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Area response function of selected vegetables in West Bengal paving way to agricultural reforms in India

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ABSTRACT

Vegetables have emerged as an important sector with high potential in our economy. They are regarded as high value crops due to its high potentiality in terms of income augmentation and employment generation. The economic importance of the crops has been slowly increasing on account of increase in domestic as well as international demand. West Bengal is the leading vegetable producing state in the country, accounting over 10% of crop's area and 8% of output in the country. The growth of vegetables has been uneven across regions and over time in West Bengal. While the area under cultivation recorded a significant expansion in some regions, in other regions it either declined or was stagnant. The objective is to study the factors influencing the area response of vegetables in selected regions of West Bengal and to project the emerging scenario of how the substitute crops influence the area response decision of the vegetable growers in the state. An improvised version of Nerlove's adjustment lag model has been adopted to explain area allocation decisions of farmers and it is preferred over expectation model. It can be said that the experience regarding area response of vegetable is not similar, the technological factors, price factors vis-à-vis higher return have favored vegetable cultivation in area increasing regions. Technological factors like irrigation though insignificant, have worked to the detriment of vegetable cultivation in Rarh and Eastern Plateau region. It has been also observed that vegetable did not enjoy any distinct comparative advantage over its substitutes either in terms of yield or price in this region and hence possibly this accounts for the stagnation of the crop in the area.

Key words: area response, income augmentation, agricultural reforms

Vegetables have emerged as an important sector with high potential in our economy. They are regarded as high value crops due to its high potentiality in terms of income augmentation and employment generation. The economic importance of the crops has been slowly increasing on account of increase in domestic as well as international demand. West Bengal is the leading vegetable producing state in the country, accounting over 10% of crop's area and 8% of output in the country.

Under the above backdrop the objective is to study the factors influencing the area response of vegetables in selected regions of West Bengal and to project the emerging scenario of how the substitute crops influence the area response decision of the vegetable growers in the state

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FACTORS INFLUENCING AREA RESPONSE OF VEGETABLES

The growth of vegetables has been uneven across regions and over time in West Bengal. While the area under cultivation recorded a significant expansion in some regions, in other regions it either declined or was stagnant. The factors influencing the area response of vegetables in selected regions of West Bengal have been analyzed. An improvised version of Nerlove's adjustment lag model has been adopted to explain area allocation decisions of farmers. It is preferred over expectation model because of its advantages spelt out by Raj Krishna. The model is:

$$A_t^* = a_0 + a_1 P_{t-1} + a_2 Y_{t-1} + a_3 {}^{\sigma}P_t + a_4 {}^{\sigma}Y_t + a_5 I_t + a_6 W_t + U_t \quad \ldots\ldots\ldots\ldots\ldots (1)$$

$$A_t - A_{t-1} = \gamma (A_t^* - A_{t-1}) \quad \ldots\ldots\ldots\ldots (2)$$

Where,

A_t= Area under the crop in year't'

P_{t-1}= Price of crop deflated by price of substitute crop in year't-1'

Y_{t-1}= Yield of crop deflated by yield of substitute crop in year't-1'

${}^{\sigma}P_t$ = Standard deviation of preceding three years price of crop relative to that of substitute crop

${}^{\sigma}Y_t$= Standard deviation of proceeding three years yield rates of crop relative to that of substitute crop

W_t= Rainfall during a specified period (either in kharif or rabi season)

I_t= Gross irrigated area under all crops in the current year

A_t^*= Desired area under the crop in year 't'

A_{t-1}= Area under the crop in year 't-1'

γ = Adjustment coefficient

U_t= Error term

The first equation is a behavioural relationship stating that the desired area under the crop (A_t^*) depends on relative farm prices and yield (both lagged by one year), price and yield risk (in relative terms) and irrigation and weather (represented by rainfall). The second equation is a partial area adjustment equation. The γ is the Nerlovian coefficient of adjustment. The growers, it is postulated, are able to increase the area of the crop in any year only to the extent of a fraction γ of the difference between the area they would like to plant and the area actually planted in the preceding year. The above two equations (after some algebraic manipulations) may give the estimating equations as follows:

$$A_t = b_0 + b_1 P_{t-1} + b_2 Y_{t-1} + b_3 {}^{\sigma}P_t + b_4 {}^{\sigma}Y_t + b_5 I_t + b_6 W_t + b_7 A_{t-1} + V_t \quad \ldots\ldots\ldots\ldots (3)$$

Where,

$b_1 = a_1 \gamma$ $\quad$ $b_5 = a_5 \gamma$

$b_2 = a_2 \gamma$ $\quad$ $b_6 = a_6 \gamma$

$b_3 = a_3 \gamma$ $\quad$ $b_7 = (1 - \gamma)$

$b_4 = a_4 \gamma$ $\quad$ $V_t = \gamma U_t$

In order to relate profitability to the area allocation decisions of farmers an alternate model has been tried wherein lagged relative gross income variable has been used instead of separate price and yield variables. Other alternate models have also been tried by dropping some of the independent variables like irrigation and lagged area.

Output decisions of growers are approximated in terms of the planted area rather than yield. Further area is subject to endogenous factors, that is, within a farmer's control, whereas yield is influenced by several exogenous factors which are beyond the grower's control, such as weather.

It is, of course true that a grower can keep area constant and increase output by varying yield levels. Area should be taken as a proxy for output if secondary data be not available. In case of most vegetables area has been the main source of growth in output. Hence area response functions can more or less truly represent output supply response functions in the case of vegetables.

Instead of selecting several substitute crops it is preferred to select only two substitute crops per region, one food crop and another a cash crop. This means a vegetable grower has two alternatives i.e, either to grow a food crop or a cash crop. An inter-correlation matrix of the change in area under different vegetables and their substitute have to be fitted for different regions and these results are to be taken into account while selecting the substitute crop for the vegetables to be studied. Further, while selecting the substitutes the weightage of the substitutes in the states' crop economy should be taken into account. In other words, the selected substitute crop should be a major crop in the respective regions. Multiple linear regression models using ordinary least squares (OLS) techniques have to be fitted to estimate the coefficients in the area supply functions.

The analysis has been conducted at the region level and hence can throw light on the role of different factors in different regions which may not be possible, if the analysis was at the state level only.

The supply function has been fitted by attempting a cross section analysis at region level in order to assess the role of different factors in different regions. In order to adequately assess the role of different factors in different regions, regions have been classified on the basis of typology of growth. Since area is selected as the dependent variable in the supply function the growth trend in area has been used as the criterion for classifying regions. Three broad typologies have been identified (1) regions reporting positive and significant trends in area, for conveniences are referred to as "area increasing regions", (2) regions with negative and significant trends in area are referred to as "area declining regions" and (3) regions where the trends in area, positive or negative, are not statistically significant are referred to as "area stagnant regions". In case a region reported a particular trend in one period and a different one in the next period (say positive in one and negative in next) in such cases the trend of the latter period has been taken into account to group the region. Though there are apparent limitations in attempting a supply analysis of area stagnant regions still the analysis has been attempted in the hope of getting some clues about the factors influencing vegetable cultivation in these regions. At least one region from each group of regions has been selected in order to comprehend the role of different factors in different contexts in explaining the growth behaviour of the vegetables under study.

West Bengal is the leading vegetable producing state in the country, as mentioned earlier, accounting for over 10% of the crop's area and 8% of the output in the country. Area under vegetable cultivation in the state increased rapidly over 3lakh hectares during 1980-81 to 1985-86. However, after 1985-86 the vegetable area started declining and only after 1990-91 that this trend was reversed and the crop's cultivation started picking up again. Its area during 2001-02 to 2012-2013 was estimated over 5lakh hectares. The area under vegetable increased marginally to 9.23 lakh hectares in 2017-18 from 9.12 lakh hectares in 2007-08.

Though vegetables are cultivated in all regions of West Bengal, over 61% of the crop's output comes from the Alluvial and Coastal regions alone, particularly from the districts of 24-Parganas (South), 24-Parganas (North), Nadia, Hooghly, Burdwan, Murshidabad and Midnapore. The crops that compete with vegetables in West Bengal are mainly summer paddy in summer, Kharif paddy in rainy season and mustard as well as wheat in the winter season. These crops have

been selected as the substitute crops for the analysis of the vegetables area response. It will be helpful to know as to how vegetable growers in West Bengal respond given the alternative of growing food crops like paddy and wheat or a non-food cash crop like mustard. An analysis of the changes in the area under vegetables, paddy and wheat during 2010-11 to 2017-18 indicated a negative and statistically significant correlation between vegetables area and that of paddy and wheat area, the coefficients being -0.92 in case of paddy and -0.67 in case of wheat. Though the mustard area was positively correlated with the vegetables area the coefficient 0.14 was not statistically significant. The analysis of the growth behaviour and pattern of growth of vegetables indicated that Alluvial and Coastal regions recorded a significant expansion of the area under vegetables during the period under study. Barind and Terai regions recorded a significant decline, whereas Rarh and Eastern Plateau reported that the area was stagnant during this period. It has been mentioned earlier that Alluvial and Coastal regions are the leading vegetable producing regions accounting more than 61 % area in the state in 2017-18.

By observing the movements in the yield rates and prices of vegetables vis-à-vis those of its substitute crops in West Bengal during 2010-11 to 2017-18, it appears that vegetable yields have declined in relation to the yields of its substitute. What is commendable is that the ratio of vegetable yield to that of wheat and mustard yields was greater than unity during the period. In relation to paddy it was slightly less than unity during 2010-11 to 2017-18. Taking entire twenty years period, the ratio of vegetable yield to paddy has been greater than unity. Thus, though vegetable has been losing its yield advantage over some of its substitute, it still continues to hold an edge over them in this respect.

The price of vegetable relative to the prices of paddy, wheat and mustard has increased significantly, taking the period as a whole. The ratio of vegetable price to those of paddy, and wheat has exceeded one during 2010-11 to 2017-18 and less than unity in relation to mustard. But vegetable price relative to mustard has been improving over time. Trends fitted to the relative gross income (i.e. yield valued at farm harvest price) of vegetable to those of its substitute crops indicate that they have declined in relation to paddy and wheat whereas they have improved in relation to mustard, taking the period as a whole. Though the movements in relative gross income have been favorable to vegetable vis-à-vis mustard it is not so in relation to paddy and wheat. However, in terms of gross returns vegetable still enjoys a distinct advantage over paddy, wheat and mustard. The ratio of gross income from vegetable to paddy is around 3, and over 4 in relation to both wheat and mustard.

Table 1.1 presents the OLS estimate of vegetable area response for West Bengal during 2010-11 to 2017-18. It is interesting to observe that the relative yield variable is positively and significantly correlated with the vegetable area where paddy is the substitute crop. The relative yield risk variable is negative and significant in case of wheat substitution only. Irrigation is seen to have a positive and significant influence on the vegetable area when paddy is considered as a substitute crop. The coefficient is positive in some equations and negative in others, though none is significant. Does this imply that price is not at all a factor of consequence in influencing the vegetable area response? In fact the relative gross income variable is positively correlated and significant with the vegetable area when wheat and mustard are the substitute crops. This clearly shows that ultimately it is the expected returns which influence the supply response behavior of vegetable growers. Though ultimately it is the expected returns from vegetable, technology-related factors, seem to be more prominent in explaining the variations in vegetable area.

Hill region accounts for about 2% of the area and output in the state. The area under vegetable cultivation which was around 7.5 thousand hectares in 2010-11 declined steadily and the crop's area during 2017-18 was estimated at over 6.5 thousand hectares. As in other districts, in hill region also the substitute crops of vegetable are

mainly coarse cereals and ginger. For the analysis of vegetable area response in this region two substitute crops have been selected i.e. one maize a food crop and the other ginger a non food crop. The correlation coefficient between the vegetable area and the maize area was negative (- 0.33) and positive (0.24) in case of ginger area. But the coefficients in both cases are not statistically significant. The movement of the vegetable area and that of maize and ginger have not necessarily been in opposite directions.

The yield or price of vegetable relative to yields and prices of maize and ginger have not shown any significant rise in the state during the period under review. In fact, vegetable yield relative to ginger yield recorded a decline. In relation to maize yield it recorded a positive trend. But these trends are not statistically significant. Trends in the gross income from vegetable relative to maize and ginger did not record any significant rise. In fact, in relation to ginger, gross income of vegetable declined taking the trend for this period. Thus, movement of relative yields, prices and gross incomes has not been favorable to vegetable in hill region.

Table 1.1 Factors influencing vegetable area response in Alluvial and Coastal regions of W.B.

Equation No.	Constant term	Lagged area	Lagged Relative yield	Lagged Relative price	Lagged Relative Gross income	Relative Yield risk	Relative Price risk	Irrigation	Rainfall	.	h or DW Statistics
Subs	titute	Crop:	Paddy								
1. a	-138.61	0.84*	291.70*	-229.21	-	0.39	0.75	0.35***	0.17	0.83	-1.46
2. a	1814.58*	-	-	-	-56.58	-0.63	5.61	-	0.20	0.11	0.49
Subs	titute	Crop:	Wheat								
3. a	126.73	0.73*	163.85**	-71.21	-	-33.21***	-11.09	0.18	0.17	0.81	-1.69
4. a	1381.56*	-	-	-	121.71***	- 60.41***	11.98	0.20	-0.02	0.32	0.65
Subs	titute	Crop:	Mustard								
5. a	-384.20	0.74*	82.61*	671.56	-	-0.51	9.91	-0.02	0.28	0.82	-1.16
6. a	1018.41*	-	-	-	182.64***	1.12	41.23	0.14	0.20	0.28	0.53

Notes: 1. *, **, *** significant at 1%, 5% and 10% levels of significance.
2. In the equations where lagged area variable appears we have presented
the 'h'statistics, in other cases the DW statistics.

The OLS estimates of the vegetable area response in hill region are presented in Table – 1.2. The yield variable is positive and significant where ginger is substitute crop. The price risk variable is negative and significant. But what is most interesting to observe is that the irrigation variable is negatively correlated with the vegetable area. In other words the farmers in the hill region faced new production options and hence when irrigation is available the farmers preferred to grow other crops. In fact, there is a strong positive and significant correlation between the gross irrigated area and the maize, paddy and ginger area in the region, the correlation coefficients exceeding 0.9 with respect to these three crops. Availability of irrigation and access to high yielding new varieties and other modern inputs have thus worked out to be detriment of vegetable in the region.

Rarh and Eastern Plateau region is also major vegetable producing area accounting for around 12 to 13% of the crops total area and output in the state. The area under the crop in the region has been more or less stagnant varying between 50 to 53 thousand hectares during the period 2017-18. In spite of a significant increase in the gross irrigated area in the region over the years, it still covers only less than 20% of the state's gross sown area. This has affected vegetable also and as of today only about 40 to 50 % of the vegetable area is properly irrigated. The bulk of the crop is therefore raised under severe crisis of irrigation.

Paddy, wheat, sugarcane and mustard are the main competing crops of vegetable in this region. For the analysis of the vegetable area response paddy, wheat and mustard have been selected as the substitute crops. This will enable one to know as to how vegetable growers in this region will respond given the alternative of growing a food crop like paddy or wheat or an oilseed crop like mustard. The correlation coefficient between the vegetable area and the paddy area for the period 2010-11 to 2017-18 was negative (-0.21) though not statistically significant, and positive with respect to wheat area (0.29) and the mustard area (0.56). Unlike vegetable, the paddy and wheat have recorded a significant increase in the region during the period under review, increasing at over 11 and 0.7 % per annum respectively.

The yield of vegetable relative to those of paddy, wheat and mustard has registered a significant decline in this region during the period under study. The price of vegetable relative to those of its substitute appears to have increased during the same period. But these positive trends in the vegetable's relative price to paddy, wheat and mustard were significant only in case of wheat. Whatever advantage vegetable may have gained through an increase in its relative price has been offset by the steep decline in its relative yield. In fact, trends fitted to the relative gross income of vegetable to those of paddy, wheat and mustard indicate a decline in the relative gross income of vegetable during the period under study.

Table 1.2 Factors influencing vegetable area response in Barind and Terai regions of W.B.

Equation No.	Constant term	Lagged area	Lagged Relative yield	Lagged Relative price	Lagged Relative Gross income	Relative Yield risk	Relative Price risk	Irrigation	Rain-fall		h or DW Statistics
Subs	Titute	Crop:	Maize								
1. a	13.23	0.97*	1.97	6.65	-	0.48	-3.61	-0.01	0.001	0.91	2.06
2. a	-36.10	-	-	-	0.07	13.44***	0.39	0.01***	0.11	0.35	0.56
Subs	Titute	Crop:	Paddy								
3. a	229.97	0.50**	5.05	3.09	-	-31.21	-11.41**	-0.02	0.03	0.55	-0.34
4. a	521.06*	-	-	-	-39.67	51.38	-14.90*	-1.01	-0.002	0.41	1.35
Subs	Titute	Crop:	Ginger								
5. a	-64.20	0.91*	16.61*	31.56	-	-0.07	8.51	-0.002	0.02	0.92	0.54
6. a	42.65	-	-	-	26.94	0.43	37.76***	0.01**	0.04	0.37	0.69

Notes: 1. *, **, *** significant at 1%, 5% and 10% levels of significance.
2. In the equations where lagged area variable appears we have presented the 'h' statistics, in other cases the DW statistics.

The OLS estimates of vegetable area response for Rarh and Eastern Plateau region are presented in Table - 1.3. The table shows that the relative yield variable has a positive and significant influence on the vegetable area, excepting mustard as substitute crop. The relative price risk variable has a negative sign and it is significant too only in case of wheat. The relative gross income variable is positively correlated with the vegetable area. But it is statistically significant only where mustard is the substitute crop. Interestingly, in this situation the irrigation variable is negative and significant which seems to suggest that the spread of irrigation has been working to the detriment of vegetable. No other clues could be obtained from the regression results as to why the vegetable area has been more or less stagnant in Rarh and Eastern Plateau region. However, as already observed, movement in relative yields and relative gross income of vegetable have not been favorable in this region. It is this factor which explains the stagnancy of vegetable in Rarh and Eastern Plateau region.

Table 1.3 Factors influencing vegetable area response in Rarh and Eastern Plateau regions of W.B.

Equation No.	Constant term	Lagged area	Lagged Relative yield	Lagged Relative price	Lagged Relative Gross income	Relative Yield risk	Relative Price risk	Irrigation	Rain-fall	R^2	h or DW Statistics
Subs 1. a	titute 939.69**	Crop: -0.06	Paddy 27.81**	-32.10	-	-0.15	2.86	-0.02	0.11	0.11	0.33
2. a	827.81*	-	-	-	14.81	1.43	-5.21	-	0.08	0.04	1.75
Subs 3. a	titute 790.17*	Crop: 0.13	Wheat 28.71**	23.10	-	11.61	- 23.11*	-0.01	0.01	0.43	0.23
4. a	817.79*	-	-	-	9.51	12.81	- 22.08*	-0.002	0.002	0.38	1.67
Subs 5. a	titute 711.88**	Crop: 0.11	Mustard 2.72	144.51	-	2.25***	-25.61	-0.09	0.21	0.36	- 0.34
6. a	876.43	-	-	-	3.21***	2.04***	-14.51	- 0.08***	0.21	0.34	1.88

Notes: 1. *, **, *** significant at 1%, 5% and 10% levels of significance.
2. In the equations where lagged area variable appears we have presented the 'h' statistics, in other cases the DW statistics.

To sum up it can be said that the experience regarding area response of vegetable is not similar. It has been observed that the technological factors, price factors vis-à-vis higher return have favored vegetable cultivation in area increasing regions. Technological factors like irrigation though insignificant, have worked to the detriment of vegetable cultivation in Rarh and Eastern Plateau region. It has been also observed that vegetable did not enjoy any distinct comparative advantage over its substitutes either in terms of yield or price in this region and hence possibly this accounts for the stagnation of the crop in this area.

CONCLUSION

Major vegetables grown in the state of West Bengal show significant overall increase in their production as well as productivity levels even in the face of considerable variation in acreage under these crops. It has been found that output instability has been observed to be much higher than area and yield instabilities across major vegetables in West Bengal.

It is fact that the growth of vegetables too has been uneven across regions and over time in West Bengal. While the area under cultivation of these crops recorded a significant expansion in some regions, in other regions it either declined or was stagnant. Thus the factors influencing the area response of vegetables in selected regions in West Bengal during 2010-11 to 2017-18 have been analyzed. It has been found that in Alluvial and Coastal region, lagged area as well as lagged yield ratios has positive and significant effect on area when paddy is taken as substitute crop. Lagged relative gross income favours area under vegetables when wheat and mustard are taken as substitute for vegetables. In case of wheat as substitute, relative yield risk has adverse effect on area allocation. In Barind and Terai regions of West Bengal, lagged area has positive and significant effect on area under vegetables in all the three crops substitution situations. In case of ginger as substitute crop, lagged yield ratios is in favour of area under vegetables. Relative price ratio has adverse effect on vegetable area when paddy is a substitute crop. In Rarh and Eastern Plateau region, lagged yield ratio has positive and significant effect except mustard, on vegetable area. Relative price risk has negative but significant effect on vegetable area only in case of wheat as substitute crop. The study clearly highlights that none of the factors considered have common effect on area response under vegetables in the three area allocation situations (regions) and crop substitution situations

REFERENCES

Adhiguru, P., S. Vimala Devi and M. Kanagaraj. 2004. Strengthening economic and nutrition security; Role of vegetables. Paper presented in the National Workshop on Impact of Vegetable Research in India IIVR, Varanasi, 1-2 March.

Alam, A. 2001. Production, processing and marketing of fruits and vegetables by small farmers: Problems and prospects, In: Problems of small and marginal farmers in marketing of fruits and vegetables. Ed. A. Singh. New Delhi: Farmers' Education and Welfare Society. pp. 11-23.

Anonymous. 1977. Analysis of an FAO Survey of Post harvest Crop Losses in Developing Countries. Rome, Italy: FAO of the United Nations.

Atteri, B.R. 1995. Post Harvest Handling, Marketing and assessment of Losses of Fruits and Vegetables. Project report, Division of Agricultural Economics, Indian Agricultural research Institute, New Delhi.

Ayyasamy, P.K. 1980. Distress sales in Tomato-Tomato producers get only 50% of what the consumers pay, Indian Express, January 24, p. 9.

Bhag Mal and V. Joshi. 1995. Genetic resources of under utilized vegetables. In: Genetic Resources of Vegetable Crops, Eds: R.S.Rana; P.N.Gupta; M. Rai and S. Kochhar. New Delhi: National Bureau of Plant Genetic Resources. Pp. 213-224.

Bhale Rao, M.M., S.L. Ansari and B.P. Tyagi. 1981. Marketing of vegetables- A Sample Study. *Agricultural Marketing*, **24** (1): 27-29.

Bhat K. and M.D. Shah 1999. The Miracles of Live Juices, Pune: Nature Cure Ashram, Uruli-Kanchan.

Bhatnagar A.P. 1985. Growth of cold storage industry in India. Agricuture Marketing, **28** (8): 69-72.

Bhupal D.S. 2000. Changing pattern of agricultural marketing (A case study of vegetable marketing in Delhi between 1988-98). *Indian journal of Agricultural Marketing*, **14** (3): 8-17.

Brithal, P., S. Brithal and S. Kumar. 2004. Adoption and inpact of IPM in cabbage production, Paper presented in the National Workshop on Impact of Vegetable Research in India IIVR, Varanasi, 1-2 March.

Chand, R. and P. S. Brithal, 1997. Pesticide use in Indian agriculture in relation to growth in area and production and technological change. *Indian Journal of Agricultural Economics*. **52** (3), 488-98.

Feder, G. 1985. Adoption of agricultural innovationsin developing countries. Economic Development and Cultural Change, **32**: 255-298.

Gajanana, T. M. and K. V. Subrahmanyam 1993. Cooperative marketing of fruits and vegetables-Present status and future requirements, Indian Cooperative Review, **31** (1): 34-38.

Gajanana T. M. and M. Sudha, 2004. Marketing Strategies for vegetables in the context of the changing policy environment. In: Impact of Vegetable Research in India. Eds. S. Kumar; P.K. Joshi and S.Pal. New Delhi: National Centre for Agricultural Economics and Policy Research. Proceedings No. 13. pp. 179-189.

Ghosh S. P. 1999. Horticulture Production, marketing and export in India-The smell of success, Indian Farming (Special Issue on World Food Day), October.

Gopal K. N. 1978. An Analysis of Problems of Marketing of a few Vegetables in Bangalore City , M.Sc.(Agril. Economics) Thesis, UAS, Bangalore.

Govt. of India 1989. Eighth Plan Working Group Report for Horticulture and Plantation Crops. New Delhi, Govt. of India.

Gujrati P.M. 1994. Study on assessment of export potential of fresh and processed fruits and vegetables from West Bengal, Agriculture Processed Food Products Export Development Authority, Govt. of India, New Delhi.

Haque, T. 2000. Contractual arrangements in land and labour markets in rural India, *Indian Journal of Agricultural Economics*, **55** (3): 233-252.

Harper, J. K., M. E. Rister, J. W. Mjelde, B. M. Dress and M. O. Way, 1990. Factors influencing the adoption of insect management technology. *American Journal of Agricultural Economics*, **72** (4): 997-1005.

Hugar, L.B., S. Suryaprakash and D. S. Lokamanya. 1983. A Study of Cost and Margins in marketing of Brinjals in Belgium City, *Agricultural Marketing*, **26** (1): 23-30.

Indian Institute of Horticultural Research (IIHR), 1989. Economics of Cultivation of Horticultural Crops in South India, Hessarghatta, Bangalore.

Kasar, D.V.; B.S. Ambre; R.C. Raut and V.S. Rasane. 1994. Marketing of bitter gourd in Ahmednagar district of Maharashtra, Indian *Journal of Agricultural Marketing*, **8** (2): 246-249.

Kumar, P. 1998. Food Demand and Supply Projection for India. Agricultural economic policy paper 98-01. New Delhi: Indian Agricultural Research Institute.

Kumar, P. and Mruthyunjaya, 1995. Demand for fruits and vegetables, India. *Agricultural Economics Research Review*, **8** (2).

Kumar, P. and V.C. Mathur, 1996. Agriculture in future: Demand-supply perspective for the Ninth Five Year Plan. Economic and Political Weekly, 28 September: A131-A139.

Kumar, P. and V.C. Mathur, 1996. Structural changes in the demand for food in India. Indian Journal of Agricultural Economics, **51**(4): 664-773.

Kumar, P., P. Kumar and S. Mittal 2004. Vegetable demand and production in India: Long-term perspective. In: Impact of vegetable research in India. Eds. S.Kumar, P.K.Joshi and S.Pal, New Delhi: National Centre for Agricultural Economics and Policy Research. Proceedings No.13. pp. 161-177.

Lapar, M.L.A. and S.Pandey 1999. Adoption of Soil Conservation; The case of the Philippine uplands, *Agricultural Economics*, **21**: 241-256.

Maji, C.C. and Kazi M.B. Rahim, 1996. An investigation into small firms diversification: Some Case studies in West Bengal, In: Small Farm Diversification: Problems and Prospects, National Centre for Agricultural Economics and Policy Research, Workshop Proceedings I, New Delhi.

Mishra, R.B. 1972. Cooperative cold storage-Some lessons from Bihar, Indian Cooperative Review, 10(1): 73-84.

Mishra S.N.; S. Tripathi and B.K. Prusty, 1995. Production and marketing of onion in Kalahandi district of Orissa. Indian Journal of Agricultural Marketing, Conference Special, 9(1), 167.

Rais Ahmed, WTO and Indian Agriculture (set 3 vols.) by (Mittal Publications) D. Narasimha Reddy & Srijit Mishra, Agrarian Crisis in India; Shovan Ray, Handbook of Agriculture in India

Narasimhan, M.K. and N.S. Ravindra, 1989. Role of cooperative society in the marketing of vegetables in Bangalore City, *Indian Journal of Agricultural Marketing*, **3** (2); 126.

National Horticulture Board, 1998. Indian Horticulture Database, New Delhi: NHB Publication.

Navadkar, D.S.; D.V. Kasar and D.B. Yadav. 2004. Constraints in adoption of improved vegetable technologies in western Maharashtra. In: Impact of vegetable research in India. Eds: S.Kumar; P.K.Joshi and S.Pal. New Delhi: National Centre for Agricultural Economics and Policy Research. Proceedings No. 13. P. 220.

Economic Review and Statistical Appendix by BAESDPD, Govt. of W.B. (2005-06 to 2009-10)

Navadkar, D.S.; D.V. Kasar and D.B. Yadav. 2004. Constraints in adoption of improved vegetable technologies in western Maharashtra. In: Impact of vegetable research in India. Eds: S.Kumar; P.K.Joshi and S.Pal. New Delhi: National Centre for Agricultural Economics and Policy Research. Proceedings No. 13. P. 220.

Economic Review and Statistical Appendix by BAESDPD, Govt. of W.B. (2005-06 to 2009-10)

Nkonya, E., T. Schroeder and D. Norman. 1997. Factors affecting adoption of improved maize seed and fertilizer in northern Tanzania. *Journal of Agricultural Economics*, **48**: 1-2.

Parmer, G.R., G. D. Naik and K. S. Patil. 1989. Selling of Chiku and price received by chiku growers from different purchasing agencies in south Gujarat. *Indian Cooperative Review*, **27** (2): 202-209.

Polson, R. A. and S. C. Spencer. 1991. The technology adoption process in subsistence agriculture: The case of cassava in south western Nigeria. Agricultural Systems, **36**: 65-78.

Mythili G. 2001. A note on Acreage response for major crops in the selected states in accelerating growth through globalization of Indian agriculture, (ed.) Kaliranjan K.P.; G. Mythili and U. Sarkar, Macmillan India Ltd.