Agriculture: Where does the problem lie?

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Once Gunnar Murdyl, the Nobel Laureate had stated that it is the agriculture sector which decides if the battle for long term economic development will be won. This is absolutely true for a developing country like India. Despite its share decreasing in GDP (54% in 1960-61 to 23% in 2004-05), agriculture still remains the backbone of the Indian economy. Without its growth, it is futile to think of a high GDP growth rate of the country. Agriculture is still a provider of wage goods like food, fiber and fuel and also provider of raw material for a large number of industries. Agriculture boosts the economy through backward and forward linkages. Sharad Joshi, founder of Shetkari Sanghathan and also a Rajya Sabha member has said "**Agriculture is the basic source of wealth and also the prime mover of the demand function. India being a developing county, the role of agriculture sector is even more important. It provides livelihood to over 60% of the population. And in India it also provides a cushion for the ratio between the urban and rural income**." Being such an important sector of the economy it can not be ignored or neglected.

India initiated the process of globalization and liberalization since 1991. Over the past decade globalization and liberalization in India has been discussed mainly in terms of foreign investment, industrial development, information technology and the tremendous growth of service sector etc and there has been a substantial media coverage of all these aspects of the Indian economy. Despite its importance in the

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economy, agriculture has received much less attention and adequate efforts have not been made to analyze the impact of globalization on this sector. The present study is an attempt to analyze the growth of agriculture sector during the pre and post reform period as well as identify the most important factors that determine its growth performance. On the basis of this analysis an attempt has been made to recommend certain suggestive measures to revitalize the agriculture sector.

Hypothesis: To achieve these objectives following hypothesis have been formulated:

a. Agriculture growth rate is mainly dependent on the two most important factors: (1) Monsoon and (2) Public Investment in agriculture.
b. The annual compound growth rates (CAGR) of Agriculture Gross Domestic Product (AGDP) has declined during post reform period in comparison to the pre reform period.

Data, Methodology and Results: - The present study is based on secondary data collected from various issues of the Economic Survey, a publication of the Government of India and CMIE reports for the period of 25 years from 1981-82 to 2004-05. To analyze the agriculture growth rate the whole time span has been divided into two subject periods: Pre-reform period (1981-82 – 1990-91) and post reform period (1991-92 – 2003-04).

(1) We started the analysis by finding the correlation coefficients between the 'Percent change in AGDP over the previous year' (the dependent variable) in the post reform period (1991-92 – 2003-04) and various independent variables as follows.

(1) Percent change in countrywide monsoon over normal
(2) Percent change over previous year in disbursement of institutional credit
(3) Percent change over previous year in fertilizer consumption
(4) Percent change over previous year in public investment in agriculture
(5) Percent change over previous year in gross capital formation

The correlation results were as follows: (Table 1)

Factors affecting % Change in AGDP	**Pearson's Correlation with % Change in AGDP over previous year** (Sample size = 11)

Percent change in countrywide monsoon over normal	**0.322 (significance 0.167)**
Percent change over previous year in disbursement of institutional credit	**- 0.395 (significance 0.115)**
Percent change over previous year in fertilizer consumption	- 0.109 (significance 0.375)
Percent change over previous year in public investment in agriculture	**0.459 (significance 0.078)**
Percent change over previous year in gross capital formation	0.175 (significance 0.304)

From this data, it is obvious that the 'Public Investment in Agriculture' is a significant factor while estimating the percent change in AGDP. Other factors worth investigating are the 'Percent change in countrywide monsoon over normal' and the 'Percent change over previous year in disbursement of institutional credit'.

(2) Consequently, as further investigation, we built 5 multiple regression models with 'Percent Growth in AGDP over previous year' as the dependent variable, and the factors mentioned above as the independent variables. The models were built by adding the independent variables one at a time. The associated F values for the various models are follows:

ANOVA (Table 2)

Model	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
# 1					
Regression	19.166	1	19.166	1.043	0.334[a]
Residual	165.409	9	18.379		
Total	184.575	10			
#2					
Regression	40.102	2	20.051	1.110	0.375[b]
Residual	144.473	8	18.059		
Total	184.575	10			
# 3					
Regression	55.501	3	18.5	1.003	0.446[c]
Residual	129.074	7	18.439		
Total	184.575	10			
# 4					
Regression	110.289	4	27.572	2.227	0.182[d]
Residual	74.286	6	12.381		
Total	184.575	10			
# 5					
Regression	111.509	5	22.302	1.526	0.327[e]
Residual	73.066	5	14.613		
Total	184.575	10			

a.: Predictors: (Constant), Percent Change in Countrywide Monsoon compared to Normal

b.: Predictors: (Constant), Percent Change in Countrywide Monsoon compared to Normal, Percent change over previous Year in disbursement Credit

c.: Predictors: (Constant), Percent Change in Countrywide Monsoon compared to Normal, Percent change over previous Year in disbursement Credit, Percent Change over previous year in Fertilizer Consumption

d.: Predictors: (Constant), Percent Change in Countrywide Monsoon compared to Normal, Percent change over previous Year in disbursement Credit, Percent Change over previous year in Fertilizer Consumption, Percent Change in Public Investment over previous Year.
e.: Predictors: (Constant), Percent Change in Countrywide Monsoon compared to Normal, Percent change over previous Year in disbursement Credit, Percent Change over previous year in Fertilizer Consumption, Percent Change in Public Investment over previous Year, Percent Growth over previous Year in Gross Capital Formation.
f.: Dependent Variable: Percent Growth over previous Year in AGDP

It is clear that the model No 4 above has the highest F value and the best significance value amongst all. This is also confirmed by the R square change values shown below:

MODEL SUMMARY (Table 3)

Model	R	R Square	Adjusted R Square	Std. Error Of the Estimate	Change Statistics				
					R Square Change	F Change	df 1	df 2	Sig. F change
1	0.322 a	0.104	0.004	4.28705	0.104	1.043	1	9	0.334
2	0.466 b	0.217	0.022	4.24960	0.113	1.159	1	8	0.313
3	0.548 c	0.301	0.001	4.29409	0.083	0.835	1	7	0.391
4	0.773 d	0.598	0.329	3.51867	0.297	4.425	1	6	0.080
5	0.777 e	0.604	0.208	3.82273	0.007	0.083	1	5	0.784

a, b, c, d, e and f as mentioned in ANOVA table

COEFFICIENTS (Table 4)

(Dependent Variable: Percent Growth over previous Year in AGDP)

Model	**Unstandardised Coefficients**		**Standardised Coefficients**	**t**	**Significance**
	B	**Std Error**	**B**		

# 1: (Constant),	3.180	1.328		2.394	0.040
A	0.214	0.210	0.322	1.021	0.334
# 2 (Constant),	6.032	2.959		2.039	0.076
A	0.168	0.213	0.253	0.792	0.451
B	-0.148	0.137	-0.344	- 1.077	0.313
# 3 (Constant),	6.534	3.039		2.150	0.069
A	0.310	0.265	0.466	1.171	0.280
B	-0.122	0.142	-0.283	-0.858	0.419
C	-0.258	0.282	-0.357	-0.914	0.391
# 4 (Constant),	6.532	2.491		2.623	0.039
A	0.375	0.219	0.564	1.710	0.138
B	-0.124	0.116	-0.289	- 1.070	0.326
C	-0.321	0.233	-0.444	- 1.376	0.218
D	0.199	0.094	0.552	2.104	0.080
# 5 (Constant),	6.830	2.896		2.359	0.065
A	0.370	0.239	0.556	1.548	0.182
B	-0.141	0.140	-0.329	- 1.013	0.357
C	-0.336	0.259	-0.465	- 1.299	0.251
D	0.176	0.130	0.488	1.355	0.233
E	0.0593	0.205	0.115	0.289	0.784

A: Percent Change in Countrywide Monsoon compared to Normal,
B: Percent change over previous Year in disbursement Credit,
C: Percent Change over previous year in Fertilizer Consumption
D: Percent Change in Public Investment over previous Year.
E: Percent Growth over previous Year in Gross Capital Formation.

The R square change values are large in case of model No 1 (when the predictor Monsoon was added), model No 2 (when the predictor 'Percent change over previous year in disbursement credit ' was added and was the highest in case of model No 4 (when the predictor 'Percent change in public Investment over previous year' was added).

Taking the analysis further, we have the studied the standardised and the unstandardised coefficients of the predictor variables in the various multiple regression models. This is shown in **table 4**.

Studying the standardised coefficients (Beta) column, the largest values that help predict the variance in the dependent variable 'Percent change in AGDP over previous year' are the two independent variables, namely 'Percent change in

countrywide monsoon compared to normal' and 'Percent change in public investment over previous year'.

(3) On the basis of these findings, we have developed a final model with 'Percentage change in AGDP over previous year' as the dependent variable and 'Percentage change in countrywide monsoon over normal' and the 'Percentage change in Public Investment over previous year' as the two independent (predictor variables).

Thus Hypotheses (a) stands accepted based on the statistical analysis described above. The general equation for multiple regression is:

$Y = a + b_1 X_1 + b_2 X_2$, where

Y = % change in AGDP over the previous year (Dependent Variable)

X_1 = % change in monsoon country-wide over the previous year as compared to normal (Independent variable)

X_2 = % change in public investment over the previous year in agriculture.

b_1 = Coefficient of Percent Change in Monsoon

b_2 = Coefficient of Percent change in Public Investment

The exact results for the model developed are as follows:

ANOVA[b] (Table 5)

Model	Sum Of Squares	df	Mean Square	F	Significance
Regression	165.527	2	82.764	6.744	0.014[a]
Residual	122.718	10	12.272		
Total	288.245	12			

a.: Predictors: (Constant), Percent Change in Countrywide Monsoon compared to Normal, Percent Change in Public Investment over previous Year.

b.: Dependent Variable: Percent Growth over previous Year in AGDP

The point to note here is that the F value is 6.744 with a significance level of 0.14. This makes it a reliable model. The model summary below tells us that this model explains 57.4 % of the variance in the dependent variable (percent change in AGDP over previous year).

MODEL SUMMARY (Table 6)

Model	R	R Squar	Adjusted R	Std Error	Change Statistics				
					R	F	df	df	Significanc

		e	Square	of the Estimate	Square Change	Change	1	2	e of F Change
1[a]	0.758	0.574	0.489	3.503113	0.574	6.744	2	10	0.014

a.: Predictors: (Constant), Percent Change in Countrywide Monsoon compared to Normal, Percent Change in Public Investment over previous Year.

The exact multiple linear regression model has been estimated. The coefficients b_1 and b_2 (for monsoon and pubic investment in agriculture) has been estimated on the basis of the availability of data i.e. 1991-92 to 2003 - 04 and the following multiple regression equation has been found:

$$Y = 2.936 + 0.194 X_1 + 0.279 X_2$$
$$(t = 2.84)^{**} \quad (t = 2.38)^{**} \quad (t = 2.21)^{*}$$

** significant at 5 % level * significant at 10% level

Where,

Y = Percent growth rate of AGDP over previous year

X_1 = Percent change in Public Investment in Agriculture over previous Year

X_2 = Percent change in countrywide monsoon compared to normal

R Square for this linear equation is 0.574 representing that 57.4 % variation in the output variable is explained by this equation. The F Value for this linear equation is 6.744 and the associated significance level of this linear equation is 0.014 which leads to a confidence level of 98.6%.

Interpretation:

On the basis of the standardised coefficients we come to the following conclusions:

(1) 1 % change in Public Investment leads to 0.1825 % change in AGDP growth rate. . We can say this with 95% confidence.

(2) 1% change in Monsoon compared to normal leads to 0.3011% change in AGDP growth rate. We can say this with 90% confidence.

Analysis of Hypothesis No (b):

Growth of Agriculture during per & post reform period:- To examine and evaluate the performance of agriculture sector during the pre and post reform period, the annual growth rates of the AGDP have been computed for the period of 25 years i.e. from 1981-82 and 2004-05. To compare the performance of the sector during pre and post reform period, the annual compound growth rates (CAGR) for these two sub-periods have also been computed and shown in the following table:

(Table 7) AGDP and growth rates of AGDP at 1993-94 Prices

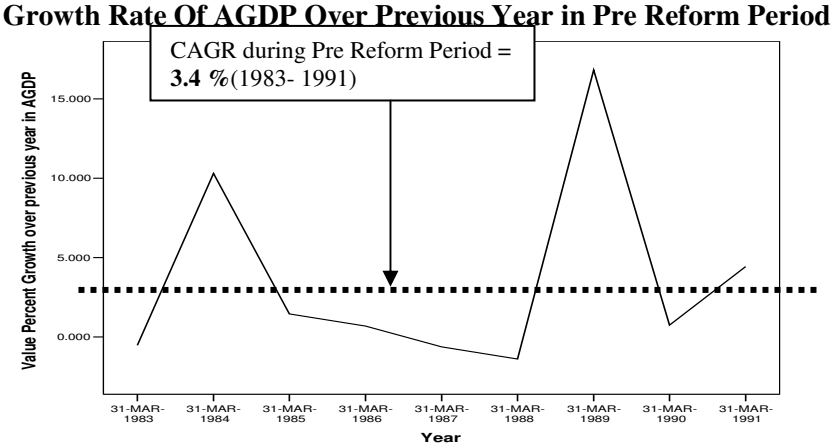
Pre-reform period(1981-82 to 1990-91)			**Post-reform Period (1991–92 to 2003 – 04)**		
Years	**AGDP (Rs.Crores)**	**Annual Growth Rates % (over previous year)**	**Year**	**AGDP (Rs. Crores)**	**Annual Growth Rates % (over previous year)**
1981 - 82	151477	-	1991 - 92	200634	-1.853
1982 - 83	150686	- 0.522	1992 - 93	213105	+ 6.216
1983 - 84	166195	+ 10.292	1993 - 94	221834	+ 4.096
1984 - 85	168593	+ 1.443	1994 - 95	233099	+ 5.078
1985 - 86	169749	+ 0.686	1995 - 96	230469	-1.128
1986 – 87	168707	- 0.614	1996 - 97	253750	+ 10.102
1987 - 88	166355	- 1.394	1997 - 98	246598	- 2.755
1988 - 89	194316	+ 16.808	1998 - 99	263540	+ 6.801
1989 - 90	195756	+ 0.741	1999 - 00	263258	- 0.107
1990 - 91	204421	+ 4.426	2000 - 01	261587	- 0.635
			2001 - 02	276573	+ 5.729
			2002 - 03	262192	- 5.200
			2003 - 04	286051	+ 9.100

Mean Value	**173626**	**3.4 % ***		**247130**	**2.8 % ***

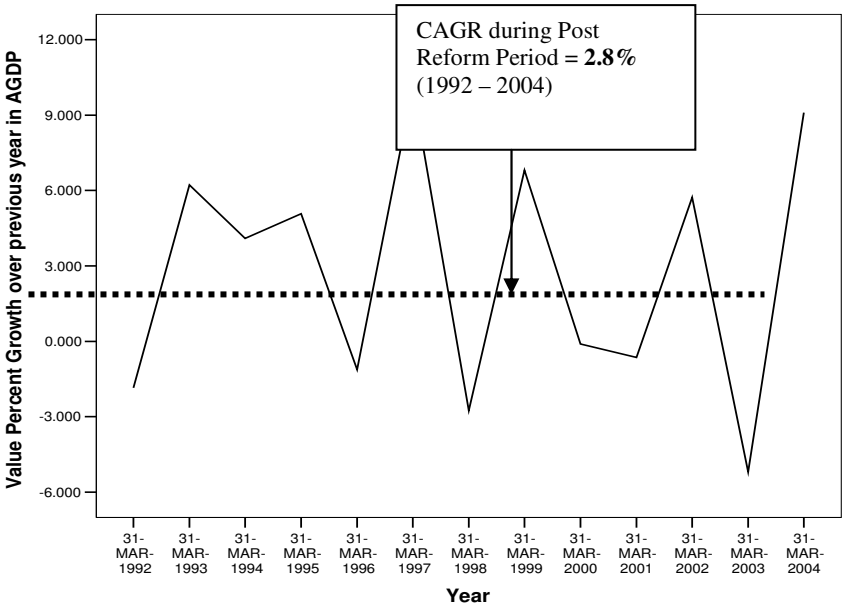
* Compound Annual Growth Rates (CAGR) (**Source**: Economic Survey and CMIE Reports)

The data and graphs, showing the time behavior of AGDP, reveal certain concerning facts. First at all, during the pre reform period agriculture sector has grown by an annual compound growth rate of 3.4 % while during post reform period this rate has declined to 2.8 % recording a decrease of which indicates the severity of the situation. Secondly, the growth rate of the sector fell from 3.2% during 1980-1996 to 2.1 per cent in the Ninth Plan (1997-2002). The cornerstone of the Tenth Plan strategy was a reversal of this trend, targeting a growth rate of 4 per cent per annum. Unfortunately however, the growth rate has decelerated even further, **dropping to just around 1.5% during the first three years of the plan (2002 - 2005).**

Annual Growth Rate Of AGDP Over Previous Year in Pre Reform Period



Annual Growth Rate of AGDP Over Previous Year in Post Reform Period



The most concerning factor noticed here is that the growth rate has touched the minimum level of – 2.8% in the year of 1996-97 . During the entire 25 years under the study this rate has been the least, which is an alarming situation. In this case it is not surprising that the population which depends on agriculture is getting increasingly impoverished. In the recent study, "**Farmers at the Millennium"** Abhijit Sen and M. S. Bhatia have shown the net farm business income grew at just about one per cent over this period, which is not sufficient even to neutralize the effect of inflation.

On the basis of this analysis, the Hypothesis (b) also stands accepted.

Agriculture Growth and Public Investment:- Statistical analysis has confirmed that 'Public Investment in Agriculture' is one of the major determinants of the growth and productivity in Agriculture Gross Domestic Product (AGDP). The trends of the growth of 'public investment in agriculture' and its share in 'Total Investment in Agriculture' has been shown in the following table:

Trends in Public Investment in Agriculture at 93 – 94 Prices (table 8)

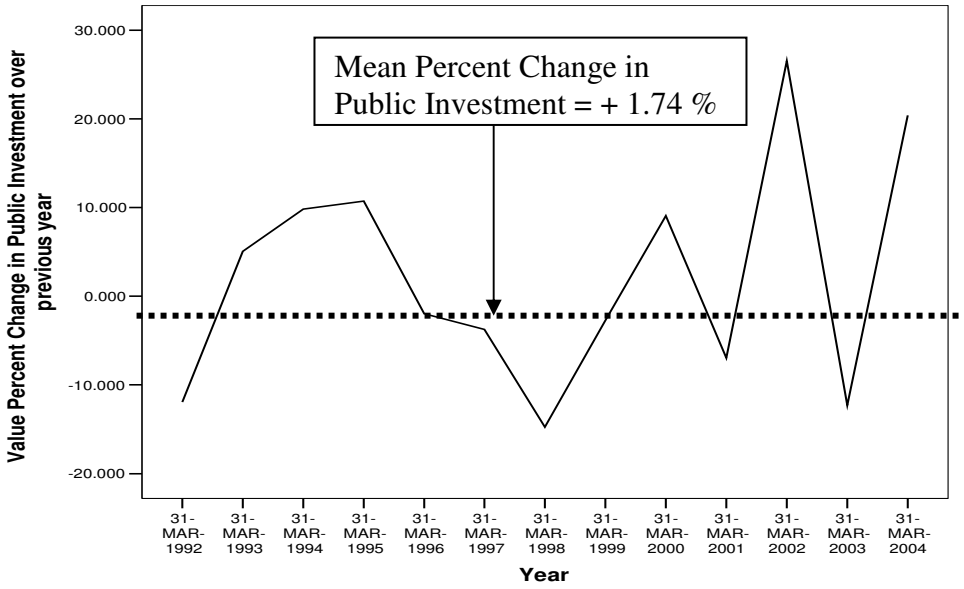
Year	Public Investment in Agriculture (Rs Crores)	Percent Change in Public Investment over previous year	Percentage share of Public Investment in Total Investment in Agiculture
1990 - 91	4395	-	29.6 %
1991 – 92	3871	- 11.92 %	28.9 %
1992 – 93	4067	+ 5.06 %	28.1 %
1993 – 94	4467	+ 9.84 %	33.0 %
1994 – 95	4947	+ 10.75 %	33.0 %
1995 – 96	4849	- 1.98 %	30.9 %
1996 – 97	4668	- 3.73 %	28.9 %
1997 – 98	3979	- 14.76 %	25.0 %
1998 – 99	3870	- 2.74 %	26.0 %
1999 – 2000	4221	+ 9.07 %	24.4 %
2000 – 2001	3927	- 9.57 %	23.2 %
2001 – 2002	4969	+ 26.53 %	28.9 %
2002 – 2003	4359	- 12.10 %	23.9%
2003 – 2004	5249	+ 20.42 %	25.6 %
Mean Values	4417	+ 1.74 %	

(**Source: Central Statistical Organisation**)

The government allocation to agriculture has never increased significantly, but after the economic reforms the situation has become worse. Capital formation in agriculture which was 1.9% of GDP in the early 1990 and this declined to 1.3 per cent in 2000-01. This has dragged down not only the growth rate of the sector but also parented the economy from attaining its real growth potential. The decline in the share of agriculture sector capital formation in GDP from 1.9 per cent to 1.3 per cent in early 2000 is a matter of concern .This declining share was mainly due to the stagnation or fall in **public investment in agriculture,** particularly in the mid -1990s. However there is a indication of a reversal of this trend of late with the public sector investment in agriculture attaining a 5-year high in 2003 -04.

The above table reveals that the public investment in agriculture which was Rs. 4395 crore in 1990-91 (at 1993-94 prices) touched the minimum level of Rs. 3870 crore in 1998-99 recording **a decline of 11.94 per cent** in 8 years. The following

graphs depict the annual growth rates of public expenditure and its share in total investment in agriculture



These graphs reveal some surprising situations. (1) In an agriculture-dominant country like India, during the post reform period of 12 years (from 1991-92 to 2003-2004) there are 7 years when the annual growth rate of 'Public Investment in Agriculture' has been negative. (2) Going into details we find that the 'annual average growth rate of public expenditure' during these 12 years **has been just 1.74 %** which is really negligible. This meagre increase in 'public expenditure in agriculture' had adversely affected the growth performance of the agriculture sector. (3) As far as the relative share of public sector investment in agriculture is concerned, the situation is not different. The relative share of public sector investment in agriculture has declined significantly from 29.6% in 1990-91 to 23.2 % in 2000-01. The main reason for this decline is the diversion of resources from agricultural investments to current expenditures such as subsidies on food and fertilizers etc. This has left the state with little resources to spend on modernization programs and on the development projects that could raise irrigation levels and bring more land under agriculture.

Agricultural Growth and Monsoon

On the basis of statistical data it might be said that monsoon is still one the most crucial factors affecting the agricultural growth. Even after 55 years of planning we are not able to provide the irrigation facilities to the bulk of our farmers and still agriculture is the gamble of the monsoon. A whopping 63 percent of the arable land is still rain fed now. Agricultural production has been adversely affected by the erratic and delayed monsoon with uneven distribution of rainfall countrywide.

This is really concerning as the growth in productivity and yield is directly related to the rate at which irrigation levels are going to rise. Thus slow pace of irrigation is indeed a serious constraint .

The monsoon in India is very much irregular and the following table shows the trends in the monsoon for the period of fifteen years starting from 1998 to 2004.

Table 9

Year	Actual Deviation in Countrywide Monsoon as a percentage of Normal (100%)	Year	Actual Deviation in Countrywide Monsoon as a percentage of Normal (100%)
1988	+ 19 %	1996	+ 3 %
1989	1 %	1997	+ 2 %
1990	6%	1998	+ 6 %
1991	- 9%	1999	- 4 %
1992	- 7%	2000	- 8 %
1993	0 %	2001	- 9 %
1994	+ 10 %	2002	- 19 %
1995	0 %	2003	+ 5 %
		2004	- 13 %
Mean			**- 1 %**
Standard Deviation			2.24 %

From the table it is clear that during the post reform period (from 1992-2004), there were 7 years out of 12 when the actual rain fall has been less than normal. Secondly, when we calculate the mean value of 'per cent change in rainfall compared to normal' during the post reform period, it comes to **-1 per cent**. Thus it can be interpreted that

during post reform period the average annual rainfall is declining by 1 percent per year.

Conclusions: On the basis of the above discussion it can be concluded that besides the apathy of the government our agriculture is also bearing the wrath of nature. In this regard Mr. Sharad Joshi, founder of Setsari Sanghatana and a Rajya Sabha member has appropriately stated , **"The problems of the farmers fall basically into two heads: One being Asmani (dependent on nature) and the other Sultani (dependent on the government) ".**

As this empirical study shows, Mr Sharad Joshi's contention is correct. The problems arise due to lack of investment (government policy) and irregular monsoon (nature's wrath). One thing for sure is that agriculture has been neglected and it is not getting its due attention. It's high time to pay attention to this sector otherwise we might soon have a social volcano on our hands. We cannot neglect 63% of our rural population and leave them on the whims of nature. Otherwise this section will soon protest and tear apart the fabric of our society. Urgent measures are necessary to make agriculture a profitable activity at the earliest not only to benefit farmers and rural poor but also to give a boost to the economy.

Suggestions pertaining to Public Investment in Agriculture: To reverse the declining trend of public expenditure in agriculture is the need of the hour. There has been a substantial cut in public investment in agriculture due to diversion of budgetary resources to foot the growing subsidy bills. Unfortunately the growing subsidies have not really benefited the poor farmers. Thus the government should make serious efforts to cut down the subsidies and to step up the public investment in agriculture as suggested below:

(1) An adequate risk management framework is required to revitalize the agriculture sector. The rationalization of the minimum support prices regime, introduction of more risk mitigation measures (like agricultural risk protection act USA) can assure the farmers some assured returns at the end of the day. Thus improvement and expansion of crop insurance schemes and access to these schemes are key measures to strengthen the safety net of the agricultural producers.

(2) Over the past few years the debt burden in the sector has increased significantly. According to the findings of the National Sample Survey Organization (NSSO) (59^{th} Round), almost half of farmer households are in debt. A large number of small

farmers still depend on unscrupulous moneylenders for their credit needs and the reach to institutional credit is still restricted to the relatively better-off farmers. The debt burden has also lead to large scale suicides by farmers in different parts of the country. The government should make efforts for substantial expansion of institutional credit to the people who need it the most at an affordable rate of interest.

(3) There is an urgent need to strengthen the marketing infrastructure for agriculture. It will improve the market efficiency and help promote agricultural export and agro processing industries.

Suggestions pertaining to the vagaries of Monsoon: (1) Another area which needs the highest priority is the water management and to provide irrigation facilities to the farmers. Water management holds the key to farm growth. As our Agriculture Minister Mr. Sharad Pawar, has pointed out, "**About 20 million hectare of additional land could be brought under the irrigation by completing the ongoing irrigation projects ".** Promotion of micro-irrigation technology along with early completion of irrigation projects, is along necessary to improve efficiency of water use. On the basis of RBI studies and studies of many experts it can be pointed out that in Indian agriculture the water use efficiency is one of the lowest in the world. We can not afford such a large scale inefficient use of our scarce water resource particularly when water scarcity is on the rise due to decreasing overall rainfall every year.

At last it might be concluded that today, Agriculture is at the crossroads. Whole hearted, comprehensive and holistic approach and a long term vision is the need of the hour to make sustainable and globally competitive. It is the pious duty of the government to bring the smile back to the small rural farmer. Former minister of state for agriculture Mr Som Pal has stated very correctly, "The situation is not crucial but if do not re-orient ourselves, we will land in a crisis." This will necessitate the active participation of the central, state and local governments as well as the farming communities.

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