Special volume published March 2016 containing selected papers from the IAAE-ISAE Inter-Conference Symposium on Re-visiting Agricultural Policies in the Light of Globalisation Experience: The Indian Context. The symposium was held in Hyderabad, India, October 12-14, 2014.

RE-VISITING AGRICULTURAL POLICIES IN THE LIGHT OF GLOBALISATION EXPERIENCE: THE INDIAN CONTEXT

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in collaboration with
National Institute of Agricultural Extension Management (MANAGE)
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International Association of Agricultural Economists (IAAE)

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Strategies for Viable Profitability of Indian Agriculture: An Empirical Study Based on Reality during Reforms Era

I

INTRODUCTION

Economic viability of farming is considered as one of the core agricultural policy issues in the context of globalisation experiences and economic reforms in India (IJAE, 2013, pp.631). It is recognised that agriculture sector is not only an important source of rural livelihoods but also it ensures food security and this sector has vast potentiality to reduce rural poverty in India. The contribution of agriculture to economic growth and development largely depends on its total factor productivity growth and sustained rise in profitability or farm income. Productivity and profitability of agriculture in turn depends on how effectively and efficiently farmers use agricultural resources to maximise their production and total farm income. One of the important features of Indian farming system is that it is dominated by small and marginal farmers. Marginal and small farms constitute the overwhelming majority of farmers of more than 96 percent in West Bengal during 2010-11. The present study is a modest attempt to explore some clues or answers to the following research questions: (i) What is the pattern and extent of farm profitability of Indian agriculture? (ii) Is farm profitability declining during economic reforms era? (iii) Why are Indian farmers carrying their business with persistent losses? (iv) Are the small and marginal farmers under distress today? (v) What are the factors affecting the farm profitability? (vi) Is farm level productive efficiency a matter to increase profitability? (vii) What are the appropriate strategies or policy-instruments for sustainable profitability of agriculture in India?

The novelty of this paper is that it distinguishes between 'profit earning farms' and 'loss incurring farms' in terms of their resource use efficiency. It follows modern frontier techniques and system approach covering wide ranges of crops and regions in India. The study analyses trends in profitability of Indian agriculture with particular focus on West Bengal paddy during 2000-01 to 2012-13 based on large sample of plot-level (unit) data under cost of cultivation scheme. The paper also analyses plight of marginal farmers. The present study identifies some major concerns of Indian farmers and suggests some innovative strategies for sustainable profitability of Indian agriculture.

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We are very grateful to our respected teacher Prof. Pranab Kumar Chatterjee, Retired Professor of Economics, Kalyani University for his valuable suggestions.

II

ANALYTICAL FRAMEWORK

Let us examine the inter-relationship between productivity, cost and profit of farms. If y_j is the yield rate (per hectare), p_j is the unit price and c_j is the unit cost of the j-th crop then, $(p_j - c_j)$ is termed as unit profit and the profit per hectare from the j-th crop (π_j) is defined as:

$$\pi_j = y_j (p_j - c_j) = y_j p_j - y_j c_j \quad \ldots.(1)$$

That is, net profit per hectare = value of output per hectare – total cost per hectare. The gross profit per hectare = value of output per hectare – total paid-out cost per hectare.

Multiply both sides of (1) by a_j and summing over all j, we get profit from farming system,

$\Sigma a_j \pi_j = \Sigma a_j y_j p_j - \Sigma a_j y_j c_j$, where a_j is the proportion of area under the j-th crop.

Further, c_j (= C_j/Q_j, where C_j = total cost and Q_j = total output of the crop j) is a composite term because C_j includes costs for different fixed and variable inputs (k) as:

$$C_j = \sum_k X_{jk} P_k, \quad \ldots.(2)$$

where X_{jk} = quantity of the k-th input for production of crop j and P_k is price of the kth input.

Therefore, yield rates, rate of input use, input structure, and prices of inputs are the crucial determinants of unit cost (c_j) of production which in turn influence farm profitability.

A profit function relates maximised profits to the prices of products (p_y), prices of inputs (p_1, p_2, ….p_m), and as also to other exogenous variables such as fixed inputs, or agro-climatic characteristics and social variables (say, z_1, z_2,…., z_n) (Sankhayan, 1988, pp. 85-86). In the short run, the producer needs only to maximise variable profits (= sales value of output minus cost of variable inputs), because the opportunity cost of the fixed inputs is zero. The profit function may be written as:

$$\pi = \pi (p_y, p_1, p_2, \ldots. p_m, z_1, z_2, \ldots., z_n) \quad \ldots.(3)$$

It is expected that yield rate and price of product promote profit or farmer's income but farm profitability is inversely related to the price of inputs. Generally, price of output and price of inputs are not under direct control of farmers. With proper selection, combination of input resources and management of crops, farmers can increase productivity and reduce unit cost of production to enhance rate of return

or profit from farming. Again, higher farm income or profitability increases potential investment in agriculture and increase use of modern technology and inputs resulting to increase land productivity. Thus, there is simultaneous relationship between productivity, cost and profitability in agriculture.

It is assumed that there is significant difference between profit earning farms and loss incurring farms in respect of efficient and effective resource utilisation in agriculture. Farm level efficient use of resources is crucial for increase in agricultural production (Farrell, 1957, pp. 253-290). In a study, Lau and Yotopoulos (1971, pp. 94-109) have developed dual profit function model to measure both allocative efficiency and technical efficiency of groups of farms. If increase of price of inputs (particularly imported inputs) is greater than that of price of outputs then cost of production will increase and profit will decrease. Prof. V. S. Vyas (2003, pp.266) has observed that the share of purchased inputs in the input structure has increased significantly over the period of time in Indian agriculture and this is partly due to subsidy policy of the government. But the subsidy induced increase in inputs has not resulted in more efficient use of inputs. He has found that small farms used inputs like fertiliser and irrigation more intensively but because of their meager land base, and low value cropping pattern, activity-mix, and the bias of the supportive systems they are not able to generate enough incomes. M. S. Bhatia (2006, pp. 89-100) pointed out that because of decline in the real minimum support prices and stagnant or marginal change in yield rate along with no spectacular improvement in technology since 1980s in Indian agriculture, the economic condition of the farmers has deteriorated.

III

DATA BASE AND METHODOLOGY

3.1 *Data Base*

The present study is mainly based on plot level summary data on various crops with particular focus on paddy production during 2000-01 to 2012-13. A plot[1] is considered as a unit (farm) of the study. The secondary data are collected from the Directorate of Economics and Statistics, Ministry of Agriculture and Farmers welfare, Government of India (website: http://eands.dacnet.nic.in).

3.2 *Indicators of Farm Profitability*

Following different costs concepts under cost of cultivation scheme (COC), we have considered farm profitability indicators as: (i) Net profit = Surplus (or deficit) over total cost (i.e., Output – C2, where Output = sum of values of 'Main product' and 'By product' and C2 is the total cost of production), (ii) Gross profit = Surplus (or deficit) over paid-out cost (= Output - A2), (iii) Normalised profit= profit per unit

of price, (iv) Percentage of profit (loss) earning (incurring) plots to total number of plots under cultivation, (v) Benefit-Cost Ratio (BCR=Output/C2), (vi) unit profit = price-unit cost of production.

3.3. *Hypothesis and Analytical Tools*

We have considered following hypothesis for the present study:

H1: Farm profitability is declining during reforms era in India.

H2: There is a great variation in farm profitability across size groups of farms, crops, states, and agro-climatic zones.

H3: There is a significant difference in respect of resources utilisation between two groups of farms: profit earning units (PMU) and loss incurring units (LIU).

H4: The probability of profit earning from production of a principal crop (paddy) will be significantly lower due to climate change in agriculture.

H5: Marginal and small farmers are under distress in Indian agriculture.

H6: Price of output, land productivity and farm level resource use efficiency are the crucial determinants of farm profitability in India. Increase in unit cost reduces farm profitability.

In addition to simple analytical approach (Table, Graph and Annual average compound growth rate by using semi-logarithmic stochastic regression equation) we have used following analytical tools to test these hypotheses: simultaneous regression equations (system approach) to assess interrelationship between productivity, cost and profitability, Binary Logit Model and dummy (explanatory) variable regression to examine impact of climate change and time trend on profitability, and two steps frontier regression techniques to examine role of farm level resource use efficiency in increase profitability.

The Logit model is specified as:

$$P_i = P(Y_i = 1) = F(Z_i) = 1/(1+e^{-Z_i})$$

where P_i = probability of $Y_i = 1$ (when farm has earned positive net profit from farming i.e., farm is economically viable), and $(1-P_i)$ = probability that $Y_i = 0$ (when farm has incurred losses (negative net profit) from farming); $F(Z_i)$ = CDF of the logistic function; e= base of natural logarithms; and Z is a predictor variable defined as:

$$Z = \alpha + \sum \beta_k X_k + \gamma T + \theta D,$$

where T represents time period, D represents agro-climatic zone wise dummy variable and X_k represent other explanatory variables.

So, Log $(P_i/1-P_i) = Z_i = \alpha + \sum\beta_k X_{ik} + \gamma T + \theta D$

The marginal effects after logit indicate the rate of change in the probability of the event occurring with respect to a unit change in explanatory variable or change in agro-climatic dummy variable. To examine profitability of West Bengal paddy due to climate change we have defined agro-climatic dummy variable (D) as

D = 1 for climate prone zones (Zone 6-coastal, Zone 2- Terai, Zone 5-Red Laterite)

= 0 for normal zones (zone 3, 4- old and new alluvial zones are considered as base)

Two-steps regression exercise is as follows:

Step 1. Stochastic frontier production function of the following form estimates farm level technical efficiency scores.

Suppose Y_i is the actual output for the ith farm, X_i represents input vector used by farm i and β is a vector of unknown parameters to be estimated. Then, the stochastic production frontier production function can be written as

$$Y_i = f (X_i, \beta) \exp. (\varepsilon_i)$$

where, $\varepsilon_i = v_i - u_i$

Such that $v_i \sim N (0, \sigma_v^2)$, for $-\infty < v_i < \infty$ (Normal distribution) and

$u_i \sim |N (0, \sigma_u^2)|$, for $u_i \geq 0$, (half normal distribution)

The specific model of this function in terms of Cobb Douglas Production function is:

$$\text{Log } Y_i = \text{Log } A + \sum \beta_j \text{ Log } X_{ij} + v_i - u_i$$

Technical efficiency for the i-th farm $(TE_i) = Y_i / Y_i^*$

= actual output/maximum possible output.

$$TE_i = \frac{Yi}{f(X_i, \beta) \exp.(v)} = \exp. (-u_i)$$

Therefore, technical inefficiency of the farm i = 1 - exp. $(-u_i)$

$= 1 - (Y_i / Y_i^*)$,

where Y_i^* is the maximum possible output.

Step 2. Farm level technical efficiency score (TE_i) is used as an explanatory variable in the following profit function:

Profit = f (price, variable input prices, productivity, efficiency (i.e. estimated TE_i), and other shift factors like, technology, agro-climatic zones, farm size).

IV

RESULTS AND DISCUSSION

4.1 *Patterns and Trends in Profitability of Indian Agriculture*

Figure 1 and Table 1 present that there is a great variation in profitability of Indian agriculture in terms of net profit and gross profit across different crops and over different time periods. The study reveals that out of total sample of 32742 plots of different major and minor crops under cultivation during 2012-13, only 61 per cent plots have earned profits (surplus over total cost) and the remaining 39 per cent plots have incurred losses (deficit over total cost) from farming in India. The share of such profit earning plots in total number of plots increases from 51.4 per cent during 2000-01 to 51.4 per cent in 2004-05, and 66.1 per cent in 2010-11. There is a positive growth of number of profit earning units in almost all crops grown during 2000-01 to 2012-13. Thus, on an average, there is an increasing trend in farm profitability in terms of net profit in India.

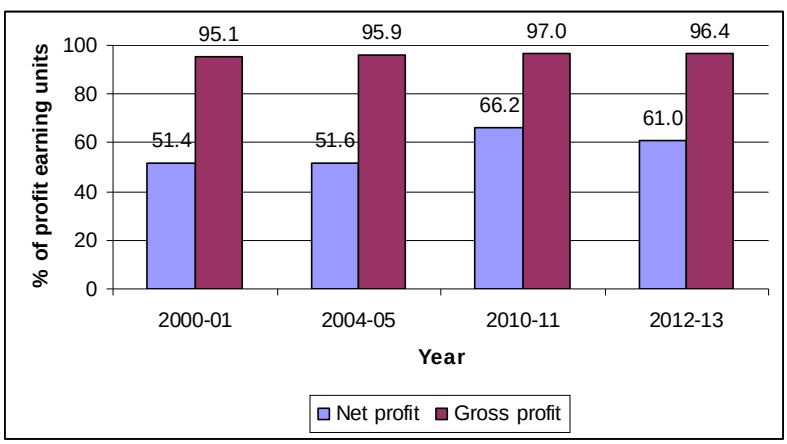

Figure 1. Changes in Profitability of Indian Agriculture, 2000-01 to 2012-13 (in terms of per cent of farms which have earned positive profit from all crops).

TABLE 1. CHANGES IN PROFITABILITY OF INDIAN AGRICULTURE DURING 2000-01 TO 2012-13

	Per cent of farms (plots) have earned positive profit from farming					
Basis	(Net Profit) 2000-01	(Net Profit) 2004-05	(Net Profit) 2010-11	(Net Profit) 2012-13	Growth rate (per cent) 2000-01 to 2012-13	(Gross Profit) 2012-13
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Arhar, Redgram	55.2	53.1	57.3	48.7	-0.5	93.9
Bajra	37.8	41.9	56.9	52.9	3.4	94.9
Barley	56.1	51.9	69.5	74.2	2.8	100.0
Cotton	44.1	60.6	83.9	62.4	3.8	93.9

Contd.

TABLE 1. CONCLD.

Basis	Per cent of farms (plots) have earned positive profit from farming					
	(Net Profit) 2000-01	(Net Profit) 2004-05	(Net Profit) 2010-11	(Net Profit) 2012-13	Growth rate (per cent) 2000-01 to 2012-13	(Gross Profit) 2012-13
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Gram	76.7	64.7	66.5	72.0	-0.5	95.1
Groundnut	32.8	45.5	58.0	57.6	4.8	89.5
Jowar	44.1	44.1	45.9	39.7	-0.5	89.9
Jute	28.6	20.2	78.4	46.0	8.0	99.0
Lentil	65.1	67.2	70.4	70.5	0.7	99.3
Maize	29.5	39.3	54.2	48.7	4.7	94.6
Moong, Greengram	34.8	14.6	45.6	42.9	4.8	93.2
Mustard, Rapeseed	48.6	58.5	65.5	67.7	2.7	96.3
Nigerseed	NA	50.0	43.8	41.9	-2.2	100.0
Onion	66.0	37.0	87.5	85.6	4.3	93.9
Paddy	48.4	44.1	58.0	48.3	0.9	96.9
Pea	NA	31.5	43.8	43.7	4.5	92.0
Potato	57.7	53.9	66.2	52.0	0.1	87.5
Ragi	11.0	17.6	18.8	22.9	5.3	86.2
Safflower	35.7	51.2	40.0	20.0	-4.0	100.0
Sesamum (Til)	33.1	42.9	38.4	48.2	2.1	93.7
Soyabean	45.4	61.8	74.6	91.4	5.4	99.2
Sugarcane	83.4	87.0	91.8	93.1	0.9	99.2
Sunflower	23.1	36.9	49.1	49.2	6.4	92.3
Urad, Blackgram	44.1	31.5	61.8	34.1	0.7	91.7
Wheat	70.3	71.7	84.3	81.4	1.5	98.8
All	51.4	51.6	66.2	61.0	2.0	96.4
(CV)	(38.3)	(36.3)	(29.2)	(35.1)		(4.2)
Sample size (No. of plots)	30314	31853	33525	32742		32742

Note: Net profit = Surplus over total cost, Gross profit = Surplus over paid out cost.

An analysis of farm profitability measured in terms of benefit – cost ratio (BCR) also shows that there is an increasing trend in farm profitability during 2000-01 to 2010-11 (Table 2).

TABLE 2. ANNUAL AVERAGE COMPOUND GROWTH RATE (PER CENT) OF BENEFIT COST RATIO (BCR) DURING 2000-01 TO 2010-11

States	Crops	LIU		PMU	
		Growth rate of BCR	Sd.	Growth rate of BCR	Sd.
(1)	(2)	(3)	(4)	(5)	(6)
Andhra Pradesh	Paddy	0.38	0.034	0.62	0.037
	Sugarcane	-0.10	0.092	0.20	0.071
	Cotton	0.95	0.094	0.24	0.087
	Groundnut	-0.04	0.052	-0.16	0.074
	Jowar	1.43	0.061	0.79	0.121
	Maize	0.55	0.058	-0.12	0.076
	Moong, Greengram	1.01	0.059	0.06	0.117
	Ragi	5.66	0.150	-0.57	0.051
Gujarat	Cotton	1.84	0.061	1.81	0.169

Contd.

TABLE 2. CONCLD.

States	Crops	LIU		PMU	
		Growth rate of BCR	Sd.	Growth rate of BCR	Sd.
(1)	(2)	(3)	(4)	(5)	(6)
Maharashtra	Sugarcane	-1.27	0.047	2.54	0.241
Punjab	Paddy	0.68	0.040	1.12	0.113
	Wheat	0.65	0.039	0.68	0.073
	Cotton	2.94	0.098	1.38	0.092
Rajasthan	Mustard, Rapeseed	2.38	0.070	1.08	0.122
Uttar Pradesh	Paddy	0.78	0.027	1.75	0.103
	Potato	1.46	0.057	2.02	0.161
	Sugarcane	-0.03	0.066	2.42	0.275
	Wheat	0.51	0.018	1.10	0.088
	Mustard, Rapeseed	0.44	0.046	0.85	0.080
	Maize	1.75	0.050	0.10	0.087
	Masur, Lentil	0.64	0.060	1.39	0.198
West Bengal	Paddy	0.56	0.020	0.62	0.036
	Jute	0.71	0.033	2.89	0.154
	Potato	0.97	0.098	0.29	0.058

Source: Same as Table 1.

Note: sd = Standard deviation. LIU=Loss incurring units, PMU= Profit making units.

There is significantly positive growth rate of profitability indicator of benefit-cost ratio (BCR) in all crops except in sugarcane, groundnut, ragi and maize during this period. A close perusal of Standard Deviation (sd) value of BCR shows that there is a year-wise fluctuations in farm profitability particularly in production of sugarcane, potato, jute, pulses and course cereals which may be due to inherent nature of Indian agriculture (largely depends on agro-climatic conditions), inefficient farm resource use, lack of controlled irrigation facilities, shortage of investment and support systems including effective marketing system, lack of proper agricultural development policies, and impact of globalisation. What is alarming is that the gap between profit making farms (PMU) and loss incurring farms (LIU) is found to be increasing in Indian agriculture which is observed from an analysis of differential growth rates of BCR. Thus, overall impression regarding farm profitability of Indian agriculture is not satisfactory.

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growth rates of BCR. Thus, overall impression regarding farm profitability of Indian agriculture is not satisfactory.

In case of paddy (other than Basmati) production, there is a deficit over total cost (negative net profit) in most of the plots under cultivation during study period (for example, 56 per cent of paddy plots in 2004-05 and during 2012-13 it is about 52 per cent). The share of loss incurring units in total production units varies significantly across states: from about 7 per cent in Punjab and Haryana to 85.4 per cent in Assam; 75.4 per cent in Jharkand, 70.9 per cent in Orissa, 69.7 per cent in West Bengal, 59.1 per cent in Uttarakhand, and 58.2 per cent in Bihar during 2012-13 (Table 3). This is a serious concern of the government or policy makers particularly in the context of sustainable agriculture, food security and regional inequality. There is an urgent need of reduction of number of loss incurring farm units. Naturally, the question may arise that why Indian farmers are continuing their farming even with such huge losses in terms of net profit. Reasons may be: (i) farmers have earned gross profit i.e., surplus over paid out cost (last column of Table 1), (ii) agriculture is mostly self-employed enterprise. The share of labour cost still remains at about 53 per cent of total operational cost of paddy even after WTO while the cost of machine use increases from 6.2 per cent in 1996-97 to 13.5 per cent in 2010-11 (Table 4). (iii) low opportunity cost of family labour, (iv) expectation – farmers expect to earn positive net profits from other plots of the same crop or different crops, and (v) lack of alternative avenues to the farmers. It is very unfortunate that Indian farmers have also experienced with negative gross profit (that means they did not recover even

TABLE 3. VULNERABILITY OF PADDY PRODUCTION IN TERMS OF LOSSES BY STATES

States	Per cent of loss units (plots) to total plots			
	2012-13	2010-11	2004-05	2000-01
(1)	(2)	(3)	(4)	(5)
Andhra Pradesh	25.2	36.6	27.0	34.1
Assam	85.4	52.3	71.2	49.6
Bihar	58.2	43.5	62.1	57.1
Chhattisgarh	14.5	18.3	29.2	
Gujarat	41.4	5.7		
Haryana	7.1	5.5	26.7	
Pradesh	43.1	30.2		
Jharkand	75.4	85.8	78.7	
Karnataka	26.3	42.3	50.3	36.6
Kerala	23.2	30.2	53.4	38.7
Madhya Pradesh	8.5	30.4	59.7	61.9
Maharashtra	41.9	87.4		
Orissa	70.9	58.4	60.5	55.2
Punjab	7.0	8.2	14.9	23.4
Tamil Nadu	26.0	37.8	51.3	47.7
Uttar Pradesh	39.1	30.7	57.3	52.0
Uttarakhand	59.1	14.5		
West Bengal	69.7	47.1	64.6	66.0
All India	51.7	42.0	55.9	51.6
Sample size	11891	12253	11675	12695

Source: Same as Table 1.

Note: Loss = deficit over total cost.

paid-out cost from farming; for example, 13 per cent plots of potato in 2012-13 to 23 per cent plots of onion in 2004-05) resulting to persistent indebtedness and undesirable incidences like, farmers' suicide in Indian agriculture.

TABLE 4. CHANGES IN INPUT STRUCTURE OF PADDY PRODUCTION IN INDIA

	1996-97*		2004-05		2010-11	
	Input share (per cent) in total operational cost of paddy production					
Inputs	Mean	CV	Mean	CV	Mean	CV
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Human Labour	53.0	17.7	49.1	20.5	53.1	14.1
Machine	6.2	75.6	9.1	61.0	13.5	45.8
Fertiliser	11.2	40.7	9.9	39.1	8.2	34.6
Irrigation	4.4	121.8	5.7	108.7	3.6	103.4

Source: Estimated from state level aggregated data
Note: CV = coefficient of variation (per cent).

The changes in prices of input and output of paddy in India during reforms era are shown in Table 5 and Table 6. Increase in price of inputs is found to be greater than that of price of output during post-WTO period. The growth rate of Minimum Support Price (nominal MSP) of different crops is estimated to be declined during post-WTO period as compared with pre-WTO period. Real growth of MSP may be found negative (due to spiral effects of general price inflation) in some cases. Government policy of supply of food at a cheaper rate may lower market price of food grains. But Indian farmers are the net sellers and they will be most sufferers. One the one hand, lower output price (due to ineffective agriculture marketing system, lack of proper implementation of MSP at the appropriate time and level) and on the other hand, high cost of labour along with (farm) labour scarcity (particularly due to impact of MGNREGA and food security policy), increasing cost of irrigation, seeds, pesticides, and requirement of higher dose of fertiliser without soil testing, etc. (i.e., the policy of openness to input markets but restricted output market) are making agriculture as unprofitable business among Indian farmers. Such uneven changes in input prices and output prices in Indian agriculture is one of the important factor responsible for slow progress of farm profitability and high incidences of farmers' indebtedness, rural poverty resulting to Indian farmers quit from agriculture or even worse 'quit their lives'.

TABLE 5. CHANGES IN UNIT PRICES OF INPUTS AND OUTPUT OF PADDY IN INDIA AFTER WTO
(BASE: 1996-97=100)

Rate per unit (Rs.)	1996-97	2004-05	2010-11
(1)	(2)	(3)	(4)
Seed (kg.)	100	131	247
Fertiliser (kg. nutrients)	100	121	139
Manure (qtl.)	100	142	231
Human labour (man Hrs.)	100	139	291
Animal labour (pair Hrs.)	100	196	368
Price-implicit rate (Rs./qtl.)	100	121	231

Source: Estimated from data under cost of cultivation scheme.

TABLE 6. GROWTH OF MSP DURING PRE-WTO AND POST-WTO PERIODS

MSP	Growth (per cent) 1985-2014	Growth (per cent) 1985-1995	Growth (per cent) 1996-2014
(1)	(2)	(3)	(4)
Paddy common	8.1	11.0	7.5
Coarse cereals	8.3	9.9	8.0
Wheat	8.1	10.4	6.8
Gram	8.7	11.7	8.1
Arhar (Tur)	9.3	11.6	9.8
Moong	9.8	11.6	10.6
Urad	9.6	11.6	10.2
Sugarcane	8.8	10.5	8.7
Cotton	7.2	10.4	6.0
Jute	8.3	9.6	8.4
Groundnut(in shell)	8.0	11.1	8.2
Soyabean black	7.6	10.5	7.8
Soyabean yellow	7.2	10.4	7.1
Sunflower seed	7.8	12.3	8.2
Rapeseed mustard	7.1	9.2	6.9
Safflower	7.0	8.5	6.8

Source: Estimated from data, RBI website statistics (time series).

4.2 *Plight of marginal farmers in India*

An analysis of incidence of loss units from farming across size groups of farms reveals that there is a positive relationship between farm size and profitability of Indian agriculture (Figure 2 and Figure 3). The incidence of loss units is found to be highest among marginal farmers (holding land below one hectare) during 2012-13 (50.7 per cent of plots of all crops and 64.3 per cent of paddy plots of marginal farmers). Table 7 presents productivity, profitability and resource use patterns across size groups of paddy plots between the two groups of farms: loss units (LIU) and profit units (PMU). It is observed that: (i) there is a very high incidence of losses (68.4 per cent) in the size group of plots of below 0.5 hectare of land, and (ii) there is significant difference between the groups of loss units and profit units in respect of productivity, profitability, price of output, quantity and quality of inputs use in paddy production during 2012-13. It is important to note that yield rate and the rate of gross profit may not be so low for marginal farmers because they have use resources (irrigation, manure) intensively with more family labour as compared to others. The mean technical efficiency score of paddy in West Bengal is estimated as high as 0.902 during 2012-13. Mean efficiency score for the loss units is estimated as 0.881 compared with 0.957 for the profit earning units. Efficiency is essential for their survival; they have no choice. The farm size group wise mean efficiency scores are found to be: Marginal farmers (0.866), Small (0.901), Semi-medium (0.904), Medium (0.947), and Large farmers (0.950). The plight of a farmer depends not only on his rate of earning per hectare or efficiency but also on the area of land holdings at his disposal (average size of holding for marginal farmers is only 0.39 hectare in India and 0.49 hectare in West Bengal as per Agricultural Census of 2010-11). Their

size holding is so low that even their total farm income may not exceed existing poverty line income. In India, the number of agricultural workers increases from 27.3 million (28.1 per cent of rural population) in 1951 to 144.3 million (54.9 per cent) in 2011, and the number of cultivators decreases from 127.3 million (54.4 per cent) in 2001 to 118.7 million (45.1 per cent) in 2011 (Pocket book on Agricultural Statistics, 2013). Increasing marginalisation may jeopardise the prospect of Indian agriculture.

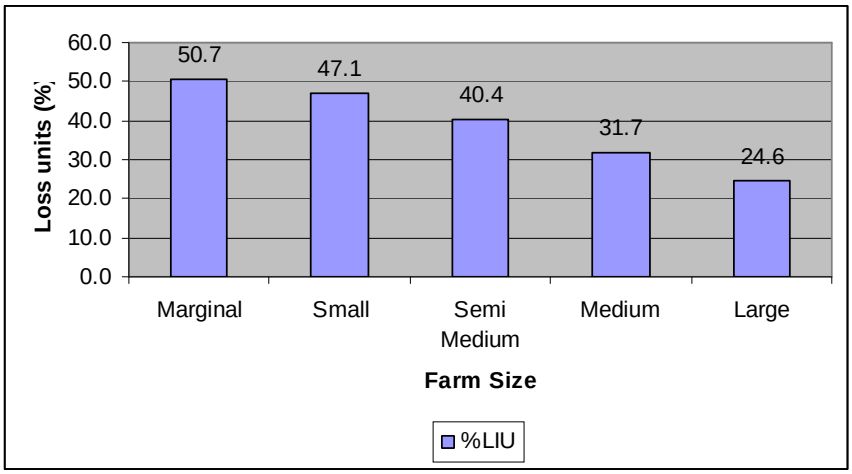

Figure 2. Incidence of Loss units by farm size groups, all crops, India, 2012-13 (sample size = 32742)
(per cent of Loss units (LIU) to total units)

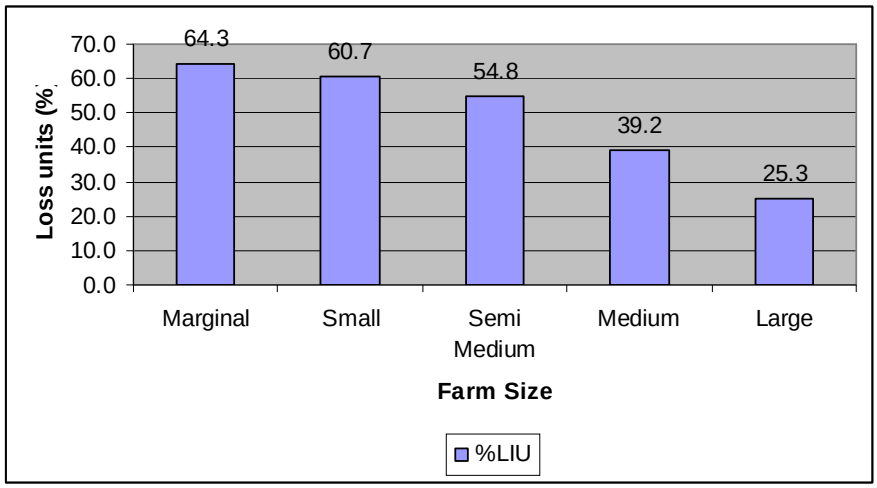

Figure 3. Incidence of Loss units by farm size groups, Paddy, India, 2012-13 (sample size = 11891) (per cent of Loss units (LIU) to total units).

TABLE 7. PLIGHT OF MARGINAL FARMERS (PLOTS) IN TERMS OF PROFITABILITY AND RESOURCE USE PATTERNS IN PADDY, 2012-13

	Size groups of paddy plots in hectare			
	Below 0.5 ha	0.5 -1 ha.	1ha and above	Total
(1)	(2)	(3)	(4)	(5)
Items (mean)	Loss incurring units (LIU)			
Yield (qtls/ha)	33.6	29.6	28.2	31.9
Price (Rs./qtl)	1075.6	1019.0	1024.1	1054.5
Unit cost (Rs.)	1540.3	1351.2	1295.2	1462.3
Rental (Rs/ha)	10106.4	8768.5	8662.0	9584.0
Unit profit (Rs.)	-464.7	-332.2	-271.1	-407.8
Gross profit/ha (Rs.)	18409.5	13630.6	10207.1	16232.5
Net profit/ha (Rs.)	-13268.4	-7869.9	-6353.3	-11049.4
Irrigation exp/ha (Rs.)	1741.1	858.3	592.0	1376.3
Manure (kg/ha)	18.5	14.2	8.6	16.3
Machine hrs/ha	9.2	8.9	11.5	9.3
Bullock hrs/ha	100.5	107.5	58.1	98.1
Per cent of family labour	54.9	43.3	30.0	49.1
Insecticides (Rs/ha)	404.8	308.9	602.2	398.1
	Profit making units (PMU)			
Yield (Qtls/ha)	43.4	42.9	47.9	44.9
Price (Rs./Qtl)	1314.8	1256.6	1334.5	1302.8
Unit cost (Rs.)	1033.5	951.0	927.7	967.7
Rental (Rs/ha)	13697.8	13735.3	16923.1	14887.4
Unit profit (Rs.)	281.3	305.7	406.7	335.1
Gross profit/ha (Rs.)	38773.3	36164.4	42923.9	39429.6
Net profit/ha (Rs.)	12639.1	13865.5	20257.4	15823.6
Irrigation exp/ha (Rs.)	1762.5	1285.9	1216.0	1406.1
Manure (kg/ha)	14.4	14.9	11.6	13.5
Machine hrs/ha	11.2	11.4	13.1	12.0
Bullock hrs/ha	37.1	37.5	16.8	29.8
Per cent of family labour	44.1	35.9	28.3	35.7
Insecticides (Rs/ha)	716.7	737.7	1449.2	991.0
Per cent of LIU	68.4	47.6	23.0	51.7

Source: same as Table 1.
Note: LIU= loss units.

Within West Bengal, agro-climatic zone wise profitability analysis shows that there is a high rate of incidence of losses from paddy production in the Coastal and Saline Zone (88.8 per cent), Terai Zone (79.9 per cent) and Red and Laterite zone (69.7 per cent) during 2012-13. Climate change in agriculture is an important factor to explain variation in production, productivity and profitability of Indian agriculture (Basu and Nandi, 2015). Table 8 reveals that on an average, only 25.7 per cent farms under coastal saline zone have earned profit and remaining 74.3 percent have incurred loss from paddy production during 2000-01 to 2012-13. In case oilseeds (Mustard and Rapeseed) the profit earning units are estimated to be only 15.6 per cent in coastal zone 6. Terai zone 2 and Red and Laterite Zone 5 have also experienced with great economic failure of agricultural resources utilisations in wheat, Jute, potato, mustard and rapeseed, and paddy production. Thus, area specific and crop-wise proper plan of farming is important to reduce number of loss units in agriculture. Increase in the well being of the farming community seems to require that the number

of marginal farmers be reduced mainly by absorbing a substantial portion of them in more remunerative non-agricultural occupations, to be promoted not by taking away productive agricultural land but by developing agro-based industries and production of mass consumption goods by the mass in the vicinity of rural areas.

TABLE 8. PERCENTAGE OF UNITS INCURRED LOSSES FROM FARMING IN WEST BENGAL (DURING 2000-01 TO 2012-13)

Agr-climatic zones	Paddy	Mustard, Rapeseed	Potato	Jute	Wheat
(1)	(2)	(3)	(4)	(5)	(6)
Zone1-Hill	---	---	---	---	---
Zone2-Terai	69.8	76.1	44.3	56.0	78.6
Zone3-Old Alluvial	58.0	37.8	36.7	47.9	68.3
Zone4-New Alluvial	57.9	66.0	53.2	57.6	84.4
Zone5-Red and Laterite	64.0	75.8	62.9	76.4	96.1
Zone6-Coastal Saline	74.3	84.4	49.5	---	---
West Bengal	62.9	55.0	50.7	51.2	77.8

Source: Same as Table 1.

The regression results (Binary Logit model: =1 for profit and =0 for loss units) on West Bengal paddy across different agro-climatic zones are summarised in Table 9. We have observed that the probability of profit earning from paddy production decreases about 4.5 per cent in the climate prone zones as compared to normal alluvial zones due to climate change (coefficient of climate dummy (D) is estimated as -0.338 and marginal effect = dy/dx = -0.045). It is observed that as farm size and yield rate increase, probability of profit earning from farming will increase about 14.6 per cent and 0.35 per cent respectively, but increase in unit cost may decrease 0.16 per cent profitability of agriculture. The positive coefficient of time variable (2000-01 to 2012-13) signifies that there is a potentiality to increase profit from paddy farming in West Bengal at about 9 per cent per year.

TABLE 9. REGRESSION RESULTS ON PROFITABILITY OF PADDY IN WEST BENGAL (BINARY LOGIT MODEL: Y= 1 FOR PROFIT AND 0 FOR LOSS IN PADDY PRODUCTION)

Explanatory variables	Coef. (marginal effects)
(1)	(2)
Area	1.082 (0.146)
Yield	0.026 (0.0035)
Unit cost	-0.012 (-0.0016)
Time trend (T)	0.683 (0.0923)
Constant	1.939
Agro-climatic dummy (D)	-0.338 (-0.045)
Pseudo R^2	0.447
No. of Obs.	29332

Note: All coefficients are statistically significant (p- value= 0.000). D= 0 for normal alluvial zones and D= 1 for Climate prone zones.

4.3 *Determinants of Farm Profitability*

Results of *three stage least-squares regression* of productivity (yield rate), cost (unit cost of production) and profitability (benefit-cost ratio) of agriculture based on

686 plot level data on paddy production in West Bengal during 2012-13 are summarised in Table 10. It is found that: (i) productivity and profitability increases with farm size but unit cost of production decreases with farm size significantly, (ii) Use of improve variety seeds, machine use, irrigation promote land productivity (yield rate) significantly along with the use of labour and chemical fertiliser, (iii) Dummy variable (Dbcr = 0 for loss units and 1 for profit earning units) in productivity equation signifies that there is significant difference between loss units (LIU) and profit rearing units (PIU) in respect of resource (land) utilisation. The

TABLE 10. DETERMINANTS OF PRODUCTIVITY, UNIT COST AND PROFITABILITY OF PADDY (WEST BENGAL, 2012-13) THREE-STAGE LEAST-SQUARES REGRESSION RESULTS

		Coef.	z	P > z
Endogenous variables	Exogenous variables	(Number of obs = 687)		
(1)	(2)	(3)	(4)	(5)
1. lyld				
(productivity)	zcode	-0.022	-1.9	0.054
R-sq = 0.281	sg	0.021	2.4	0.016
	lhlabph	0.086	2.5	0.013
chi2 =277.3	lmachph	0.023	2.3	0.022
	lfertph	0.031	1.7	0.087
P = 0.000	ltirrrsph	0.013	2.9	0.003
	variety	0.010	8.0	0.000
	Dbcr	0.241	13.1	0.000
	_cons	2.385	9.3	0.000
2. luc				
(unit cost)	zcode	0.022	2.1	0.040
R-sq=0.527	sg	-0.022	-3.0	0.003
	lplab	0.357	11.5	0.000
chi2=785.4	lpmach	0.011	1.2	0.239
	lpfert	0.081	1.7	0.085
P=0.000	lyld	-0.690	-19.7	0.000
	lossnf	-0.048	-3.5	0.000
	_cons	8.338	42.1	0.000
3. lbcr				
(profitability)	zcode	-0.048	-4.9	0.000
R-sq=0.654	sg	0.012	1.7	0.089
	lplab	-0.325	-12.6	0.000
chi2=2010.2	lpmach	-0.006	-0.7	0.485
	lpfert	-0.009	-0.2	0.820
P=0.000	lyld	0.382	6.6	0.000
	ltec	0.013	3.8	0.000
	lprice	0.793	29.2	0.000
	leff	0.615	5.5	0.000
	_cons	-5.849	-17.4	0.000

Source: Same as Table 1.

Note: l stands for log.

Endo. Variables: yld = yield rate, uc = unit cost, bcr=benefit-cost ratio (=O/C2)

Exo. Variables: zcode= zone code (terai-2, old alluvial-3, new alluvial-4, Red laterite-5, coastal & saline-6). sg= size groups of farms (marginal-1, small-2, semi-medium -3, medium-4, large-5)., hlabph, machph, fertph, and tirrrsph are the per hectare inputs use of human labour (hrs), machine (hrs), chemical fertiliser (kg) and irrigation (Rs.) respectively. Variety= seeds variety code (local-10, improve-50, hybrid-60).

Dbcr= dummy variable defined as 0 for loss units (BCR<1) and 1 for profit units (BCR>1).

plab, pmach, pfert are the input prices of labour, machine and fertiliser respectively.

price=price of output, eff= efficiency score, tec=technology (ratio of machine use to labour use).

estimated dummy variable coefficient of 0.241 implies that yield rate would have increased about 24 per cent if there were no loss units in paddy production, (iv) Increase in yield rate reduces unit cost of production but average wage rate, and price of chemical fertiliser increase unit cost significantly, (v) the analysis of partial elasticity coefficients of profit function reveals that price of output (0.793), farm level resource use efficiency (0.615), land productivity (0.382), and technology use i.e, farm mechanisation (0.013) have played significant role to improve profitability of agriculture. On the other hand, increase in average wage rate significantly reduces farm profitability to the extent of 32.5 per cent.

V

CONCLUSION AND POLICY IMPLICATIONS

Economic viability of India agriculture in terms of profitability is considered as one of the key policy issues, today. On the basis of plot level data under cost of cultivation scheme, the present study has estimated that 61 per cent farms (plots) have earned profits and the remaining 39 per cent farms have incurred losses from farming of different crops during 2012-13 in India. In case of paddy, the share of loss incurring units in total number of plots is estimated as high as 52 per cent for the country and such rate of loss units varies significantly from about 7 per cent in Punjab and Haryana to 70 per cent and above in Assam, Jharkand, Orissa, and West Bengal. There is a palpable indication of increasing farm profitability during 2000-01 to 2012-13 with some degree of instability. Farm profitability also varies significantly across crops, states, farm sizes, and agro-climatic zones. The incidence of losses from farming is observed quite high among marginal farmers and small farmers as well as in climate-prone zones. A significant number of farms even experiences with deficit over paid-out cost in almost all crops resulting to persistent indebtedness and undesirable incidences among Indian farmers. There is no rational use of existing resources to maximise profit in Indian agriculture. Decreasing size of cultivated plots and increasing marginalisation may jeopardise the prospect of Indian agriculture and aggravate rural poverty. The gap between profit earning farms and loss incurring farms in respect of resource utilisation in agriculture is increasing during the reforms era. This is a matter of grave concern. There is an urgent need of reduction of number of loss incurring units in agriculture.

Increase in yield rate reduces unit cost of production but average wage rate, and price of chemical fertiliser increase unit cost significantly. Increase in unit cost of production and average wage rate significantly reduces farm profitability. Price of output, farm level resource use efficiency, land productivity, and farm mechanisation have played significant role to improve profitability of agriculture. Farm mechanisation, effective use of water resources and use of improved variety seeds enhance land productivity which in turn increase profitability. Enhancement of yield rate in a system of multiple cropping is crucial for increase in farm profitability. An appropriate strategy should be evolved to reduce unit cost of production and increase

land and labour productivity. Organic farming that has employment generating potentiality may be developed. The choice of remunerative cropping pattern is another significant aspect of increase in farm income. Effective agricultural marketing system should be developed so that farmers get incentive price and consumers pay fair price. The farmers may also get higher income even at stable price if an appropriate productivity increasing low cost technology can be evolved through the intensive research and investment in agriculture. Viable extraction of 'by-products' is another option to increase farm profitability. Agro-based industries of production of mass consumption goods in and around rural areas should be developed. Sustained growth of agricultural output is very crucial for sustainable profitability and stable rate of labour absorption in agriculture. Since yield rate of traditional crops in Indian agriculture reaching a plateau in most of the areas and wage rate is very much sensitive to the standard of living of rural people, then the agricultural development policies should be directed to minimise unit cost of production and increase land and labour productivity through multi-pronged strategies: expansion of irrigation facilities and effective use of water resources, implementation of suitable farm mechanisation, efficient use of existing resources, reduction of use of high cost chemical technology, development of organic farming, expansion of agricultural extension services and credit facilities, enhancement of production and utilisation of 'by products', area-specific appropriate selection and combination of multiple crops, and by ensuring free mobility of agricultural inputs and products through the development of rural infrastructures and agricultural support systems, strengthening linkages to non-farm sectors of the economy, and to promote effective agricultural marketing facilities at both domestic and international levels.

NOTE

1. A plot is a part of a parcel devoted to one activity. A parcel is one piece of land with identical tenure and physical characteristics (vide, Manual on Cost of Cultivation Surveys).

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