https://doi.org/10.56093/ijas.v90i10.107890

Indian Journal of Agricultural Sciences **90** (10): 1888–93, October 2020/Article

An analysis of economic benefits from adoption of drought tolerant soybean (*Glycine max*) in Madhya Pradesh

RAGHAVENDRA K J[1] and A SURESH[2]

ICAR-Indian Agricultural Research Institute, New Delhi 110 012, India

Received: 25 November 2019; Accepted: 4 February 2020

ABSTRACT

The research conducted to estimate the potential economic benefit from adoption of drought tolerant soybean (*Glycine max* (L.) Merr.) variety NRC-7 in Indore district of Madhya Pradesh, where majority of area is under rainfed system. In this study, the potential economic benefit in terms of economic surplus and risk reduction was estimated for NRC-7 and alternative varieties, JS-93-05 and JS 95-60. NRC-7 requires less cost of cultivation compared to other two varieties, and withstands stress condition. In normal condition, the economic surplus for NRC-7 was ₹ 686 million per year, and that of, JS-93-05 and JS 95-60 is about ₹ 3161 million, ₹ 6291 million, respectively. For NRC-7, the risk reduction benefit was to the level of ₹ 547 million, which accounted for about 83.8% of total benefits for that variety. On per ha basis, NRC 7 performs well over the other two varieties in reducing the fluctuation in income of farmers. So there is a need to develop and increase the awareness of abiotic stress tolerant varieties to cope up with the income fluctuation due to weather risks.

Key words: Climate change, Drought tolerant, Economic surplus model, Risk benefit

The diversified geographical area in India made the agriculture more unpredictable due to climatic events. The arid and semi-arid tropics together accounts for 62% of the country's gross cropped area and 54% of the value of the crop output (Gulati and Kelley 1999).These rainfed areas are susceptible to weather fluctuations. Climate-related natural disasters (droughts, floods, and typhoons) are the principal sources of risk and uncertainty in agriculture (Pandey *et al*. 2007). Production or yield risks arise because of two principal factors-random uncontrolled inputs (e.g. moisture, temperatures) due to weather fluctuations and incidence of pests and diseases. (Ramaswami *et al*. 2003). According to the report of the National Commission of Agriculture (Government of India 1976), rainfall fluctuations could be responsible for 50% of variability in yield. Drought has been historically associated with food shortages of varying intensities, including those that have resulted in major famines in different parts of Asia and Africa. In India, major droughts in 1918, 1957-58, and 1965 resulted in famines during the 20th century (FAO 2001). In these situations farmers modify their production practices to provide "self-insurance" so that the likely impact of adverse outcome is reduced to an acceptable level.

The role of weather factors in crop growth often means that short duration varieties have lower climate induced variability than long duration varieties. This was asserted in the case of wheat cultivars by Kalra and Aggarwal (1996). In the situations of limited rainfall cultivation of drought tolerant varieties have insurance implanted in them and can provide cost effective long run solution against the adverse effect of the drought (Birthal *et al* 2012). Agricultural research that reduces production risk without sacrificing the crop yield can make significant contribution towards mitigating adverse effects of drought.

Ex-ante strategies can be grouped into two categories: those that reduce risk by means of diversification and on other hand do so by adopting risk withstanding mechanisms (Suresh *et al.* 2014). The risk of income shortfall is reduced by growing several crops that have negatively or weakly correlated returns. Drought tolerant variety is one of the mitigating strategies to cope risk.

MATERIALS AND METHODS

In India, the highest area under soybean (*Glycine max* (L.) Merr.) cultivation is in Madhya Pradesh where around 78% of the area under rainfed cultivation. Therefore, Madhya Pradesh was selected for the study. The primary data were collected in Indore district which was purposively selected since it has a higher concentration of net sown area of soybean. In Indore, 2 tehsils were randomly selected.

[1]Ph D student (Email : raghavakj@gmail.com), Division of Agricultural Economics, IARI, PUSA New Delhi 110 012; [2]Principal Scientist (email:sureshcswri@gmail.com), Central Institute of Fisheries Technology, Kochi, Kerala 682 029.

From each tehsil 2 villages were selected randomly for data collection. Thus a total of four villages were selected. From each village, 30 farmers who are cultivating soybean were selected for data collections. Thus a total sample of 120 farmers was selected for the study through personal interview.

District-wise data on area, production, yield, and farm harvest prices of soybean was collected from Directorate of Economics and Statistics (DES), Government of India (GOI). The study used data on the usage of breeder seeds of public sector varieties (Seednet India, Ministry of Agriculture and Farmers Welfare, GoI). The details regarding the soybean varieties released in Madhya Pradesh under public sector and their important characteristics were collected from the annual reports of All India Coordinated Research Project (AICRP) on soybean and Indian Institute of Soybean Research (IISR), Indore.

Cultivation of soybean being in the rainfed condition and requires timely rainfall during sowing season. Data shows high fluctuation in rainfall with a coefficient of variation of 106% in the month of June (Table 1).

Soybean in Indore shows a steady growth of production and yield over the period of 1998-99 to 2015-16, but there is no much growth in the area under soybean cultivation. Average area under soybean cultivation in Indore is 2.2 mh in 2015-16 with a yield of 12.14 q/ha (Table 2).

Description of varieties

Madhya Pradesh constitutes around 56% of the soybean production in India.Net cropped area of Indore is 2.57 Mha out of which 92% of area is under soybean cultivation. Cropping intensity being at 170% with crops like soybean, maize, potato and pulses in *kharif*, gram, wheat, onion in *rabi*. For the evaluation of the economic benefit three varieties had been selected, viz. JS-93-05 and JS-95-60 are high yielding and NRC-7 being the drought tolerant one. Jawahar Soybean (JS) varieties are of Jawaharlal Nehru Vishwa Vidhyalay, Jabalpur, and NRC-7 from Indian Institute of Soybean Research (IISR), Indore. JS-95-60 released in 2007 is a short duration crop with 80-90 days of maturity, having 40% protein and 20% oil. JS-93-05 released in 2002 having high yielding ability with resistance to root rot and tolerance to major biotic stresses. NRC-7 released in 1998 is 90-100 days crop, with oil content more than 25%, 2 to 3 life saving irrigation is sufficient, planted in June-July, harvested in October month.

Table 1 Precipitation in Indore district, Madhya Pradesh: 2014-18

	Jun	Jul	Aug	Sep	Oct	Annual
Mean normal RF (mm)	136.76	357.08	244.54	134.1	10.54	930.3
CV%	58.53	34.82	22.61	33.63	94.74	22.08

Table 2 Growth and variability in production of soybean in Indore, Madhya Pradesh: 1998-99 to 2015-16

	Area (Mha)	Production (Mt)	Yield (q/ha)
CAGR	0.473	3.493	2.995
Mean	2.2	2.68	11.56
CV	2.89	22.53	21.53

Estimation of economic benefit

The total benefits of cultivating a variety in the risky production situations consists of two parts- benefits out of yield advantage and the benefits that may arise due to the risk reduction. In the present study, the benefits out of both the factors have been estimated.

The method most often used to estimate the economic benefits of agricultural technologies is based on the principle of economic surplus (Alston *et al.* 1995). In the study, the economic surplus model is used to calculate the potential benefits derived from the adoption of improved soybean varieties that have yield advantage.

The economic surplus model, as described by Alston *et al.* (1995), consists of a set of supply and demand equations that model the market as a system. Algebraic manipulations of these equations allow computation of total surplus and its distribution into producer surplus and consumer surplus. In reality, the economic surplus model is implemented through the incorporation of parameters that include size and openness of the economy, whether the country is a large or small producer, demand and supply elasticities, adoption rates, and years required for adoption, potential yield advantage, etc. A diagrammatic representation of the economic surplus model is produced in the figure.

The data required for estimating the model is typically gathered from a variety of sources. They include sample survey of farmers, trial data (field and greenhouse), secondary data from different sources. The analysis can be conducted at the regional, national, or global level.

In case of soybean, small open economy is assumed. India imports close to 70% of edible oil requirement. Any widespread fluctuation in the oil price in the domestic economy is addressed through imports. India contributes less than 10% of the global soybean production, and is not in a position to influence the global trade. On the basis of this, it is presumed that modeling using small open economy framework would be ideal.

In small open economy, the reference price is the world price. The total surplus would be having only one component, that is the producer surplus as the consumer surplus is equal to zero ($\Delta CS = 0$). The producer surplus in the small open economy model is expressed as :

$$\Delta PS = \Delta TS = P_w Q_0 K(1 + 0.5Z\varepsilon)$$

where, ΔPS is the change in producer surplus, ΔTS is the change in total surplus stemming from the introduction of an innovation (variety), Q_0 is the quantity produced before innovation adoption, and P_w is the world price of soybean.

In the present study, the surplus of three varieties of soybean was estimated. Three high yielding varieties, JS 93-05, JS 95-60 and NRC-7 were considered for the

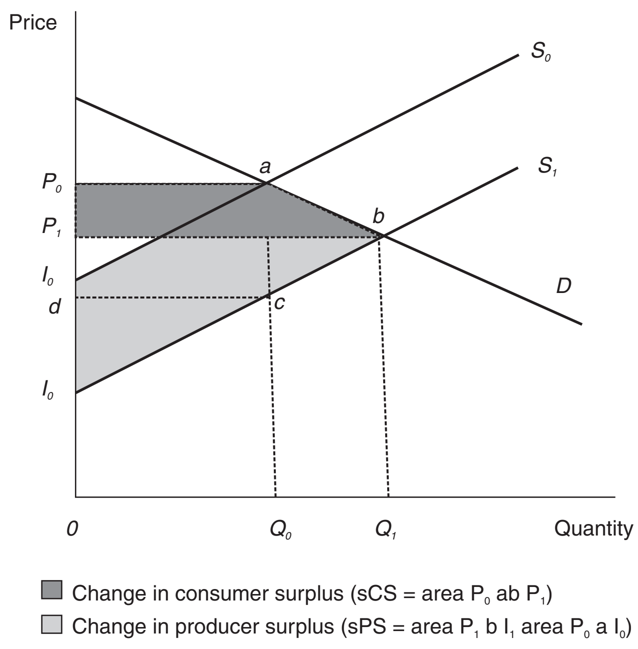

Fig 1 Economic surplus due to yield improvement in open small economy.

analysis. While all the three varieties are reported to be yield enhancing, the NRC- 7, has an additional advantage of being drought tolerant. In the present study, the economic surplus out of the yield enhancement has been estimated for all the varieties, while the benefit out of the risk reduction has been estimated for NRC-7. The model is used to measure the total surplus obtained from the adoption of the three varieties in the selected region. The basic information needed for the model is as given below Fig 1.

The calculation of the economic surplus needs an estimate of demand and supply for the oilseed. Srinivasan *et al.* (2005), has reported the demand elasticity for rural areas and for urban areas. By using weighted averages, the demand elasticity of -0.73 was used for the study. Srinivasan *et al.* (2005) has also reported the supply elasticity to be about 0.84 for soybean. The value of the proportionate change in yield for varieties was taken from the reported source of All India Coordinated Research Project (AICRP) on Soybean, which conducts a frontline demonstration of the improved varieties. The probability of research success was taken as one because the technology already adopted completely and is available in the field. The seed industry in Madhya Pradesh was dominated by the private sector. Using these estimates, data of seed replacement rate (SRR) and the share of the three varieties in the breeder seed supply, the share of the three varieties in Madhya Pradesh was estimated. The price of soybean in the international market is taken as ₹ 3432 per q (World Bank) for the year 2015. The production of the soybean in Madhya Pradesh for TE 2009-10 was taken as 5912 ('000 tonnes).

Newbery-Stiglitz Approach to measure risk benefit

The benefits from reduction in yield variance due to the adoption of NRC-7 was analyzed using the framework provided by Newbery and Stiglitz (1981). The adoption of NRC-7 generates risk benefits by lowering the variance in real income.

Let, Y_0 is the mean yield for the old variety. Y_1 Change mean yield due to adoption of a drought tolerant variety. The benefits due to change in variance in yield can be estimated using

$$\frac{B}{Y_0} = 0.5R(\sigma^2{}_{y1} - \sigma^2{}_{y0})$$

where, $\sigma^2{}_{y0}$ Coefficient of variation of yield for old variety. $\sigma^2{}_{y1}$ Coefficient of variation of yield for new variety. B - Monetary benefits associated with the change in reduction in yield variance, and R is Risk aversion coefficient.

RESULTS AND DISCUSSION

An understanding of the socio-economic pattern of sampled farmers would provide an insight to the farm situation and background regarding the decision-making pattern of the farmers in the sampled area. Details of social and economic characteristics of the farm households are provided in Table 4.The study indicated that majority of the sampled farmers belonged to medium to large farm category. The mean age of the farmers was about 50 years and the average family size was 7 members. The mean number of years of education was about 8.6, indicating a secondary level. Many farmers with higher education were observed in large farm size category. They could be targeted to work as change agents for spreading the adoptions of modern and high production technology and farming practices. The mean number of years of experience in farming was about 35 years in case of large farmers and 33 years in case of small farms. Out of SC/STs, about 53% of farmers were

Table 3 Components of economic surplus model

Particulars	JS 93-05	JS 95-60	NRC-7	Source
Demand elasticity	-0.73	-0.73	-0.73	Srinivasan (2005)
Supply elasticity	0.84	0.84	0.84	Srinivasan (2005)
Proportionate yield change (%)	24.3	34.2	29.0	IISR, Indore
Proportionate change in input cost (%)	0.86	0.96	0.81	IISR, Indore
Probability of research success	1	1	1	Already variety released
Share of variety in total area (%)	6.90	8.95	0.19	Authors calculation
International market price (₹/q), 2015	3432	3432	3432	World bank (TE 2014-15)
Quantity ('000 tonnes) TE 2009-10	5912	5912	5912	DES, GoI
Mean yield (q/ha)	13.8	13.9	11.9	Primary survey

Table 4 Social and economic status of sampled farmers

Particulars	Small farmers (<2 ha)	Large farmers (>2 ha)	Overall
Numbers of farmers (no.)	30	90	120
Age (years)	50.9	51.3	51.2
Education (number of years of schooling)	8.5	8.7	8.6
Average family size (no.)	7.4	7.1	7.2
Average adult family size (no.)	4.7	4.4	4.5
Farming experience (years)	33	35.3	34.8
Caste			
SC/ST (%)	53.3	46.7	100
Others (%)	46.6	53.4	100
Mean land holding (ha)			
owned land	1.84	5.9	4.9
leased-in land	0.08	0.09	0.09
leased-out land	0.06	0.12	0.1
operational holding	1.7	5.9	4.9
Mean irrigated area (ha)	0.1	0.4	0.3
Area irrigated (%)	9.4	7.7	7.8
Possession of Kisan Credit Card (KCC) (%)	76.6	77.7	77.5
Membership in organizations			
Gram Panchayat (%)	13.3	12.2	12.5
Co-operative society (%)	40.0	37.8	38.3
Marketing society (%)	33.3	43.3	40.8
SHG's (%)	56.6	65.5	63.3
Adoption of micro-irrigation (%)	10.0	20.0	17.5
Adoption of crop insurance (%)	53.3	57.7	56.6
Cropping intensity (%)	177	157.7	162.5

small and 47% remaining were large farmers, in terms of operational size of holding. The proportion of the small farmers was low in case of "other" category farmers 47% small and 53% large. The average size of operational land holding was 4.9 ha-1.7 ha for small holders and 5.9 for large holders. The crop cultivation was mostly being carried out under rainfed condition. The average area under irrigation was quite low, only 7.8% of the area was irrigated. The status of availing credit through Kisan Credit Card (KCC) Scheme was around 77% in case of large farmers. Small farmers were numerically more in Gram Panchayat and co-operative societies, while large farmers dominated in marketing society and SHGs. It was also observed that about 57% of the farmers adopted crop insurance. The mean level of cropping intensity was 163%, with the small farmers with a significantly higher level.

The study has also collected information on variety-wise cost of cultivation, as it would provide deeper insight into the risk at the farm level, with respect to varieties adopted. All the varieties analyzed (NRC-7, JS 93-05 and JS 95-60) were the products of Indian Institute of Soybean Research, Indore. The cost of cultivation for these three varieties is provided in Table 5. The table provides the mean values along with the respective coefficient of variation for small and large farmers, and for the overall sample. It shows that among three varieties, the expenditure towards machine labour was the least for NRC-7 and the highest for JS 93-05. Major item of expenditure in cost of cultivation was human labour, followed by machine, and fertilizer cost. The miscellaneous costs include packing and marketing cost, the CV of which was high as it depended on the farmers' yield and the type of market chosen to sell the product. The cost of cultivation in case of NRC-7 was the lowest, i.e ₹ 30374, while JS 93-05 and JS 95-60 had a cost of cultivation of ₹ 31172 and ₹ 31601, respectively.

Assessment of economic benefit and risk benefit from adoption of improved varieties

The yield benefit of adoption of improved varieties was estimated by economic surplus method. The risk benefits were estimated by using the method as in Konstandinin *et al.* (2009). The total benefits were arrived by summation of the yield benefits and risk reduction benefits. Out of the three varieties considered, the risk reduction benefits were estimated for NRC-7, a variety that is tolerant to droughts. The salient basic information used for estimation purpose is provided in Table 3.

The demand elasticity of the soybean in Madhya Pradesh was -0.73 and supply elasticity was 0.84. The price of soybean in the international market was taken as 3432

Table 5 Cost of cultivation for different soybean varieties

Component	NRC-7		JS 93-05		JS 95-60	
	Mean (₹/ha)	CV	Mean (₹/ha)	CV	Mean (₹/ha)	CV
Seed	5148.3	6.3	5108.4	7.6	5145.1	8.7
Tractor/machine labour	6184.5	16.6	6580	6.2	6522	8
Fertilizer	5457.3	13.3	5524.9	6.4	5599.2	5.9
Chemicals	4664	12.1	4912.7	9.9	5160.6	12.4
Irrigation	225	47.1	203.3	60.8	212.3	36.9
Total labour	7827.7	5.2	7956.4	5.3	8096.9	8.4
Miscellaneous	1077.5	26.5	1062.9	27	1026.2	22.3
Total cost	30374.3	6.3	31172.5	4	31601.7	4.8
Price (₹/q)	3522	0.8	3533.4	1	3508.9	4.2
Gross revenue (₹/ha)	41787.5	4.9	48631.3	5.2	48763.9	7.8
Net revenue (₹/ha)	11413.2	23.3	17458.8	15.4	17162.2	22.6
Yield (q/ha)	11.9	4.7	13.8	5.2	13.9	6.1
Unit cost of production (₹/q)	2564	7	2270	6.1	2282	7.1

Table 6 Benefit from drought variety cultivation in normal condition and drought condition

Discount rate	Economic surplus (million ₹)			Risk benefit (million ₹)			Total benefit (million ₹)		
	JS 93-05	JS 95-60	NRC-7	JS 93-05	JS 95-60	NRC-7	JS 93-05	JS 95-60	NRC-7
Normal condition									
@5.20	3,160.91	6,291.24	111.03 (16.19)	0	0	574.66 (83.81)	3160.91	6291.24	685.69
@ 8.0	2,500.73	4,977.27	87.84 (16.19)	0	0	454.64 (83.81)	2500.73	4977.27	542.48
Drought condition									
	Economic surplus (million ₹)			*Risk benefit (million ₹)*			*Total benefit (million ₹)*		
	JS 93-05	*JS 95-60*	*NRC-7*	*JS 93-05*	*JS 95-60*	*NRC-7*	*JS 93-05*	*JS 95-60*	*NRC-7*
@5.20	1409.10	3065.56	96.88 (15.78)	0	0	517.19 (84.22)	1409.1	3065.56	614.07
@ 8.0	1114.80	2425.30	76.65 (15.78)	0	0	409.17 (84.22)	1114.8	2425.3	485.82

₹/q (World Bank) for the year 2015. The benefit stream generated over a period of time was discounted to obtain the net present value (NPV).

For calculating the NPV two different discount rates were used. Kula (2004) has reported that the social discount rate is 5.2% for developing countries, which was taken for this analysis. Another set of sensitivity analysis has been carried using a discount rate of 8.0% per year, in tune with the mean interest rate currently in vogue in India.

The analysis has been carried for a normal period and a drought period. The potential reduction of yield during an average drought period has been obtained from published literature and using this value, the economic surplus changes were calculated. The economic benefit from the adoption of drought tolerant variety in normal period and drought period given in table 6.

In normal condition the economic surplus for JS-93-05, JS 95-60 and NRC-7 at 5.2% of discount rate would be about ₹ 3161 million, ₹ 6291 million and ₹ 686 million per year, respectively. At 8.0% discount rate, the net benefits fall considerably for all the three varieties. It has been noted that out of the total benefit for NRC-7, a drought tolerant variety, the risk reduction benefit was to the tune ₹ 547 million, which accounted for about 83.8% of total benefits for that variety. The drought tolerant variety has reported lower level of benefit compared to other varieties on account of lower adoption at field level.

Table 6 indicates the corresponding benefits during a drought year. All varieties have shown a decline in the level of benefit, but the extent of reduction in case of the NRC-7 was lower compared to that by the other two varieties. This has also been estimated at 5.2% and 8.0%. The results point to the impact of the benefit-stabilizing characteristic of abiotic stress-resistant/tolerant varieties.

In order to remove the effect of area/ adoption rate in the total benefit, the results were normalized on a per-ha basis (Table 7). On a per-ha basis, taking into consideration the risk benefits, the total benefit out of NRC-7 under normal condition is about ₹ 10046/ ha compared to ₹ 7970 for JS 93-05 and ₹ 12161 for JS 95-60. However, on a drought condition, on a per hectare basis, the benefits of NRC- 7 far outweighs other two varieties, both in terms of economic surplus and risk reduction benefits. This reflects the need to develop abiotic stress resistant varieties for marginal and rainfed areas. The issue becomes more relevant in the context of climate change.

Conclusion

The study revealed large level of economic benefit out of cultivation of improved varieties of soybean. The study targeted three varieties to measure the economic surplus and risk benefits (JS 93-05, JS 95-60 and NRC-7). All the varieties were of National Agricultural Research System (NARS). The analysis was done for two discount rates, a social discount rate at 5.2% and a sensitive analysis at 8%. In normal climate conditions, the economic benefits

Table 7 Surplus value per year per ha basis

Variety	Total surplus on a per ha basis (₹/ha/year)		Share of components (₹/ha/year)			
	Normal	Drought condition	Normal		Drought	
			Economic surplus	Risk benefit	Economic surplus	Risk benefit
JS 93-05	7970	3553	7970	0	3553	0
JS 95-60	12161	5926	12161	0	5926	0
NRC-7	62785	56227	10046	52112	8771	47456

were measured at ₹ 3160 million and ₹ 6291 million for JS 93-05 and JS 95-60, and ₹ 685 million for NRC-7. For NRC-7, about 84% of the advantage has been from risk reducing effect. On a per-ha basis, taking into consideration the risk benefits, the total benefit out of NRC-7 under normal condition is about ₹ 10046/ha compared to ₹ 7970 and ₹ 12161 for JS 93-05 and for JS 95-60 respectively. It has noted that the potential economic loss during a drought condition is much less for NRC-7 compared to other varieties, indicating high risk reduction benefits. The analysis has provided insight into the economic potential of developing abiotic stress resistant varieties. In the context of increasing challenges like drought, high variability in temperature, and change in climatic situations, abiotic stress needs greater focus in the varietal development policy. Development and popularization of abiotic stress tolerant varieties for rainfed areas has the potential to impart further resilience to rainfed farming system.

ACKNOWLEDGMENTS

Authors are thankful to Dr Girish Kumar Jha and Dr Dharam Raj Singh, Principal Scientist, ICAR-IARI, New Delhi. We thank Dr Purushottam Sharma, Senior Scientist, ICAR-IISR, Indore for his valuable guidance during data collection.

REFERENCES

Alston J M, Norton G W and Pardey P G. 1995. *Science under Scarcity: Principles and Practice for Agricultural Research Evaluation and Priority Setting*. Cornell University Press.

Birthal P S, Nigam S N, Narayanan A Vand Kareem K A. 2012. Potential economic benefits from adoption of improved drought-tolerant groundnut in India. *Agricultural Economics Research Review* ***25***(1): 1-14.

FAO (Food and Agriculture Organization of the United Nations). 2001. Report of the Asia Pacific conference on early warning, prevention, and preparedness and management of disasters in floods and agriculture. Chiang Mai, Thailand, 12-15 June 2001, Bangkok, Thailand.

Government of India, Ministry of Agriculture and Irrigation. 1976. Report of the National Commission on Agriculture.

Gulati Aand Kelley T M. 1999. *Trade Liberalization & Indian Agriculture*. New Delhi: Oxford University Press.

Kalra N and Aggarwal P K. 1996. Evaluating the growth response for wheat under varying inputs and changing climate options using Wheat Growth Simulator –WTGROWS. (in) *Climate Variability and Agriculture*, pp 188-203. Yash P. Abrol, Sulochana Gadgil and Govind B Pant (Eds), New Delhi.

Kostandini G, Mills B F, Omamo S W and Wood S. 2009. Ex-ante analysis of the benefits of transgenic drought tolerance research on cereal crops in low income countries. *Agricultural Economics* **40:** 477-492.

Kula E. 2004. Estimation of a social rate of interest for India. *Journal of Agricultural Economics* **55**: 91-99.

Newbery D M G and Stiglitz J E. 1981. *The Theory of Commodity Price Stabilization: A Study in the Economics of Risk*. Clarendon Press, Oxford.

Pandey S, Bhandari H Sand Hardy B (Eds). 2007. *Economic Costs of Drought and Rice Farmers' Coping Mechanisms: A Cross-country Comparative Analysis*. International Rice Research Institute.

Ramaswami R, Ravi S and Chopra S. 2008. Risk management in agriculture. Discussion papers, 03-08, Indian Statistical Institute, Planning Unit, New Delhi, .

Srinivasan P V. 2005. *Impact of Trade Liberalization on India's Oilseed and Edible Oils Sector*. Indira Gandhi Institute of Development Research, Mumbai.

Suresh A, Raju S S, Chauhan Sand Chaudhary K R. 2014. Rainfed agriculture in India: An analysis of performance and implications. *Indian Journal of Agricultural Sciences* **84**(11).