

**EFFECT OF HIGH YEILDING VARIETY OF SEEDS ON YIELD
IN THE STATE OF WEST BENGAL: AN EMPIRICAL QUEST**

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ABSTRACT

Economists, in India, over the years have suggested that the effect of **High Yielding Variety (HYV)** of seeds on the yield in the state of West Bengal, a major contributor in agricultural production, was minimal if not non-existent. This study attempts to search for the degree of validity of such a claim and in turn go ahead and look for causes to prepare a postmortem of why, if so, the “miracle seeds” failed to deliver in West Bengal. The highlights of the study are (1) The attempt to look for better explanation of the aforementioned claim by carrying out a district level analysis using the 2-stage least square estimation (2SLS) technique applied to a recursive system of simultaneous equations for a 25 year period starting form 1970 to 1994, divided into two relevant sub-periods (2) Since Green Revolution was a package deal program, it was surely more suited to large scale farming. Some economists over the years have claimed that it took some time for the process to start affecting the West Bengal agriculture which due to massive implementation of the land-reforms program was significantly small-scale oriented. Thus it would be interesting to evaluate, if at all, any delayed effect did set in during the 1980s.(3) Realizing the predominance and the so professed success of the land reforms program in West Bengal agriculture we introduce a control variable namely percentage area under small and marginal farmers and observe whether it did have any significant negative impact on HYV use. We observe that there is neither contemporaneous nor delayed effect of HYV on yield in the state for the sample period in concern.

INTRODUCTION AND OBJECTIVES

After India's independence in 1947, efforts were directed at achieving food self-sufficiency. However even after two decades since her independence such efforts were not entirely successful. During these years tremendous emphasis was laid on the expansion of the farming areas, but starvation deaths were still a part of the daily news. In a perfect case of Malthusian economics, population was growing at a much faster rate than food production. This called for drastic action to increase the agricultural yield. The action came in the form of the Green Revolution, basically applied to the period from 1967 to 1978. However, it should be noted that the term "Green Revolution" is a general one, used to signify scientific experimental application in agriculture and is in no way was specific to India. The three basic elements that characterized the Green Revolution were: (1) Continued expansion of farming areas, (2) Double-cropping existing farmlands and (3) Using seeds with improved genetics.

Given that, we now have a brief idea about what the term "Green Revolution" conveys let us then turn our attention to the objectives of this paper. One of the major criticism of Green Revolution (see Vaidyanathan; 1997) has been and perhaps would always remain is the fact that the effect of the process was far from being uniform. Well this seems far off from being unnatural given the structural diverseness of the country and thus its varied ability to adapt itself to the new technology. But perhaps the major issue that cropped up amidst these criticisms was that Green Revolution tended to affect only some major agricultural pockets of the country namely Punjab, Haryana and some parts of western Uttar Pradesh (see Agarwal; 1982, Bhalla 1976; 1977, Boyce; 1987, Fracine; 1971) which basically comprises of rich and large farmers and is undoubtedly the major vote bank in an agriculture dominated Indian economy. Economists have suggested (see Saha and Swaminathan, 1994b, Sen and Sengupta; 1995) that the effect on West Bengal, a major contributor in agricultural production of the country, was minimal if not non-existent. This study attempts to search for the degree of validity of such a claim and in turn go ahead and look for causes to prepare a postmortem of why, if so, the "miracle seeds" failed to deliver in West Bengal. The highlights of the study are (1) The attempt to look for better explanation of the aforementioned claim by carrying out a district level analysis using the 2-stage least square estimation (2-SLS) technique applied to a recursive system of simultaneous equations for a 25 year period starting from 1970 to 1994, divided into two relevant sub-periods (2) Since Green Revolution was a package deal program, it was surely more suited to large scale farming. Some economists (see Saha and Swaminathan; 1994a, Roy; 1994, Sawant and Achuthan; 1995, Rogaly, White and Bose; 1995) over the years have claimed that it took some time for the process to start affecting the West Bengal agriculture which due to massive implementation of the land-reforms program¹ was significantly small-scale oriented (see Joshi; 1975, Bandhopadhyay; 1988). The intuition behind such a claim is pretty simple and goes as follows: the process stayed restricted only to large-scale farming until there was technological innovations, in terms of machineries and irrigational facilities to suit the needs of small scale farming. Thus it would be interesting to evaluate, if at all, any delayed effect did set in during the 1980s. (3) Realizing the predominance and the so professed success of the land reforms program in West Bengal agriculture we introduce a control variable namely percentage area under small and marginal farmers and observe whether it did have any significant negative impact on HYV use. This would help us in providing a better diagnosis of the impact of the process. A notable feature of this analysis is the fact that we basically concentrate on figuring out the effect of the area devoted to HYV cultivation as a proportion of total cropping area on yield of food grains.

¹Land reforms was a process trying to address the issue of equity in land holdings and in turn involved the three major features of redistribution of cultivated land, tenancy reforms and distribution of homestead plots.

METHODOLOGY:

To study the effect of HYV cultivation on food grain yield for the different districts of West Bengal we design the following recursive system² of simultaneous equations:

$$yield = const1 + a1*pfert + a2*irin + a3*hyvt + a4*labt + e1 \text{-----equation-1}$$

$$hyvt = const2 + b1*pfert + b2*irin + b3*labt + b4*psmarea + b5*lrt + b6*plit + b7*pvelec + e2$$

-----equation2

where e_i =errors of the respective equation, $i=1,2$.

$$yield = pfdgr/afdgr;$$

$$lrt = lroad/tca$$

$$labt = tlab/tca = \text{per hectare use of labor}$$

$$hyvt = hyv/tca = \text{area under HYV in proportion to total cropped area}$$

$$pfdgr = \text{Production of food grain in tons}$$

$$afdgr = \text{Area under food grain in hectare}$$

$$gia = \text{gross irrigated area in hectare}$$

$$tca = \text{total cropped area in hactre}$$

$$pfert = \text{Per hactre consumption of fertilizer in kilograms.}$$

$$irin = gia/tca = \text{irrigation intensity}$$

$$lroad = \text{length of road in sq. kilometer}$$

$$tlab = \text{total labor}$$

$$psmarea = \text{percentage of area under small and marginal farms to total area under cultivation}$$

$$plit = \text{percentage literacy rate}$$

$$pvelec = \text{percentage of villages electrified}$$

Given that our basic econometric model is a system of simultaneous equations and we will be applying 2SLS procedure to estimate the above model, it is necessary as a part of pre-test estimation to check for the

² This is a recursive system of simultaneous equations in the sense that the causality runs only in one direction. To be more specific, it is observed even though the $hyvt$ variable affects yield from the first equation, the yield variable in turn does not affect the $hyvt$ variable as the former does not appear as an independent variable in equation-2. In other words the Γ matrix in the traditional system of simultaneous equation, $Y\Gamma = XB + U$ is triangular.

identifiability of the system. We observe using the order condition³ of identification that equation -1 is over-identified⁴ and equation -2 is exactly identified⁵. Having checked for the identifiability of the system, we can now go ahead and use the 2SLS⁶ procedure to estimate our basic econometric model. Here, given the availability of data for the 15 districts of West Bengal we have restricted ourselves to the 25 year period 1970-1994. The study looks into the effect of HYV on yield by dividing the twenty five year period into two sub periods (1) 1970-1979 and (2) 1980-1994. The sub-dividing of the sample period is justified in the sense that while the first sub-period helps in figuring out if the HYV cultivation did have a contemporaneous impact on yield, the latter sub-period tries to address the claim that some economists have made about the delayed effect of the HYV's on the yield of the state. In this regard it may be noted that Saha and Swaminathan (1994) used a linearized version ($\ln y_t = a + b * t + u_t$) of the exponential functional form to analyze the growth of output in West Bengal for the period 1981-82 to 1990-91. Since the exponential form assumes constant growth, they went on to modify their analysis by incorporating a log quadratic functional form ($\ln y_t = a + b * t + c * t^2 + u_t$) in their analysis. "c" if significantly different from zero was used as the measure of acceleration or deceleration. In this analysis they also included a kinked (or trend break see Boyce; 1987), exponential functional form to test for the significant shift in the growth path of rice production in the early 80's. The equation estimated looked like the following: $\ln y_t = a + b * D_1 * t + c * D_2 * t + u_t$, where $D_j = 1$ in the jth sub-period and $t=0$ at the kink. Using such a structure they concluded that, though during the period 1965-1980 the growth of agricultural production in West Bengal was low and much lower than the rest of the India, the performance changed distinctly from the year 1980 onwards. They reported an uniform and stable aggregate crop output growth at 6.4% a year. They further suggested that the high output was not a result of good weather conditions, since a simple decomposition of growth into area and productivity indicated that the contribution of productivity growth to out put growth was significantly high. In their study they also indicated that in the 1980's the farming practices improved immensely in rural West Bengal as a fall out of the large scale use of HYV than before. More land was planted with HYV, and the positive effect showed up in the rice production hike. Given, the findings of the above study, it was thus tempting to delve into the issue of the impact of HYV cultivation on the yield of the state.

SOURCE OF DATA: The data has been collected from different issues of statistical abstract of West Bengal and district wise pocket books. The whole data set has been tabulated in Table-4 in the diskette provided along with the paper.

EMPIRICAL ANALYSIS:

(1) THE SUB-PERIOD- 1970-1979:

As can be observed From Table-1(**page-8**), that even though there was a positive effect of percentage of area devoted to HYV cultivation in 9 out of the 15 districts in concern, in all of them besides Burdwan (significant effect at the 10% level) the effect was insignificant. In the remaining 6 districts the coefficient of $hyvt$ in equation -1 bears a negative sign. However none of the estimates are significant. It is necessary to search for the economic intuition of the signs and the significance of the coefficients and variables

³ The order condition of identification requires that for a system of equation to be identified (over and exact) the sum of the number of excluded exogenous variables (m') and endogenous variables (k') in the equation should be greater than or equal to the number of endogenous variables in the system (M) less one.

⁴ Equation-1 is over identified since $m' + k' = 0 + 4 > 2 - 1 = M - 1$

⁵ Equation-2 is exactly identified since $m' + k' = 1 + 0 = 2 - 1 = M - 1$

⁶ As a part of the 2SLS estimation procedure we apply ordinary least square (OLS) estimation technique to equation-2 and having recovered the estimates for the coefficients of the equation we determine the estimated value of $hyvt$ and then replacing the predicted value for the $hyvt$ in equation-1 for $hyvt$ we again, as a part of the second stage of the estimation procedure, estimate equation-1 using the OLS technique. Note, given that this is a recursive system though we do not encounter the problems arising out of simultaneity but we have an errors in variable problem. Therefore we cannot use $hyvt$ in equation-1 as a regressor since it is not non-stochastic. To avoid this problem of stochastic regressor we have used the 2SLS procedure. We have used the `syslin` procedure in SAS to run our program.

respectively and define the underlying causes for such outcomes. To do so, we turn our attention to the estimated second equation (see Table-1A). It must be noted that the variables included in the second equation has been chosen realizing that HYV use not only required complimentary inputs but simultaneously had certain infrastructural demands. It is observed that for Burdwan perhaps the significant effect cropped up due to the significant labor use in the HYV cultivation. Note that the variable *labt* is significant at the 10% level and as can be expected has a positive coefficient in the equation-2 in other words labor as a proportion of total cropping area had a significant effect on the *hyvt* variable. Moreover, Burdwan has always been one of the developed districts in West Bengal in terms of infrastructure, though it is not obvious from the results since the effect of all the infrastructural variables on *hyvt* are insignificant. For Bankura, Hoogly and Cooch Behar, the equation-2 estimates(see Table-1A) of the respective districts indicate both insignificant effects of input use and infrastructural development on the *hyvt* variable. Thus it is not surprising that the effect of the *hyvt* variable on yield is insignificant for these districts. The districts of Howrah, Murshidabad, Nadia, Purulia, West Dinajpur suffered significant decline in irrigation intensity, possibly because the proportional increase in area under irrigational facilities compared to total cropping area was much less and thus the effect of the *hyvt* variable even though positive was nowhere near to being significant. The negative sign of the *hyvt* variable in the first equation for the other six districts may be a fall out of more than proportionate increase in total cropping area compared to the area devoted to HYV cultivation. This is perhaps because of the crop diversification that might have taken place with farmers getting more into the production of vegetables and cash crops which in turn did not call for HYV use. Besides the entire Indian agricultural structure has been and still is dependent on rainfall as the major source of water supply for ages and the situation was and is surely no different in West Bengal. So even when the total cropping area increased in an attempt to increase production basically depending upon rainfall without much effort being devoted to the development of the irrigational facilities which the HYV use demanded for this complimentary relationship between irrigational facilities and HYV use does seem to have had an negative impact on the proportion of total cropping area devoted to HYV use. Moreover as can be observed from the equation-2 (see Table-1A) for these districts either there was never a comparable significant improvement in the infrastructure or there was insignificant impact of the input use on the *hyvt*. Note that the coefficient of the *psmarea* variable is negative for 8 districts during this period but none are significant. The negative sign is desired in the sense that it would suggest that the small size of land holding due to the land reform program did hold back the HYV seeds from taking full effect on the yield. But the insignificance of the coefficients does not tell this story. So it does appear that during this sub-period when the application of the package deal program was at its peak, the HYV seeds failed miserably to affect the yield in West Bengal.

(2) THE SUB-PERIOD-1980-1994:

As can be observed from Table-2 (**page-10**), surprisingly we have nearly similar kind of results for the sub-period in concern. Here, as well we observe 9 districts where the coefficient of the area under HYV as a proportion to the total cropping area bears a positive sign. However only Midnapur has a significant positive impact at the 10% level of significance. As before we observe six districts where the coefficient of the *hyvt* variable displays a negative sign. We can advance similar kind of reasoning for the negative sign on the coefficients as was done for the first sub-period in our study. Besides this perhaps another major reason could be that the farmers started moving out of cultivation using the HYV seeds given that it failed to have any significant impact on the yield in the earlier decade. Besides, this phase in West Bengal witnessed massive labor migration to the capital city of Calcutta in hope of better job opportunities. Note that for Burdwan one can observe a positive significant (at 1%level) impact of literacy rates on *hyvt* from equation-2 estimates (see Table-2A) but probably the failure to meet the requisite complementarity requirement of the package deal held it back. The same can be said about the districts of Birbhum, Cooch Behar, Maldah. One of the surprise is in the form of Darjeeling. It is observed from the equation-2 estimates (see Table-2A) for the state that even though the *pfert*, *labt* and *plit* variables have significant positive impact on the *hyvt* at the 5%, 1% and 5% level of significance respectively, the failure of the other input use from having a significant impact, ultimately led to an insignificant positive coefficient of *hyvt* in the first equation. Midnapur stands out as the only district to have experienced a significant positive impact of HYV use on yield and the reasons are obvious. As can be witnessed from the equation-2 estimates (see Table-2A) for the district. The variables *irin*, *plit* and *lrt* have positive and significant impact at the 5%

level. The negative significant (at 10% level) coefficient of the variable psmarea helped the cause. For the district of Purulia the positive and significant (at 5% level) effect of only the pfert variable in equation-2 estimates (see Table-2A) could not do the trick. The control variable psmarea indicates no significant role of pegging back the HYV use from having significant beneficial effect on the yield of the districts. What is interesting in the analysis (see Table-3, which captures the effect of the hyvt variable on yield from equation-1) is the transition amongst the member of the groups over the two sub-period in concern. Though we still have 24-Parganas and Jalpaiguri bearing the negative coefficient on the hyvt variable, there are four new additions to the group namely Bankura, Hoogly, Howrah and Nadia. On the other hand, the coefficient of the hyvt variable in the districts of Darjeeling, Maldah, Birbhum and Midnapur has swapped signs to positive from negative as was observed in the earlier sub-period. This may easily be the fall out of improvements in the requisite conditions for latter group and degradation for the former. So the claim that perhaps, the HYV seeds had a delayed impact seems far from being true.

(TABLE-3)Hyvt

Positive impact		Negative impact	
1970-1979	1980-1994	1970-1979	1980-1994
Bankura (.5.794149)	Birbhum (.430639)	24 Parganas (-1.13663)	24 Parganas (-.91385)
Burdwan *(3.355325)	Burdwan (.882921)	Birbhum (-1.39878)	Bankura (-.10185)
Cooch Behar (.5.037950)	Cooch Behar (.888777)	Darjeeling (-8.13130)	Hoogly (-6.09170)
Hoogly (.765226)	Darjeeling (46.45179)	Jalpaiguri (-18.3135)	Howrah (-.09251)
Howrah (.115922)	Maldah (3.377141)	Maldah (-3.53678)	Jalpaiguri (-.44628)
Murshidabad (2.060096)	Midnapur *(6.965955)	Midnapur (-6.32406)	Nadia (-2.35615)
Nadia (6.216253)	Murshidabad (.910515)		
Purulia (.50.67576)	Purulia (24.92604)		
West Dinajpur (1.923702)	West Dinajpur (.021041)		

AREAS OF FURTHER RESEARCH :

(1) One of the major features of the Indian economy is her massive agricultural orientation and in turn the high dependence on the rainy season called “monsoon” as the main source of water supply. Rainfall has always had a pivotal place in the Indian agriculture and perhaps continues to be that way in many parts of the country. The study here has completely ignored the effect of rainfall, though intentionally. It would however be interesting to include this aspect in the analysis, especially as a dependent variable in the first equation and figure out if it improves the explanatory power of the model. The hunch is it would surely do so. This in turn would give us a better idea of how significantly rainfall helps in capturing the variations in the yield over the sample period in concern. Given, that this study has found minimal impact of the HYV seeds on yield for West Bengal it would perhaps be wise to look for other factors that might have caused the variation in the yield and rainfall surely would be a major contributor in this regard.

(2) The year 1991 has a significant bearing in the history of the Indian economy. This was the year when the country went for a massive liberalization, privatization and globalization (LPG) program. Nearly all the sectors got affected in their own specific way and it was no different in the case of agriculture, which is the dominant sector of the Indian economy both in terms of income and employment and is intimately linked with the rest of the economy. In particular the new policies have had strong impact on the agricultural output, prices, employment and technology. The fiscal compression carried out as a part of the Structural Adjustment Program resulted in partial withdrawal of subsidies to fertilizers. More importantly, the compressions resulted in the deceleration of public investment in irrigation, power and other rural infrastructure including agricultural research, roads and communications, etc. Further, monetary and credit reforms implemented have reduced the availability of institutional credit to the rural sector and also has raised the cost of credit to agriculture. In such a backdrop then, it would be interesting to observe the effect on the agricultural production and yield for the state. Note one could easily introduce a variable which captures the relative price of food grains to non-food grains into the analysis and carry out relevant studies to observe the effect on agricultural production and yield. However, in this analysis this was

ignored since we had set out with a different group of objectives in mind and moreover the unavailability of the data for the years 1991 and onwards was also an issue.

(3) It would be interesting to carry out similar studies for the states of Haryana and Punjab where the HYV seeds were believed to have had their major impact. This in turn would help one to identify and figure out what actually went amiss in the state of West Bengal. This would provide us with a more complete picture of the process and help us in pinpointing at factors that pegged back the miracle seeds from delivering the goods.

CONCLUSION:

This study was an attempt to look into the impact the HYV seeds might have had in different districts of the state of West Bengal. The period of study constituted of a 25 year period divided into two sub periods. The justification of such a subdivision was basically to assay if the HYV seeds had any contemporaneous effect and if not go ahead and figure out if it had any delayed effect on the yield in West Bengal. The first subdivided sample beginning from the year 1970 and running till 1979 looked into the former issue and the next sub-period starting from 1980 and extending till 1994 addressed the latter point of concern. We carried out our analysis by formulating a recursive system of simultaneous equations as our basic econometric model. After indicating the identifiability of the equations we used the 2SLS estimation procedure to estimate our model. One of the highlights of our study was the inclusion of a control variable in the form of percentage area under small and marginal farmers in the relevant equation of the system, namely the equation-2 that took into account the effect of complimentary input requirements and infrastructural demands of the HYV cultivation. The motivation of the inclusion was felt necessary, realizing the predominance and the so professed success of the land reforms program in West Bengal agriculture. The HYV application was always believed to be a large-scale capital intensive technology, so we felt the importance of monitoring whether the small land holding, a fall out of the land reforms program did peg back the miracle seeds from delivering. The study of the sub-periods suggested that perhaps the claim that the effect of HYV use on West Bengal, a major contributor in agricultural production, was minimal if not non-existent seems to be quite valid, both in the contemporaneous and delayed sense. We observed that the effect of HYV on yield was significant at the 10% level only for Burdwan and Midnapur in the first and second sub-periods respectively. Moreover the attempt to suggest that perhaps the control variable did have a significant negative impact on the HYV use fell flat. The analysis does seem to suggest that perhaps the complimentary input requirements and infrastructural demand of the HYV use was not appropriately met. However, whatever might have been the case, the study carried out for the state of West Bengal vindicates the claim that the agricultural economists in India had been suggesting for a long time. Well it does seem that the awaited miracle of the miracle seeds did keep the West Bengal agriculture waiting, at least until 1994.

Acknowledgements:

I am highly indebted to Basab Dasgupta and Ishita Sengupta for their constructive suggestions.

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TABLE :1 (1970-1979) (EQUATION-1)

Districts	Pfert	irin	hyvt	labt	R ²	Adj.R ²
24Parganas	-.04576 (-1.33)	-10.4255 (-.74)	-1.13663 (-.30)	21.75708** (1.91)	.58054	.30090
Bankura	-.00648 (-.20)	-1.99189 (-.38)	5.794149 (.66)	-2.03316 (-.25)	.10772	-.48713
Birbhum	.032934 (.87)	4.918667 (.76)	-1.39878 (-.60)	-5.69431 (-.77)	.20780	-.32034
Burdwan	.006615 (.70)	3.126707 (.58)	3.355325** (1.75)	-9.15590 (-1.52)	.62182	.36970
Cooch Behar	.029980 (.76)	-23.8913 (-.50)	5.037950 (.66)	-1.92342 (-.37)	.12117	-.46472
Darjeeling	-.00582 (-.40)	4.326202 (.24)	-8.13130 (-.14)	1.574166 (.21)	.15433	-.40945
Hoogly	.005064 (.43)	-8.19238 (-.54)	.765226 (.17)	.669987 (.06)	.08852	-.51913
Howrah	-.05447+ (-3.88)	-5.72246 (-1.06)	.115922 (.54)	-27.1646 (-4.15)	.79325	.65542
Jalpaiguri	-.10837 (-1.01)	-63.3483 (-1.61)	-18.3135 (-1.03)	15.04938 (1.34)	.43305	.05508
Maldah	.015374* (2.15)	-12.9042 (-.89)	-3.53678 (-1.09)	2.597404 (.59)	.56102	.26836
Midnapur	.019926** (2.10)	-5.58573 (-1.58)	-6.32406 (-1.45)	4.652169 (1.21)	.63331	.38886
Murshidabad	.006069 (.34)	15.19619 (1.25)	2.060096 (1.69)	-3.55736 (-1.22)	.58846	.31410
Nadia	-.00534 (-.24)	4.568999 (.39)	6.216253 (.98)	-10.12224 (-.84)	.18816	-.35307
Purulia	.028263 (.40)	-2.04960 (-.29)	50.67576 (.38)	-3.71152 (-.20)	.08505	-.52492
West Dinajpur	.038557** (2.26)	-6.37638 (.77)	1.923702 (.95)	-3.13622 (-1.26)	.57697	.29495

Note : Values in the parentheses indicate the t-ratios and +, * and ** indicate the level of significance at 1, 5 and 10 per cent level

TABLE:1A(1970-1979)-EQUATION-2

Districts	pfert	irin	Labt	psmarea	lrt	plit	pvelec	R ² (Adj.R ²)
24Parganas	.009064*(3.16)	-3.72632*(-2.89)	26.6359*(2.77)	-.05266**(-2.3)	549.7343**(2.4)	-3.29009*(-3.1)	.007436(2.1)	.98426 (.94754)
Bankura	.002149 (.63)	.129681 (.22)	-11.382 (-1.07)	-.00707(-.24)	189.9190(.35)	.142992(1.33)	-.00177(-.15)	.97384 (.91279)
Birbhum	.005302 (.54)	-.26417 (-.12)	16.02991 (.20)	.034101(.31)	-166.518(-.07)	-.28864(-.16)	-.00281(-.12)	.94234 (.80780)
Burdwan	.003824 (.70)	-.21094 (-.18)	7.83997**(2.3)	-.00741(-.28)	-765.480(-1.02)	-.12304(1.21)	-.00644(-.98)	.98258 (.94195)
Cooch Behar	.006321 (1.32)	6.778388 (1.74)	47.9112 (1.24)	.001594(.59)	148.5131(.85)	-1.08298(-1.22)	-.00675(-1.75)	.93986 (.79955)
Darjeeling	.000015 (.08)	.057195 (.28)	.137947 (.65)	-.00020(-.02)	3.20706(.30)	-.00086(-.20)	-.00021(-1.8)	.97286 (.90952)
Hoogly	-.00144 (-.58)	.764868 (.52)	-1.36872 (-.33)	.041086(1.11)	397.0233(.65)	.143109(1.35)	-.00978(-1.72)	.98321 (.94402)
Howrah	.029244 (1.99)	2.986351 (.31)	6.854794(.55)	.824881(1.89)	54.99803(.24)	.328269(2.03)	-.04474(-2.09)	.93887 (.79624)
Jalpaiguri	-.00364 (-1.23)	.052570 (.02)	10.00769 (.35)	.010888(.68)	339.7394(.35)	-.34878(-.33)	-.00028(-.06)	.92509 (.75029)
Maldah	.007843 (1.74)	-.71563 (-.25)	.148633 (.09)	-.00327(-.09)	299.3342(.73)	-.03095(-.65)	-.00103(-.30)	.83033 (.43442)
Midnapur	.003910 (1.65)	-1.03508 (-.59)	1.564269 (.96)	.067351(.29)	144.6221(.51)	-.05065(-.96)	.006470(.60)	.89411 (.64704)
Murshidabad	.009581 (1.84)	-3.50580 (-.61)	7.919715(1.37)	-.00298(-.27)	-2028.67(-1.87)	-.15303(-.58)	.0107083(.72)	.94663 (.82208)
Nadia	-.00021 (-.03)	-.53830 (-.31)	3.3518 (.79)	-.00740(-.32)	52.07924(.41)	-.04910(-.33)	-.00164(-.53)	.97292 (.90973)
Purulia	-.00006 (-.04)	.002888 (.05)	.206327 (.55)	.000660(.18)	-.38908(-.03)	-.00130(-.18)	-.00027(-.82)	.83526 (.45086)
West Dinajpur	-.00574 (-1.28)	-2.63046 (-1.24)	-11.7054(-1.13)	-6.12E-6(0)	1276.680(.5)	.509316(1.28)	.008288(1.35)	.89639 (.65462)

Note : Values in the parentheses indicate the t-ratios and +, * and ** indicate the level of significance at 1, 5 and 10 per cent level

TABLE :2 (1980-1994) (EQUATION-1)

Districts	pfert	Irin	hyvt	labt	R ²	Adj.R ²
24 Parganas	.031398+ (3.86)	-19.5708 * (-2.02)	-.91385 (-.64)	-1.50809 (-1.52)	.84872	.78829
Bankura	.029956 + (2.73)	3.393058 (.83)	-.10185 (-.03)	-2.70742 (-1.51)	.88533	.83946
Birbhum	.009957 (1.09)	9.702172 (1.17)	.430639 (.50)	-2.35891 (-.49)	.86253	.80754
Burdwan	.009366 (1.42)	-.32616 (-.22)	.882921 (.64)	1.070920 (.60)	.90749	.87049
Cooch Behar	.006694 + (4.38)	-12.2525 (-.51)	.888777 (.14)	.085839 (.08)	.86799	.81519
Darjeeling	.018481 (1.14)	-93.4281 (-1.09)	46.45179 (.41)	1.283255 (.32)	.55279	.37391
Hoogly	.005246** (1.73)	1.927545 (1.31)	-6.09170 (-1.64)	2.146443 (.80)	.55654	.37916
Howrah	.004254 (1.60)	-19.6993 (-.70)	-.09251 (-.18)	1.672274 (.41)	.57288	.40204
Jalpaiguri	-.00360 (-.35)	-1.19329 (-.24)	-.44628 (-.04)	2.713220 (.92)	.53220	.34507
Maldah	-.01894 (-.86)	-55.2586 (-3.46)	3.377141 (.40)	7.517168* (2.46)	.81997	.74795
Midnapur	-.00125 (-.18)	-4.41269 ** (-1.65)	6.965955 ** (1.60)	.462857 (.19)	.73856	.63399
Murshidabad	-.00159 (-.07)	.192718 (.18)	.910515 (.52)	.624598 (.48)	.87630	.82682
Nadia	-.00201 (-.21)	-21.0488 + (-3.94)	-2.35615 (-.93)	13.25328** (2.82)	.91202	.87683
Purulia	-.00080 (-.11)	1.331453 (.41)	24.92604 (.59)	.669239 (.56)	.30380	.02532
West Dinajpur	.007340 (1.02)	1.077327 (.39)	.021041 (.01)	.483324 (.77)	.90064	.86089

Note : Values in the parentheses indicate the t-ratios and +, * and ** indicate the level of significance at 1, 5 and 10 per cent level.

TABLE: 2A(1980-1994) EQUATION-2

Districts	Pfert	irin	Labt	psmarea	Lrt	plit	pvelec	R ² (Adj.R ²)
24Parganas	.001563(.78)	-4.59050*(-2.3)	5.865969+(-3.41)	.003203(1.49)	-653.575+(-3.5)	-2.32600+(-2.7)	.012417(1.25)	.92827(.85654)
Bankura	.001143(.9)	1.7924+(4.91)	.039991(.09)	-.00284(-1.29)	-64.2358(-.53)	-.00876(-.5)	.000936(.37)	.94055 (.88110)
Birbhum	.005145(.92)	13.63093(.59)	-9.32290(-.74)	.021912(.49)	-22.1211(-.14)	.172703(.6)	-.00079(-.05)	.76222 (.52445)
Burdwan	-.00019(-.2)	-.08581(-.37)	.548384(.74)	-.01210(-1.51)	-83.3541(-1.55)	.010102+(3.2)	-.00267(-.56)	.97129 (.94259)
Cooch Behar	.001336(1.1)	5.332860(.61)	-.04376(-.08)	-.00038(-.91)	29.9173(.65)	-.01170(-.51)	.000535(.26)	.89805 (.79611)
Darjeeling	.00145*(2.07)	-.32731(-1.21)	.043799+(4.32)	.000063(.45)	.197533(1.02)	.000414*(2.3)	-.00016(-1.6)	.76007 (.52013)
Hoogly	-.00136(-1.4)	-.18271(-.41)	.916061(1.61)	.001211(.72)	-30.0058(-.41)	.015637(.59)	-.00052(-.07)	.68054 (.36108)
Howrah	.017878+(2.9)	-63.1162(-1.17)	41.20371+(3.19)	-.00529(-1.4)	-3126.02*(-1.9)	-2.15174*(2.5)	.002270(.1)	.92482 (.84965)
Jalpaiguri	.000279(.47)	.135250(1.15)	-.28964*(-2.1)	-.00058(-1.37)	47.69291*(2.2)	.002587(.47)	-.00033(-1.11)	.72326 (.44652)
Maldah	.001162(1.33)	9.606184(1.22)	-.23322(-.19)	.000247(.57)	-169.645(-.87)	.024536(.53)	-.00080(-.56)	.94300 (.88600)
Midnapur	-.00015(-.26)	.337002*(3.01)	-1.71690**(-1.91)	.004049(.84)	161.4532*(2.5)	.019777*(2.7)	-.00263(-.93)	.97693 (.95387)
Murshidabad	.005302(.72)	-.54480(-1.32)	.138279(.17)	-.00026(-.05)	-52.1722(-.75)	.100923(.59)	-.00434(-.23)	.92848 (.85696)
Nadia	-.00385(-1.03)	2.074106(.37)	-.16614(-.04)	.001383(.67)	184.2252(.35)	.0157290(.81)	-.00687(-.81)	.54571 (.09141)
Purulia	.000228+(3.2)	-.01670(-.99)	.007396(.23)	-.00001(-.23)	-5.89718(-.4)	.002330(.98)	-.00080+(-5.4)	.92933 (.85866)
West Dinajpur	.001718(1.63)	.340492(1.29)	.843184+(4.7)	-.00036(-.71)	-338.885+(4.4)	-.00761(-.34)	-.00066(-.53)	.98854 (.97709)

Note : Values in the parentheses indicate the t-ratios and +, * and ** indicate the level of significance at 1, 5 and 10 per cent level.

