Economic implications of land degradation on sustainability and food security in India

A. K. VASISHT, R. P. SINGH AND V. C. MATHUR
Division of Agricultural Economics, Indian Agricultural Research Institute,
New Delhi – 110 012, India.

Abstract : The estimates of land degradation by different agencies vary between 53 and 188 million hectares in the country. Widely accepted estimates indicate, however, that nearly 57 per cent of the geographical area or 187.8 million hectares of land are degraded of different intensity. Water erosion covers larger area than the degradation caused by other factors. If land degradation is translated in terms of economic losses, the country looses Rs. 285.51 billion annually at current prices and Rs.89.38 billion at 1979-82 prices, which is worked out to be around 12 per cent of the total value of agricultural output in the country. The economic losses varied between 10 to 27 per cent of the value of agricultural output due to nature and severity of degradation of land and the cropping pattern across the states.

Additional key words: Sustainability, degradation, sensitivity analysis.

Introduction

India's agricultural and rural development policies have underlined the need for achieving self-sufficiency and food security for the people. Beginning with the seed – fertilizer revolution that began in the late sixties, supported by appropriate agricultural development policies, the country attained a significant and steady growth in agricultural output. However, agriculture in India is currently facing a new set of challenges. Further enhancement of yield levels and sustainable use of natural resources are the two major issues that need to be tackled. Declining soil fertility and an increase in proportion of land becoming unfit for cultivation are major issues that question the sustainability.

There are wide differences between the estimates provided by different authors/ agencies. Moreover, these estimates are confined only to physical units of land degradation. It is more important to estimate the extent of economic losses to the coun-

Table 1. Estimates of degraded land in India*

Agencies	Estimated degraded land (mha.)	% of TGA
National Commission on Agriculture, Govt. of India, (1976)	175.0	53.24
Department of Environment, Government of India, (Vohra, 1980)	95.0	28.90
Society for Promotion of Wasteland Development, (1984)	93.7	28.50
National Remote Sensing Agency, Hyderabad, (1985)	53.3	16.21
National Wasteland Development Board, Ministry of Environment and Forest, New Delhi, (1985)	123.0	37.5
Soil and Water Conservation Division, Ministry of Agriculture, (1991)	173.6	52.81
National Bureau of Soil Survey and Land Use Planning, (1994)	166.0	50.50
Abrol & Sehgal (1994), GLASOD Mapping	187.7	45.90

try on account of land degradation. Such estimates of economic losses will help us to gauge the severity of the problem, besides highlighting the imperative need to initiate measures for reclamation of the degraded land. The present study is an attempt to assess the economic losses on account of land degradation. A state level analysis will help to identify the areas that have a severe problem and which require attention and intervention to reverse the situation.

Materials and methods

The available statistics on degraded lands from different sources (Table 1) indicate wide variation and hence it is important to have realistic estimates of the physical area under degraded lands before esti-

mates of economic losses can be arrived at. Reconciled information on the extent of land degradation due to various causal factors was used (Sehgal and Abrol 1994). Based on the information on the extent of land degradation provided for other States by NBSS&LUP (Table 2), the economic losses due to different types of land degradation were estimated using the model developed for the purpose. The model is estimated by multiplying the per hectare total value of output by the extent of degraded land in each district.

The economic losses due to different types of degradation have been categorized as slight, moderate and severe on the basis of available literature and discussions with subject matter specialists. Under the slight

Table 2. Extent of land degradation in India and its states

States	*Total geographical area (000' ha)	*Net sown area (000' ha)	**Degraded land area (000' ha)	Degraded land as % of total geographical area
Andhra Pradesh	27505	10736	15662	57
Assam	7844	2762	2807	36
Bihar	17388	7329	6291	36
Gujarat	19602	9605	10336	53
Himachal Pradesh	5567	563	3008	54
Haryana	4421	3601	1384	31
Jammu & Kashmir	22224	734	2225	10
Karnataka	19179	10515	7681	40
Kerala	3886	2267	2608	67
Maharashtra	30771	17894	13328	43
Madhya Pradesh	44345	19773	26209	59
Orissa	15571	6089	6121	39
Rajasthan	34224	16683	13586	40
Tamil Nadu	13006	5414	5273	41
Uttar Pradesh	29441	17437	15253	52
West Bengal	8875	5463	2752	31
Punjab	5036	4139	896	18
All India	**328726**	**142820**	**187700**	**57**

*Statistical Abstract of Haryana (1997-98), Government of Haryana, (1999)
**NBSS & LUP (ICAR), Nagpur, (2000)

category, the extent of losses due to different causal factors range from 4 to 6 per cent and thus an average value of 5 per cent of the degraded land has been taken for this category. The average value under the moderate category has been taken as 12 per cent, the range of moderate and moderately severe being 12 to 15 per cent. Similarly, the average value under severe category has been taken as 37 per cent, it being the average of the range 25 to 50 per cent of severe and very severe category. In the case of water-logging / flooding and ravines, an average loss of 50 per cent was assumed to estimate economic losses.

Estimation model

The model proposed uses the extent of the degraded land in each district (estimated by National Remote Sensing Services) which is multiplied with the per hectare total value of output (standardized by district average yields and farm harvest prices of crops) to yield the economic losses on account of land degradation (EL_n)

$$EL_n = \sum_d \sum_l \sum_k X_{dlk} * [(\sum_l Y_{ik} * P_{ik})/ N_{ak}] .$$

Where,

Y_{ik} denotes the quantity of output of ith crop in the kth district,

P_{ik} denotes the farm harvest price of ith crop in the kth district,

N_{ak} denotes net sown area in k^{th} district,

X_{dik} denotes area under d^{th} category of degraded land and l^{th} group of losses in the kth district

Alternative scenarios

The extent of degradation of land may get reduced over time due to various reclamation measures being adopted by the Government. Also, the extent of land degradation might increase over time due to over-exploitation of natural resources and agricultural development. To capture these effects of reduced or increased degradation of land, sensitivity analysis was performed and economic losses were estimated for two alternative scenarios of 10 per cent lower extent of degradation and 10 per cent higher extent of degradation.

Data

The reconciled data on the extent of degradation due to various causal factors for different States were made available by the National Bureau of Soil Survey and Land Use Planning Nagpur. For the country as a whole, the estimates of Abrol and Sehgal (1994) are used in the study. In order to assess the economic losses, state-wise data on area and production of different crops, vegetables and fruits for the years 1994-95 and 1995-96 and the farm harvest prices for the major states were collected and the value of output for different commodities were computed to find the total value of productivity per unit of land, which indicated considerable variation between states, both at current and constant prices,

indicating that the level and magnitude of land degradation varies with the variation in total value productivity across states. Thus, the economic losses are varying considerably on account of both the factors across the States.

Results and discussion

The state-wise value productivity at current and constant prices is presented in table 3. There are wide variations in the productivity levels across states as revealed by the coefficient of variation (58 per cent). These variations in the productivity levels are on account of the differences in cropping patterns and yield levels across the states and will ultimately be reflected in the magnitude of economic losses. The data indicate that the value productivity per hectare at current prices (average of 1994-96 prices), for the country is Rs. 12288. It is the highest in case of Punjab (Rs. 33422 per ha) followed by West Bengal (Rs. 32397 per ha) and Haryana (Rs. 25648 per ha). The lowest value productivity was observed in case of Madhya Pradesh (Rs. 6433 per ha). The picture is more or less similar at constant prices (base: 1979-80 to 1981-82).

The estimated economic losses (Table 4) resulting from various sources of land degradation in the country at the current level of total land degradation work out to around Rs. 285.51 billion at current prices. The severity of the economic loss is the highest in Andhra Pradesh followed by Uttar Pradesh, Madhya Pradesh and Gujarat. The economic loss is the least in Punjab state. The estimates of economic losses re-

Table 3. State-wise total value productivity of Indian agriculture
(at Farm Harvest Prices)

Districts	Current Prices (1995-97)	Constant Prices (Base:1979-80 to 1981-82)
	Productivity (Rs/ha.)	Productivity (Rs/ha.)
Andhra Pradesh	14065	4324
Assam	13071	3661
Bihar	11571	3436
Gujarat	13811	4588
Himachal Pradesh	12597	4050
Haryana	25648	8781
Jammu & Kashmir	13196	4264
Karnataka	9674	3077
Kerala	6602	1513
Maharashtra	6524	2082
Madhya Pradesh	6432	2122
Orissa	8169	2389
Rajasthan	7597	2686
Tamilnadu	13521	4153
Uttar Pradesh	17346	5377
West Bengal	32397	8411
Punjab	33421	11083
All India	12287	3846
CV(%)	58.17	58.69

*Based on the output and farm harvest prices of crops, vegetables and fruits grown in the states

sulting from various sources of land degradation at constant (1979-82) prices reveals that at the current levels of degradation, the economic losses in the country as a whole are of the order of Rs. 89.38 billion. In per hectare terms, the economic loss due to land degradation in the country is Rs 1521 at current prices and Rs 476 at constant prices.

For the country as a whole, the overall losses at current prices and under current degradation rates are around 12 per cent of the total value product. The proportion of losses to total value product of the states vary between 10 to 27 per cent. The magnitudes of economic losses are quite severe in the States of Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Madhya Pradesh, Rajasthan, Tamil Nadu and West Bengal. These States together account for nearly 73 per cent of the total losses in the country due to land degradation.

Economic losses were also computed under alternative scenarios of 10 per cent

Table 4. Economic losses due to land degradation in India and its States.

States	*Degraded land area (000' ha)	At current prices (1995-97)		At constant prices (1979-82)		Losses as percent to total value productivity
		Total losses (Rs. billion)	Per ha. losses (Rs. /ha)	Total losses (Rs. Billion)	Per ha. losses (Rs. /ha)	
Andhra Pradesh	15662	43.10	2752	13.25	846	20
Assam	2807	9.31	3318	2.61	929	25
Bihar	6291	10.22	1625	3.04	483	14
Gujarat	10336	31.99	3095	10.63	1028	22
Himachal Pradesh	3008	10.19	3388	3.28	1090	27
Haryana	1384	5.248	3783	1.79	1295	15
Jammu & Kashmir	2225	4.86	2186	1.57	706	17
Karnataka	7681	13.59	1770	4.32	563	18
Kerala	2608	4.09	1568	0.94	360	24
Maharashtra	13328	18.92	1419	6.04	453	22
Madhya Pradesh	26209	33.37	1273	11.01	420	20
Orissa	6121	9.26	1513	2.71	443	19
Rajasthan	13586	17.60	1295	6.22	458	17
Tamil Nadu	5273	14.79	2805	4.54	862	21
Uttar Pradesh	15253	33.66	2207	10.43	684	13
West Bengal	2752	8.48	3081	2.20	800	10
Punjab	896	4.84	5401	1.71	1907	19
All India**	**187700**	**285.51**	**1521**	**89.38**	**476**	**12**

* NBSS & LUP (ICAR), Nagpur, (2000)

** Based on latest estimate by Sehgal and Abrol, (1994)

Economic implication of land degradation

Table 5. Economic losses due to land degradation in India under alternative scenarios

State	At current prices (Rs billion)			At constant prices (Rs billion)		
	Current Scenario	*Scenario I	**Scenario II	Current Scenario	*Scenario I	**Scenario II
Andhra Pradesh	43.1	47.41	38.79	13.25	14.58	11.93
Assam	9.31	10.24	8.38	2.61	2.87	2.35
Bihar	10.22	11.24	9.2	3.03	3.34	2.73
Gujarat	31.99	35.19	28.79	10.63	11.69	9.56
Haryana	5.24	5.76	4.71	1.79	1.97	1.61
Himachal Pradesh	10.19	11.21	9.17	3.28	3.6	2.95
Jammu & Kashmir	4.86	5.35	4.38	1.57	1.73	1.41
Karnataka	13.59	14.95	12.23	4.32	4.76	3.89
Kerala	4.09	4.5	3.68	0.94	1.03	0.84
Madhya Pradesh	33.37	36.7	30.03	11.01	12.11	9.91
Maharashtra	18.92	20.81	17.02	6.04	6.64	5.43
Orissa	9.26	10.19	8.34	2.71	2.98	2.44
Punjab	5.76	6.34	5.19	1.91	2.1	1.72
Rajasthan	17.6	19.36	15.85	6.22	6.84	5.6
Tamil Nadu	14.79	16.23	13.31	4.54	5	4.09
Uttar Pradesh	33.66	37.02	30.29	10.43	11.48	9.39
West Bengal	8.48	9.33	7.63	2.2	2.42	1.98
India	285.51	314.06	256.96	89.38	98.31	80.44

*Scenario I : Higher economic losses by 10% due to anticipated growth in agriculture and farm harvest prices
** Scenario II : Lower economic losses by 10% due to anticipated reclamation of degraded land

higher degradation extent (Scenario I) and 10 per cent lower extent of degradation (Scenario II). Under Scenario I, the total economic losses in the country are estimated at nearly Rs. 314.06 billion, whereas under Scenario II, the economic losses reduced to approximately Rs. 256.96 billion at current prices (Table 5). The corresponding estimates under the two alternative scenarios at constant prices are approximately Rs. 98.31 billion and Rs. 80.44 billion, respectively.

Conclusion

Of the 17 States included in the study, 15 States had over one-third of area degraded due to one or more of the causal factors. Translated in terms of economic losses, the country looses Rs.285.51 billion at current prices and Rs.89.38 billion at 1979-82 prices. Although these estimates are based on reconciled figures of degraded land, alternative scenarios with 10 per cent higher degradation and 10 per cent lower degradation. At current prices, the corresponding economic losses under these two scenarios work out to Rs. 314.06 and Rs. 256.96 billion, respectively, while at 1980-82 prices the losses are of the order of Rs. 98.31 and Rs. 80.44 billion, respectively. The economic losses at current estimates of degraded land are around 12 per cent of the total value of agricultural output in the country. The economic losses range between 10 to 27 per cent of the value of agricultural output in the states. Differences in the severity of degradation of land due to different causal factors and the cropping

pattern in the district account for the variation in the magnitude of economic losses between States.

The alarming rate of degradation associated with high economic loss call for suitable policies relating to the use of water and other purchased inputs in agriculture. Inclusion of agro-forestry, agro horticulture *etc.* would be the better proposition. At the same time, concerted and well-focused reclamation measures, must be implemented to conserve land and there by to reduce the economic losses and ensure sustainability of Indian agriculture.

References

Sehgal, J.L. and Abrol, I.P. (1994). Soil Degradation in India- Status and Impact. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi

NBSS & LUP. (2000). Report on Soil Degradation Status of Punjab State. National Bureau of Soil Survey and Land Use Planning, Regional Centre, New Delhi

Sehgal, J. L., Sharma P. K., Sidhu G. S. and Abrol I. P. (1986). Land degradation and land use changes in irrigated areas of Punjab, India. Trans. XIII Intern. Soc. Soil Science Congress, Hamburg, West Germany.

Singh, S.P., Walia., C.S., Dhankar, R.P. (2000). Land Resource Base of the Northern Region. Symposium on perspectives and policies for land use planning. National Bureau of Soil Survey and Land Use Planning, Nagpur, India. p.12-19