pests and diseases in paddy crop have been shown in Table 1.2. Major pests of paddy crop as reported by the sample households were; rice stem borer, leaf folder and plant hoppers. The rank of severity of rice stem borer was reported by 96 per cent households as not important while 4 per cent reported it as important. The frequency of attack of stem borer was reported in every season by 98 per cent households while only 2 per cent informed the attack once in two seasons while production loss less than 5 per cent was reported by 96 per cent of the households and 4 per cent households informed about the production loss between 5 to 10 per cent. The severity of leaf folder attack on paddy crop was reported by all the households as not important with 92 per cent informing its attack in every season while only 8 per cent reported its attack once in two seasons. The production loss due to leaf folder attack was less than 5 per cent as revealed by all the sample households. The rank of severity of plant hoppers on paddy crop was reported as not important by 97 per cent of the households while 3 per cent informed its attack as important. The frequency of plant hoppers attack was informed in every season by 95 per cent of the households and 5 per cent reported its occurrence once in two seasons while production loss of less than 5 per cent

TABLE 1.2—INCIDENCE OF MAJOR PESTS AND DISEASE (PERCENTAGE OF HOUSEHOLDS)—Paddy

Name of the pest/disease/weed	Rank of severity*			Frequency of attack**			Production loss***				
	1	2	3	1	2	3	1	2	3	4	5
Major Pests											
Rice stem borer	—	4.0	96.0	98.0	2.0	—	96.0	4.0	—	—	—
Leaf folder	—	—	100.0	92.0	8.0	—	100.0	—	—	—	—
Plant hoppers	—	3.0	97.0	95.0	5.0	—	97.0	3.0	—	—	—
Major Diseases											
Bacterial leaf blight			100.0	6.0	35.0	59.0	100.0	—	—	—	—
Sheath blight	—	2.0	98.0	58.0	34.0	8.0	98.0	2.0	—	—	—
False smut	—	—	100.0	6.0	47.0	47.0	100.0	—	—	—	—
Major Weeds											
Swank (*Echinochloa crusgalli*		—	100.0	100.0	—	—	100.0	—	—	—	—

Note: * very important=l; important=2; not important=3

** Every season=l; once in two seasons=2; once in three seasons=3

*** <5%=1; 5-10%=2; 10-25%=3; 25-50%=4; >50%=5

was informed by 97 per cent of the respondents and between 5 to 10 per cent was revealed by 3 per cent of the respondents. Major diseases affecting paddy crop were; bacterial leaf blight, sheath blight and false smut. The severity of bacterial leaf blight was reported as not important by all the respondents while only 6 per cent revealed its occurrence in every season, 35 per cent once in two seasons and 59 per cent once in three seasons. However, the production loss due to attack of bacterial leaf blight was reported less than 5 per cent by all the sample households. The severity of sheath blight attack was reported as not important by 98 per cent of the households while 2 per cent informed this attack as important.

The frequency of attack as reported by 58 per cent of the households was in every season while 34 per cent informed the attack as once in two seasons and 8 per cent once in three seasons. The production loss due to sheath blight was reported less than 5 per cent by 98 per cent of the respondents while only 2 per cent reported this loss between 5 to 10 per cent. The severity of false smut was informed as not important by all the households with frequency of attack in every season by 6 per cent, once in two seasons by 47 per cent and once in three seasons by 47 per cent of the households. The production loss due to false smut was reported as less than 5 per cent by all the respondents. Major weed in paddy crop was swank which was reported by all the households as not important, occurring in every season and production loss less than 5 per cent. Thus, the individual production loss in paddy crop due to major pests, diseases and .weeds was reported as less than 5 per cent by majority of the households.

The magnitudes of crop loss due to pests, disease and weed infestation in wheat crop have been depicted in Table 1.3. The actual production with attack varied between 17.65 to 18.15 quintals per acre with minimum on marginal and maximum on small farm categories while in an overall situation actual production was found to be 17.79 quintals per acre. Normal production without attack fluctuated between 18.70 to 19.32 quintals per acre with lowest on marginal and highest on small farms categories while in an overall situation normal production on sample farms was found to be 19.20 quintals per acre. The loss of output varied between 1.05 to 1.47 quintals per acre with lowest on marginal and highest on large farm categories due to better management of farms by marginal and small farmers as compared to large farmers. The per cent loss over actual production also increased with increase in farm size which was a minimum of 5.94 per cent on marginal and 8.29 per cent on large farm categories. In total, magnitude of crop loss due to pests, diseases and weed infestation was 7.93 per cent over actual and 7.35 per cent over normal production. The loss due to major pests, diseases and weeds was low due to the efficient crop management by the farmers as well as varietal characteristics and timely application of weedicides/ pesticides/fungicides.

TABLE 1.3—The Magnitude of Crop Loss due to Pests, Disease and Weed Infestation—Wheat

Description	Marginal	Small	Medium	Large	Total
Actual production with attack (quintal/acre)	17.65	18.15	17.70	17.78	17.79
Normal production without attack (quintal/acre)	18.70	19.32	18.96	19.25	19.20
Loss of output (quintal/acre)	1.05	1.17	1.26	1.47	1.41
Percentage loss over actual production	5.94	6.47	7.12	8.29	7.93
Percentage loss over normal production	5.61	6.07	6.65	7.66	7.35

The magnitudes of crop loss due to pests, disease and weed infestation in paddy crop have been depicted in Table 1.4. The actual production with pests, disease and weed infestation fluctuated between 24.93 to 26.51 quintals per acre on various farm size categories with minimum on marginal and maximum on small farms while in an overall situation actual production worked out to be 26.30 quintals per acre. Normal production without any pest disease and weed infestation varied between 26.91 to 28.79 quintals per acre with lowest on marginal and highest on large farms categories while in an overall situation normal production on sample households came out to be 28.58 quintals per acre. The loss of output varied from 1.61 to 2.36 quintals per acre with lowest on small and highest on large farm categories due to better management of farms by small farmers as compared to

large farmers. The per cent loss over actual production was 7.94 per cent on marginal, 6.07 per cent on small, 8.53 per cent on medium and 8.94 per cent on large farms categories. Thus, losses were minimum on small farms as compared to marginal, medium and small farm categories. Losses were more on marginal farms due to their involvement in other occupations along with farming. In total, magnitude of crop loss due to pests, diseases and weed infestation in paddy crop was 8.68 per cent over actual and 7.99 per cent over normal production. The loss

TABLE 1.4—The Magnitude of Crop Loss Due to Pests, Disease and Weed infestation—Paddy

Description	Marginal	Small	Medium	Large	Total
Actual production with attack (quintal/acre)	24.93	26.51	25.79	26.43	26.30
Normal production without attack (quintal/acre)	26.91	28.12	27.99	28.79	28.58
Loss of output (quintal/acre)	1.98	1.61	2.20	2.36	2.28
Percentage loss over actual production	7.94	6.07	8.53	8.94	8.68
Percentage loss over normal production	7.36	5.72	7.86	8.20	7.99

due to major pests, diseases and weeds was low due to the efficient crop management by the farmers as well as varietal characteristics and timely application of weedicides/ pesticides/fungicides.

Assessment of Post Harvest Losses of Wheat and Paddy Crops

The production losses during different stages of wheat harvest have been depicted in Table 1.5. The perusal of table shows that area harvested per household during early stage was 0.21 acres followed by 8.85 acres in mid and 1.62 acres during late harvesting of the crop. Thus, 82.87 per cent area was harvested in mid season followed by 15.16 per cent in late and 1.97 per cent in early season by the sample households. The area harvested mechanically in early stage was 2.45 per cent while in mid stage 79.14 per cent and 18.41 per cent in the late stage was harvested mechanically. The area harvested in the mid stage was 98.10 per cent of the manually harvested area while in the late stage just 1.90 per cent area was harvested. The ranking of loss during different stages of crop harvest was reported as low by 2 per cent households during early, 86 per cent during mid and 12 per cent during the late stage of harvesting. Quantity lost during early stage was 20.40 kg. per acre followed by 26.70 kg. in mid and 47.20 kg. in late harvesting stage of wheat crop. Therefore, the loss percentage of harvest amount was 1.10 per cent in early, 1.40 per cent in mid and 2.50 per cent in late harvesting stage of wheat crop on the sample households. The percent loss was more in late stage of harvesting due to shattering of grains as reported by the sample households.

TABLE 1.5—Quantity Lost at different Stages of Harvest —Wheat Crop

Stages of harvest and variety		Early		Mid		Late	
		Local	HYV	Local	HYV	Local	HYV
Area harvested per hh (acres)		—	0.21	—	8.85	—	1.62
Percentage area harvested (early, mid and late)		—	1.97	—	82.87	—	15.16
Area manually harvested (percentage)		—	—	—	98.10	—	1.90
Area mechanically harvested (percentage)		—	2.45	—	79.14	—	18.41
Rank of loss	High	—	—	—	—	—	-
(percentage of	Medium	—	—	—	—	—	-
households)	Low	—	2.0	—	86.00	—	12.00
Quantity lost	Kg. per acre of harvest	—	20.40	—	26.70	—	47.20
during harvest	Kg. per quintal of harvest	—	1.10	—	1.40.	—	2.50
	Loss % of harvest amount		1.10		1.40		2.50

The production losses during different stages of harvesting of paddy crop have been depicted in Table 1.6. Area harvested in early harvesting stage of crop was 0.47 acres, 7.75 acres in mid season and 0.77 acres in late harvesting of the crop on the sample households. In early stage, 5.22 per cent area was harvested while 86.22 per cent in mid season and 8.56 per cent in late season by the sample households. The entire area was harvested mechanically by the sample households. The ranking of loss during different stages of crop harvest was reported as low by 3 per cent households during early, 92 per cent during mid and 5 per cent during the late stage of harvesting in paddy crop. Quantity lost in early harvested crop was 93.70 kg. per acre of harvest followed by 53.60 kg. per acre in late and 38.30 kg. per acre in mid season harvesting of the crop. The loss per cent of harvest amount was maximum in early harvesting (3.40%) followed by late (1.90%) and mid (1.40%) season harvesting. The loss during early stage was more due to immature grains while in late season there was more shattering of the grains as reported by sample households.

TABLE 1.6—QUANTITY LOST AT DIFFERENT STAGES OF HARVEST —PADDY CROP

Stages of harvest and variety		Early		Mid		Late	
		Local	HYV	Local	HYV	Local	HYV
Area harvested per hh (acres)		—	0.47	—	7.75	—	0.77
Area harvested per hh (percentage		—	5.22	—	86.22	—	8.56
harvested early, mid and late)							
Area manually harvested (percentage)		—	—	—	—	—	—
Area mechanically harvested (percentage)		—	100.0	—	100.0	—	100.0
Rank of loss	High	—	—	—	—	—	—
(percentage of	Medium	—	—	—	—	—	—
households)	Low	—	3.00	—	92.00	—	5.00
Quantity lost	Kg. per acre of harvest	—	93.70	—	38.30	—	53.60
during harvest	Kg. per quintal of harvest	—	3.40	—	1.40	—	1.90
	Loss % of harvest amount	—	3.40	—	1.40	—	1.90

Total post harvest losses

The total post harvest losses per quintal by farm size have been depicted in Table 1.7. The perusal of the table reveals that the quantity lost in harvesting of wheat crop varied from 0.93 to 1.57 kg. per quintal with minimum on marginal and maximum on medium farm size category with total loss of 1.52 kg. per quintal and in threshing just 0.04 kg../qtl. Quantity lost in transport varied from a meager 0.05 kg. per quintal on medium and a maximum of 0.10 kg. per quintal on marginal farms while in total 0.06 kg. per quintal was the loss of wheat during transportation. Quantity lost in handling of wheat crop varied from a minimum of 0.17 kg. per quintal on medium farms to a maximum of 0.29 kg. per quintal on marginal farms while total loss during handling reported on the sample farms was 0.20 kg. per quintal. Storage losses of wheat varied from a minimum of 0.015 kg. per quintal on large farms to a maximum of 0.042 kg. per quintal on marginal farms while in total the storage losses worked out to be 0.02 kg. per quintal as reported by the sample households.

TABLE 1.7—TOTAL POST HARVEST LOSSES PER QUINTAL BY FARM SIZE

	Wheat					Paddy				
Particulars	Marginal	Small	Medium	Large	Total	Marginal	Small	Medium	Large	Total
Quantity lost in harvest (kg per qtl)	0.93	1.42	1.57	1.54	1.52	1.19	1.66	1.64	1.52	1.54
Quantity lost in threshing (kg per qtl)	0.05	0.09	0.02	0.04	0.04	—	—	—	—	—

TABLE 1.7—TOTAL POST HARVEST LOSSES PER QUINTAL BY FARM SIZE—*Contd.*

Particulars	Wheat					Paddy				
	Marginal	Small	Medium	Large	Total	Marginal	Small	Medium	Large	Total
Quantity lost in winnowing (kg per qtl)	—	—	—	—	—	—	—	—	—	—
Quantity lost in transport (kg per qtl)	0.10	0.08	0.05	0.06	0.06	0.09	0.09	0.05	0.06	0.06
Quantity lost in handling (kg per qtl)	0.29	0.22	0.17	0.21	0.20	0.25	0.20	0.22	0.22	0.22
Quantity lost in storage (kg per qtl) a) Due to weight loss	—	—	—	—	—	4.30	2.30	1.70	2.60	2.50
b) Storing loss	0.042	0.018	0.029	0.015	0.02	0.193	0.053	0.064	0.132	0.114
Total post harvest loss (kg per qtl)	1.412	1.828	1.839	1.865	1.84	6.023	4.303	3.674	4.532	4.434
Total post harvest loss (kg per acre) *	25.99	34.18	34.57	35.81	35.14	158.40	114.03	99.93	127.28	122.38

NOTE: Post harvest loss per acre is calculated by multiplying losses in kg per quintal by the productivity per acre.

Total post harvest losses in wheat crop came out to be a minimum of 1.412 kg per quintal on marginal farms while on large farms these losses were 1.865 kg per quintal which was also maximum. In total, post harvest losses in wheat crop worked out to be 1.84 kg per quintal and 35.81 kg per acre as revealed by the sample households. These losses in wheat crop increased with the increase in farm size.

In case of paddy crop, quantity lost during harvesting of the crop worked out to be a minimum of 1.19 kg per quintal on marginal farms while on medium farms it was 1.64 kg per quintal which was highest in all the farm categories. In total, quantity lost in paddy harvest worked out to be 1.54 kg per quintal. Meager quantity of 0.05 kg per quintal lost during transportation on medium farms while a maximum of 0.09 kg per quintal was the loss on marginal and small farms. In total, transportation losses in paddy crop worked out to be 0.06 kg per quintal. Quantity lost in handling varied from 0.20 kg to 0.22 kg per quintal with lowest on small farms and highest on medium and large farm categories while in total this 0.22 kg per quintal were the handling losses. Storage losses due to weight loss varied from 4.30 kg to 1.70 kg per quintal with highest on marginal farms and lowest on medium farm category while in total, 2.50 kg per quintal was the storage loss due to decline in weight. Storage losses due to other factors came out to be a minimum of 0.053 kg per quintal on medium and 0.193 kg per quintal on marginal farms which was also highest on all farm categories while in total the storage loss worked out to be 0.114 kg per quintal in case of paddy crop. Total post harvest losses in case of paddy crop were calculated as 3.674 kg per quintal on medium farm category which were lowest while on marginal farm category these came out to be 6.023 kg per quintal which were highest on all the farm categories. The total post harvest losses in paddy crop worked out to be 4.43 kg per quintal and 122.38 kg per acre as revealed by the sample respondents.

Concluding remarks and policy suggestions

Punjab being a pioneer state in ushering an era of green revolution resulted in making India self sufficient in food grains production particularly in case of wheat and rice. However, this paddy- wheat cropping system, especially paddy cultivation has resulted in sharp decline in underground water table and environmental degradation. Besides, there was increase in the capital investment on various farm size categories in Punjab due to huge expenditure in farm machinery and requirement of allied implements which resulted in enhancing the total cost due to increase in the non-recurring cost component. However, the profitability from wheat and paddy crops also increased due to continuous price support by the union Government and efficient marketing mechanism for these crops. Owing to specialized farming in case of wheat and paddy crops, the incidence of biotic and a-biotic stresses had multiplied over the years. These constraints are taking their toll by decreasing the productivity due to the severe incidence of insect-pest, diseases and weeds. It becomes necessary to investigate the pre and post harvest losses of these crops to bring out some suitable policy measures to restrict these losses to a reasonable level. Keeping the above cited reasons into account, the various conclusions from the study can be drawn as under:

(i) High cost of inputs such as fertilizers, insecticides, fungicides, labour etc. was the major constraint reported by the sample households.

(ii) The individual production loss in wheat crop due to incidence of pests (aphids), diseases (yellow rust and loose smut) and weeds (Phlaris minor and broad leaf weeds) was less than 5 per cent of total production.

(iii) In paddy crop also, the individual production loss due to incidence of pests (rice stem borer, leaf folder and plant hoppers), diseases (bacterial leaf blight, sheath blight and false smut) and weeds (Echinochloacrusgalli) was less than 5 per cent of the total production.

(iv) The per cent loss due to biotic stresses over actual production in wheat crop increased with increase in farm size with a minimum of 5.94 per cent on marginal and 8.29 per cent per acre on large farms. Thus, there was better management of marginal farms due to comparative smaller size.

(v) The per cent loss due to biotic stresses over actual production in paddy crop increased with increase in farm size except on marginal farms with a minimum of 6.07 per cent on small and 8.94 per cent per acre on large farms. On small farms, the management of biotic stresses in paddy crop was better than other farms.

(vi) Majority of the farmers took advice from private input dealers to solve their crop related problems.

(vii) The loss during wheat harvesting was high in case of late harvesting of the crop due to shattering of grains as reported by the sample house holds.

(viii) In case of paddy harvesting, loss during early stage was more due to immature grains while in late season harvesting there was more shattering of the grains as reported by sample households.

(ix) The quantity lost during wheat storage was minimal due to rodents and fungus attack and all the respondents stored wheat in steel drums for future domestic consumption.

(x) The quantity lost in paddy storage due to rodents was minimal and it was stored in plastic bags.

(xi) Total post harvest losses in wheat crop came out to be a minimum of 1,412 kg per quintal on marginal farms while on large farms these losses were 1.865 kg per quintal which was also found to be maximum among various farm categories.

(xii) Total post harvest losses in case of paddy crop were calculated as 3.674 kg per quintal on medium farm category which were lowest while on marginal farm category these came out to be 6.023 kg per quintal which were highest among all the farm categories.

Policy Suggestions

Keeping the above cited conclusions into consideration the following policy issues can be drawn:

(i) Ever increasing prices of farm inputs especially pesticides and fungicides should be curtailed by keeping a check on the prices being charged by the private pesticide dealers to stop exploitation of the farmers.

(ii) There is a need of imparting new training programmes to farmers for timely and cheaper control of insect-pest and disease attack to minimize the production losses due to these constraints.

(iii) There is a need of rejuvenation of the Govt. extension agencies for approaching the farming community and making themselves indispensable to curtail the dependence of farmers on private input dealers for taking advice regarding farm related problems.

(iv) Timeliness in harvesting of wheat and paddy crops should be ensured for minimizing the harvesting losses and untimely harvesting by the farmers should be discouraged by penalizing for the lapse.

(v) Post harvest losses can be further minimized by imparting training to farmers on control of rodents and fungus for storage of wheat grains.

(i) Foodgrains

During the month of March, 2013 the Wholesale Price Index (Base 2004-05=100) of pulses and foodgrains declined by 3.09 per cent and respectively 0.23 per cent while that of cereals rose by 0.47% over the previous month.

ALL INDIA INDEX NUMBER OF WHOLESALE PRICES

(Base : 2004-2005=100)

Commodity	Weight (%)	WPI for the Month of March, 2013	WPI for the Month of February, 2013	WPI A year ago	Percentage change during	
					A month	A year
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rice	1.793	206.8	205.6	175.4	0.58	17.90
Wheat	1.116	206.3	206.9	172.1	-0.29	19.87
Jowar	0.096	256.6	238.0	237.1	7.82	8.22
Bajra	0.115	261.0	256.5	204.1	1.75	27.88
Maize	0.217	249.9	250.1	220.4	-0.08	13.38
Barley	0.017	212.0	218.2	203.1	-2.84	4.38
Ragi	0.019	337.8	339.9	218.7	-0.62	54.46
Cereals	3.373	213.4	212.4	180.3	0.47	18.36
Pulses	0.717	232.4	239.8	210.3	-3.09	10.51
Foodgrains	4.09	216.7	217.2	185.6	-0.23	16.76

Source Office of the Economic Adviser, M/O Commerce and Industry.

Behaviour of Wholesale Prices

The following Table indicates the State wise trend of Wholesale Prices of Cereals during the month of March, 2013.

Commodity	Main Trend	Rising	Falling	Mixed	Steady
Rice	Rising	West Bengal Kamataka	Uttar Pradesh	Haryana	Kerala
Wheat	Falling	Kamataka	Gujarat Haryana U.P.		
Jowar	Rising	Gujarat Maharashtra U.P	A.P. Kamataka		.
Bajra	Falling	Kamataka	A.P. Maharashtra Tamilnadu	Gujarat Rajasthan	
Maize	Falling and Mixed		Gujarat	Haryana	

Procurement of Rice

2022 thousand tonnes of Rice (including paddy converted into rice) was procured during March, 2013, as against 2794 thousand tonnes of Rice (including paddy converted into rice) procured during March, 2012.The total procurement of Rice in the current marketing season i.e 2012-2013, upto 28.03.2013 stood at 29255 thousand tonnes, as against 28762 thousand tonnes of rice procured, during the corresponding period of last year. The details are given in the following table.

PROCUREMENT OF RICE

(in thousand tonnes)

State	Marketing Season 2012-13 (up to 28-03-2013)		Corresponding Period of last Year 2011-12		Marketing Year (October-September) 2011-12		2010 -11	
	Procure-ment	Percentage to Total	Procure-ment	Percentage to Total	Procure-ment	Percentage to Total	Procure-ment	Percentage to Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Andhra Pradesh	4007	13.17	4584	15.94	7540	21.52	9609	28.10
Chhatisgarh	4800	16.41	4108	14.28	4115	11.75	3746	10.95
Haryana	2602	8.89	2001	6.96	2007	5.73	1687	4.93
Maharashtra	175	0.60	142	0.49	178	0.51	308	0.90
Punjab	8557	29.25	7731	26.88	7731	22.07	8635	25.25
Tamil Nadu	447	1.53	1364	4.74	1596	4.56	1543	4.51
Uttar Pradesh	2169	7.41	3029	10.53	3355	9.58	2554	7.47
Uttarakhand	422	1.44	303	1.05	378	1.08	422	1.23
Others	6076	20.77	5500	19.12	8131	23.21	5694	16.65
Total	**29255**	**100.00**	**28762**	**100.00**	**35031**	**100.00**	**34198**	**100.00**

Source: Department of Food & Public Distribution.

Procurement of Wheat

The total procurement of wheat in the current marketing season i.e 2012-2013 upto August, 2012 is 38148 thousand tonnes against a total of 28148 thousand tonnes of wheat procured during last year. The details are given in the following table.

PROCUREMENT OF WHEAT

(in thousand tonnes)

State	Marketing Season 2012-13 (up to 2-08-2012)		Corresponding Period of last Year (2011-12)		Marketing Year (April-March) 2011-12		2010-11	
	Procure-ment	Percentage to Total	Procure-ment	Percentage to Total	Procure-ment	Percentage to Total	Procure-ment	Percentage to Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Haryana	8665	22.71	6882	24.45	6928	24.45	6347	28.19
Madhya Pradesh	8493	22.26	4905	17.43	4965	17.52	3539	15.72
Punjab	12834	33.64	10957	38.93	10958	38.67	10209	45.35
Rajasthan	1964	5.15	1303	4.63	1303	4.60	476	2.11
Uttar Pradesh	5063	13.27	3461	12.30	3461	12.21	1645	7.31
Others	1129	2.96	640	2.27	720	2.54	298	1.32
Total	**38148**	**100.00**	**28148**	**100.00**	**28335**	**100.00**	**22514**	**100.00**

Source: Department of Food & Public Distribution.

(ii) Commercial Crops

Oil Seeds and Edible Oils : The Wholesale Price Index (WPI) of nine major oilseeds as a group stood at 203.8 in March, 2013 showing an increase of 0.5 per cent and 19.0 per cent over the previous month and over the previous year.

The Wholesale Price Index (WPI) of all individual oilseeds showed a mixed trend. The WPI of Soyabean (10.5 per cent) and Gingelly seed (5.3 per cent) increased over the previous month. However, the WPI of and Copra (3.4 per cent), Groundnut seed (0.8 per cent) and Rape & Mustard (-8.5 per cent) decreased over the previous month. The WPI of Cottonseed, Niger seed, Sunflower and Safflower seed remained unchanged over the previous month.

The Wholesale Price Index (WPI) of Edible Oils as a group stood 145.0 in March, 2013 showing a fall of 2.3 per cent over the previous month. However, it increased by 2.4 per cent over the previous year. The WPI of Groundnut Oil (3.0 per cent), Cottonseed Oil (5.3 per cent), Mustard Oil (3.9 per cent), Sunflower Oil (6.7 per cent), Copra oil (0.5 per cent) and Soyabean Oil (2.6 per cent) decreased over the previous month. However, the WPI of Gingelly Oil (2.6 per cent) increased over the previous month.

Fruits and Vegetable: The Wholesale Price Index (WPI) of Fruits & Vegetable as a group stood at 186.3 in March, 2013 showing an increase of 1.7 per cent and 2.1 per cent over the previous month and over the previous year.

Potato: The Wholesale Price Index (WPI) of Potato stood at 152.0 in March, 2013 showing a fall of 1.7 per cent over the previous month. However, it increased by 20.1 per cent over the previous year.

Onion: The Wholesale Price Index (WPI) of Onion stood 265.0 in March, 2013 showing a fall of 22.1 per cent over the previous month. However, it increased by 94.9 per cent over the previous year.

Condiments and Spices: The Wholesale Price Index (WPI) of Condiments & Spices (Group) stood at 227.1 in March, 2013 showing an increase of 2.3 per cent and 6.0 per cent over the previous month and over the previous year.

The WPI- of Black Pepper decreased by 7.3 per cent, over the previous month. However, the WPI of Chillies (Dry) and Turmeric increased by 6.7 per cent and 9.6 over the previous year.

Raw Cotton: The Wholesale Price Index (WPI) of Raw Cotton stood at 216.5 in March, 2013 showing an increase of 4.2 per cent and 10.4 per cent over the previous month and over the previous year.

Raw Jute: The Wholesale Price Index (WPI) of Raw Jute stood at 273.3 in March, 2013 showing an increase of 3.8 per cent and 20.4 per cent over the previous month and over the previous year.

WHOLESALE PRICE INDEX OF COMMERCIAL CROPS FOR THE MONTH OF MARCH, 2013

(Base Year : 2004-05=100)

Commodity	Latest	Month	Year	Percentage Variation over	
	Mar., 2013	Feb., 2013	Mar., 2012	Month	Year
OIL SEEDS	203.8	202.8	171.3	0.5	19.0
Groundnut Seed	257.4	259.4	230.6	-0.8	11.6
Rape & Mustard Seed	189.4	207.1	164.7	-8.5	15.0
Cotton Seed	165.2	165.2	142.4	0.0	16.0
Copra (Coconut)	91.9	95.1	100.3	-3.4	-8.4
Gingelly Seed (Sesamum)	382.8	363.7	237.5	5.3	61.2
Niger Seed	182.4	182.4	174.4	0.0	4.6
Safflower (Kardi Seed)	150.4	150.4	132.6	0.0	13.4
Sunflower	187.8	187.8	167.8	0.0	11.9
Soyabean	223.7	202.4	161.0	10.5	38.9
EDIBLE OILS	145.0	148.4	141.6	-2.3	2.4
Groundnut Oil	189.9	195.8	181.8	-3.0	4.5
Cotton Seed Oil	161.2	170.3	151.0	-5.3	6.8
Mustard & Rapeseed Oil	148.2	154.2	147.5	-3.9	0.5
Soyabean Oil	159.3	163.6	154.5	-2.6	3.1
Copra Oil	115.7	116.3	116.0	-0.5	-0.3
Sunflower Oil	131.9	141.3	133.6	-6.7	-1.3
Gingelly Oil	196.6	191.6	153.3	2.6	28.2
FRUITS AND VEGETABLES	186.3	183.2	182.5	1.7	2.1
Potato	152.0	154.6	126.6	-1.7	20.1
Onion	265.0	340.3	136.0	-22.1	94.9
CONDIMENTS AND SPICES	227.1	222.1	214.3	2.3	6.0
Black Pepper	496.5	535.4	483.1	-7.3	2.8
Chillies(Dry)	269.0	252.1	249.0	6.7	8.0
Turmeric	204.6	186.7	156.9	9.6	30.4
Raw Cotton	216.5	207.7	196.1	4.2	10.4
Raw Jute	273.3	263.4	227.0	3.8	20.4

Source : Dte. of Econ. and Statistics, Commercial Crops Divistion.

ISSN 0002—167
Regn. No. : 840

P. Agri. 21-4-2013
600

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PRINTED BY THE MANAGER, GOVERNMENT OF INDIA PRESS, RING ROAD, MAYAPURI, NEW DELHI-110064
AND PUBLISHED BY THE CONTROLLER OF PUBLICATIONS, DELHI-110054—2013.