Farmers' Perception of Land Degradation

A Case Study

P K Joshi
S P Wani
V K Chopde
J Foster

Top soil erosion is a serious problem threatening the sustainability of rainfed agriculture in the semi-arid tropics. Yet, farmers do not take strong measures to prevent soil loss. This study, covering farmers in a watershed in Yavatmal district of Maharashtra, attempts to assess farmers' perception of land degradation and examine their actions to alleviate its perceived effects.

LAND degradation of various forms is causing serious threat to present and future agricultural growth and sustainability. Among the most serious problems that ostensibly threatening the sustainability of rainfed agriculture in the semi-arid tropics is the top soil erosion. Rainfed agriculture is already constrained by water and nutrient stress, and any soil loss further aggravates the problem which adversely affects agricultural production. It was estimated that six billion tons of soils are eroded from India's crop land each year [Narayana and Babu 1983]. On the basis of these estimates it is assessed that about 60 per cent of the crop land in the country is eroding at varying degree. Although soil erosion is a physical process, it has numerous economic consequences, affecting productivity, growth, income distribution, food sufficiency and long-term external debts [Brown 1984]. Though land degradation due to soil loss is unfolding gradually, farmers do not take strong measures to prevent the process of soil loss. Kerr and Sanghi (1992) observed that farmers do not practise recommended measures to halt the process of soil erosion. There may be several factors influencing the adoption of recommended practices to control soil erosion. Among others, the most important is the perception of farmers about soil erosion and other forms of land degradation. The information in this area is lacking to develop suitable strategies and/or technologies. It is important to understand farmers' perception on land degradation to integrate technologies on land degradation and government programmes in affected areas to prevent further degradation. This study is an attempt in this direction. More specifically, the objectives of the study are to assess farmers' perception on land degradation and examine their actions to alleviate its perceived effects.

The results of the study are based on the rapid rural appraisal conducted with the farmers located in one watershed in Yavatmal district of Maharashtra state in western part of India. Multi-stage stratified sampling scheme was used to select the study area. At the first stage, one district (Yavatmal in Maharashtra) which was severely affected due to land degradation was selected in the vertisol area. In second stage, a watershed (Manji-Karanji) was selected on the basis of following criteria: (i) covers fairly large area under land degradation, (ii) represents all levels of degradation, and (iii) no (or least) government (or non-government) intervention to develop the watershed. The watershed was then divided into three strata on the basis of upper, middle and lower reaches which was decided on the basis of its slope. Four villages, two from upper reaches (Bhuripod and Mungrda), and one each from middle (Dhoki-wai) and lower (Pimpalpur) reaches were randomly selected. At final stage, group meetings were organised with the participation of majority of the farmers in 1995.

Soil of the selected district were completely covered by coarse shallow soils except for thin ribbons of deep black soils in the river valleys. In the watershed, both coarse shallow and more productive soils were observed. There was variation down the watershed. At the top, grading into forest areas with steep slopes, there was rocky soil with almost no water holding capacity. Lower down, some flatter areas begin to have deeper and more productive soils although these areas continue to be interspersed with areas of coarse, shallow and unproductive soils. As one moves down the watershed, the better soils become more common and deeper, until, near the bottom, areas of coarse, shallow soils disappear and the soil is black and appears to be deep. Although these lower soils have all the cultivation problems of deep vertisols, they also have the moisture retention and other production advantages of these soils.

The study area can be characterised as kharif dominated agriculture with almost 75 per cent area under cotton and sorghum. Cotton is a commercial crop while sorghum is used for home consumption and for livestock fodder. The cotton is commonly intercropped with pigeonpea. In addition to pigeonpea, groundnut and chickpea are legumes grown in significant amounts.

Trends show that cotton with pigeonpea was expanding in area while sorghum was declining. Chickpea, which was often double cropped after rainfed paddy, was increasing while groundnut appeared to be declining. Soyabean was tried by numerous farmers and appeared to be expanding at an increasing rate.

The following sections present the results of the group discussions with the farmers in different locations of the watershed. It is divided into three parts: (i) farmers' perceptions on land degradation, (ii) resource allocation in different levels of degraded lands, and (iii) farmers strategies and investment priorities to manage degraded lands.

Farmers' Perception on Land Degradation

Different forms of land degradation were observed in the selected watershed. These were soil erosion, soil nutrient loss, soil salinity and waterlogging. A wide spatial variability in different forms of land degradation was noted within the watershed. Farmers do identify land as good and poor on the basis of crop yields.

In the three upper villages, the poor land is located at higher elevation within the village. In the lower village, low productivity land is found in two general locations: (i) where the land is sloping, the upper reaches are less productive because of erosion, and (ii) where the land is more flat, the lower areas are less productive because of waterlogging and salt accumulation.

Reported yields for the two major crops are given in Table 1. The ratio of yields from good and poor soils is approximately 3:1. In all villages, except one in upper reaches (Bhurkipod), yields were highest at the lowest elevation. Degradation and productivity relationships in the watershed are illustrated in the Figure. Average productivity declines as one moves up the watershed. At each specific elevation, there is a range of productivities from relatively good to relatively poor soil. Note that poor soil at the lowest level may be more productive than good soil at the highest level.

The reasons given by majority of the farmers in all villages for low productivity were similar. The low water holding capacity of the shallow soil at upper levels results in poor crop emergence and requires the crop to depend on undependable frequent rains throughout the growing season. In two villages located in the upper reaches of the watershed, soil erosion was specifically mentioned as the cause of the shallow soil, including the information that erosion removes smaller soil particles. It was observed that in the upper reaches of the watershed, geologic erosion was the major causative factor than man-induced erosion. In the other two villages, the greater depth of soil at lower elevations was mentioned.

Land Degradation and Resource Allocation

Cropping pattern: Cropping patterns were almost similar in all the selected four villages (Table 2). A clear difference between good and poor soils reflect differences in optimum uses of the two types of soils. The general pattern on good soil includes hybrid varieties of cotton and sorghum along with intercropped pigeonpea. Cotton and sorghum tend to be the high input crops. On poorer soil, farmers plant local varieties of cotton plus pigeonpea and sorghum with low inputs and on the worst land, short duration green gram and black gram. A few other minor crops are grown on the poorer land.

Input use: Except for two inputs, more inputs are used on good land than on poor land (Table 3). The exceptions are tillage when farmers make more passes on poor land to try to loosen the soil to a greater depth and cotton seed when farmers use small amounts of expensive hybrid seed on good land and substantially higher seed rates of local varieties on poor land. It was reported that the hybrid seed on good soil produces vigorous plants which fill the space with a low seeding rate while on poor soils more smaller plants are needed to fill the space.

In addition, the risk of crop failure is higher on poor, shallow soil. Farmers are reluctant to risk loss of their expensive hybrid seed. The use of FYM as one moves down the slope is instructive. In the topmost village, FYM is never used on poor soil. Next, it is used on poor soil only when farmers have no good soil and at the bottom, it is used on both good and poor soils depending to the crop. The poor soils at the bottom are, of course, more fertile than the poor soil at the top. In two villages located in lower part of the watershed, some farmers are using Rhizobium, Azotobacter and Vermicomposting.

Input levels seem similar from village to village for similar soils except for differences in the number of pesticide sprays on cotton. In all villages, the number of sprays has increased over the last decade or two from none to one when needed to 2-3 per year and on to present levels.

Nutrient mining: Farmers in all villages were aware of and in agreement that their current cotton/sorghum cropping system was mining soil nutrients because both are strong feeders on soil nutrients. The legumes, grown on less than 15 per cent of the crop land, are insufficient for maintaining soil nitrogen levels. In the recent past, fertiliser use is

Table 1: Range of Comparative Crop Yields for Cotton and Sorghum in Four Villages in Mangi-Karanji Watershed, Yavatmal District, Maharashtra, India 1994-95

Village	Location in Watershed	Cotton (q/ha)		Sorghum (q/ha)	
		Good Soil	Poor Soil	Good Soil	Poor Soil
Bhurkipod	Upper	15-20	–	17-20	5-10
Mangurda	Upper	10	3-4	25-37	8-10
Dhoki-wai	Middle	10	5-6	10-25	6
Pimpalpur	Lower	10-12	4-5	37-40	13-15

Table 2: Cropping Patterns by Soil Productivity Levels in Four Villages in Mangi-Karanji Watershed, Yavatmal District, Maharashtra, India, 1994-95

Village	Crops on Good Soil	Crops on Poor Soil
Bhurkipod	Hybrid sorghum, hybrid cotton, pigeonpea, pearlmillet, some black gram and green gram	Local sorghum, blackgram green gram
Mangurda	Hybrid cotton, hybrid sorghum, pigeonpea	Local cotton, green gram, black gram, pearlmillet and sesamum
Dhoki-wai	Hybrid cotton, hybrid sorghum, pigeonpea	Green gram, black gram, pigeonpea
Pimpalpur	Hybrid cotton, hybrid sorghum, pigeonpea, soyabean	Greem gram, black gram, sesamum, mothbean, local sorghum (for rotation purposes)

Note: In Pimpalpur, low lying soil is used for kharif paddy with rabi chickpea, coriander and linseed and irrigated land is used for wheat and sorghum.

Table 3 Production Input Levels on Good and Poor Land in Four Villages in Mangi-Karanji Watershed, Yavatmal District, Maharashtra, India, 1994-95

Village	Input	Good Land	Poor Land
Bhurkipod	Tillage	Normal tillage	More passes to loosen soil
	FYM[a]	5 cartloads/ha	None
	Fertiliser[b, d]	125 kg/ha	50 kg/ha
	Seed	Cotton improved and hybrids	Cotton local and improved
	Pesticide[c]	2-4 sprays on cotton	
Mangurda	Tillage	Normal tillage	Requires more tillage
	FYM[e]	All	See note e
	Fertiliser	125-187 kg/ha of mixed fertiliser (18:18:10) plus 125 kg/ha of urea (cotton)	None
	Seed	Cotton:1.8 kg/ha	Cotton:7.5 kg/ha
	Pesticide	Cotton (improved): 8-12 sprays	Cotton (local): 1-2 sprays if time permits
Dhoki-wai	Tillage[f]	Less tillage: more tillage cause waterlogging	
	FYM	10-12 cartloads/ha	usually none
	Fertiliser	250 kgs/ha mixed (18:18:10)	125 kgs/ha mixed
	Seed	Cotton (improved): 1.8 kg/ha	Cotton (local) 7.5 kg/ha
	Pesticide	No information	No information
Pimpalpur	Tillage	Normal tillage	Next to good lands
	FYM[g]	Mostly applied on cotton; some on sorghum	Application based on crop rather than soil
	Fertiliser	Cotton: 125-250 kg/ha mixed (18:18:10); 125-250 kg urea/ha	60 kg mixed (18x18x10) fertiliser/ha (murram soil)
	Seed[h]	Cotton improved and hybrid sorghum	Improved cotton and hybrid sorghum with black gram and green gram
	Pesticide	8-9 sprays (cotton)	

Notes: Bhorkipod: a – Not all farmers have animals to produce FYM.
b – Mixed fertiliser is 18-18-10 of nutrient content (cotton and hybrid sorghum receives the mixed fertiliser). Some farmers use no fertiliser
c – Number of sprays is increasing over time.
d – They use more fertiliser in good soil because of confidence they will get a good response with lower risk.
Mangurda: e – Farmers with no good land put FYM on poor land at the top of the slope, expecting rain water to move the FYM down the slope within their own field.
Dhoki-wai: f – Resources are first allocated to good soil.
Pimpalpur: g – Animal dung is not burned for fuel. Mostly converted to FYM.
h – Farmers are using very expensive private hybrid seed on their good land.

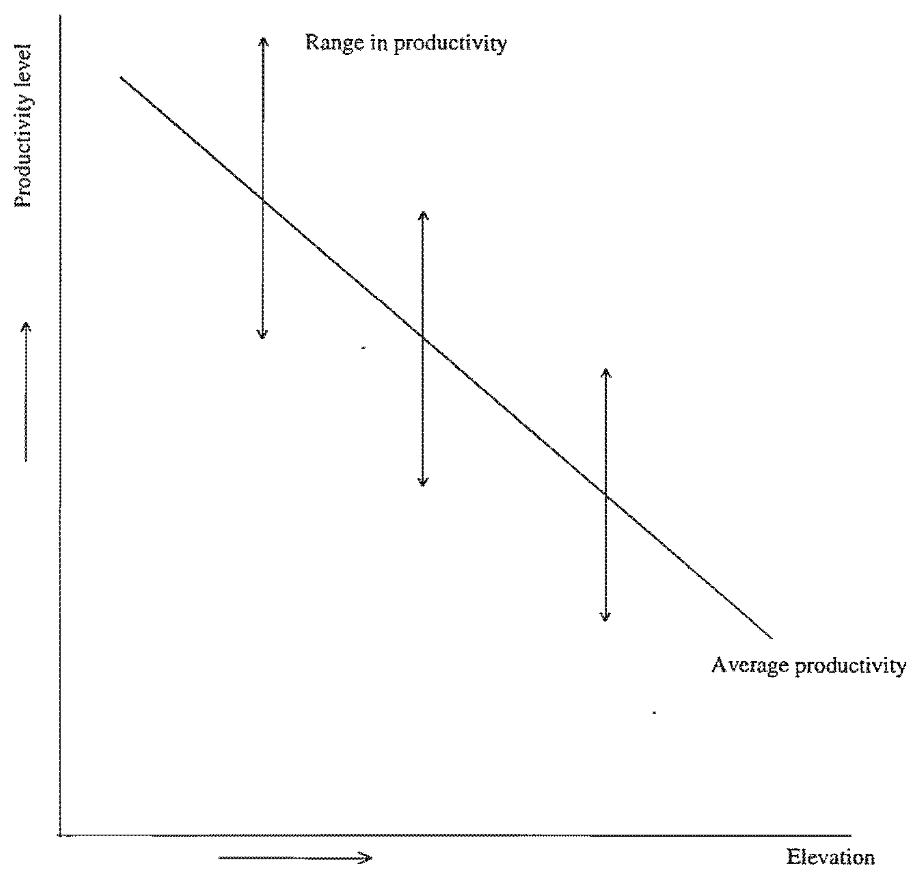
expanding. Farmers avoid sorghum after sorghum in the rotation because they have learned that this system will give a poor crop in the second year. Farmers were aware that the application of fertiliser and FYM needed to be increased from year to year to sustain crop yields. They believe that a constant level of inputs and management over time would result in declining yields, a reasonable expectation in view of the dominance of cotton and sorghum. This trend, however, is masked by increasing levels of input and the availability of new technology, especially improved seeds, with the result that yields stay fairly constant. One can assume that low input levels on poor soils serve to sustain low yields while higher input level on good soil serve to sustain higher yields.

There was no change observed in the use of low productivity land over the past two decades. No land has moved out of crop production. However, farmers were of the opinion that land must receive increasing levels of input and new technology in order to stay in production at acceptable levels.

Crop land value: The market value of crop land is an excellent summary of farmers' expectations, generally based on past experience, of the returns from owning land. The myriad and complex factors involved in price making such as expected future money returns, the prestige and security of land ownership, the inflation hedge opportunities and many others as well as the relative importance of each are neatly packaged in the market price. Changes in market prices over time can reveal even more about what is happening inside the heads of farmers relative to their understanding of future opportunities. With many factors such as the prestige of owning land remaining somewhat constant over time, price changes tend to be more fully related to perceptions of economic opportunity.

The first observation relates to general increases in crop land values in the selected watershed in the last five years (Table 4). Both good land and poor land has sharply increased in value in this period in all four villages. Surely inflation is a major factor in this rise but other factors such as increases in expected net income from farming (technology change, input/output price ratio changes) and changing desires of farmers to own land may also be involved.

FIGURE 1: AVERAGE PRODUCTIVITY RELATED TO ELEVATION IN A WATERSHED AND PRODUCTIVITY RANGES AT SPECIFIC ELEVATIONS



Second, one can note that current prices are related to location on the watershed although prices in Dhoki-wai do not fit this pattern. There are reasons to think that information on this aspect in Dhoki is inaccurate. Otherwise, prices increase as one moves down the watershed, indicating that the productivity of all types of crop land increases from higher to lower. For instance, poor land at lower levels is more than double in value compared with poor land at the top of the watershed.

Of greater relevance to this study is the differential changes in market value over time. The opportunities for future intensification, increased investment, increased productivity and increased net returns are clearly viewed as higher on the good land than on the poor land at all levels in the watershed. The degraded land is seen as not only less productive of net income in the present but also as providing less opportunity to benefit from future technological opportunities than the good land. This is indicated by the differing per cent increase in value over five years between the good and poor land. It is also indicated by the increasing percentage change in value of the good land as one moves down the watershed where the opportunities for intensification are perceived to be highest and increasing fastest on the good land at the bottom of the watershed. The same relationship holds for poor land.

It can be illustrated, as shown in Table 5 by taking Kharif sorghum in the selected region as an example. It is seen that the highest rates of growth in yield are found

TABLE 4: MARKET PRICES OF CROP LAND WITH VARIOUS LEVELS OF PRODUCTIVITY, FOUR VILLAGES IN MANGI-KARANJI WATERSHED, YAVATMAL DISTRICT, MAHARASHTRA, 1995

Village	Location in Watershed	Type of Land	Market Price (Rs/Ha) 1995	Market Price (Rs/Ha) 1990	Per Cent Change in Five Years
Bhurkipod	Upper-upper	Good	12,500-17,500	7,500	100
		Poor	5000	3,100	61
Mangurda	Upper	Good	25,000-30,000	15,000	83
		Poor	10,000-12,500	7,500	50
Dhoki -wai	Middle	Good	20,000	7,500-10,000	129
		Medium	12,500-17,500	–	–
		Poor	10,000	6,300	59
Pimpalpur	Lower	Good	37,500	12,500	200
		Medium	20,000-22,500	7,500-12,500	113
		Poor	10,000-12,500	no demand	–

TABLE 5: RELATIONSHIP BETWEEN YIELD AND RATE OF GROWTH IN YIELD OF KHARIF SORGHUM IN SELECTED PRODUCTION SYSTEM

District Average Yield, 1988-90 (Kg/ha)	Number of Districts	Annual Growth Rates in Yield 1970-90 (Per Cent)
Above 1000	10	6.0
800-1000	3	4.4
Below 800	9	–0.2

in districts with the highest yields In a competitive sense, districts with lower yields gradually fall further and further behind in the market place

In summary, the future for owners of good land in a village is perceived to be increasingly brighter than for owners of poor land in the same village At the same time, the future is increasingly brighter for good land at the bottom of the watershed than for good land at the top and with the same relationship for poor land Probably farmers do not yet realise it but experience in other countries points to poor land at upper levels (the poorest land on the watershed) moving out of production entirely after a few years because of its inability to keep up with intensification of production on better land

Another way of making the same point is to observe that the most expensive land in the watershed is the best investment and the lowest priced land is the worst investment in a dynamic agriculture such as that of Yavatmal district From a purely net returns point of view, a smart move for a farmer owning poor land would be to sell his poor land and use the money to buy fewer acres of good land (as long as only a very few farmers recognise this opportunity) The farmers of Mangi-Karangi watershed clearly understand these forces as shown by the way they are pricing their land of differing productivity

Farmers' Strategies and Investment Priorities

Soil and water conservation practices Each of the villages is somewhat unique in the use of soil and water conservation practices In Bhurkipod, the government has recently completed few field bunds, small tank bunds, gully bunds and 'Khas' grass bunds The bunds have been constructed with hired labour, mostly from the village Thus the farmers are well aware of conservation and its benefits (at least in the form of daily wages) Farmers indicated that they also have made some bunds on their own, using family labour They use rocks, cotton stalks. and thorns to avoid theft or as fences in gullies They are also sowing across the slope, thanks to the government training and visit programme

In Mangurda, located in upper reach of the watershed, farmers have received no government help for soil and water conservation activities They also have built conservation works on their own, including small stone bunds, with cotton stalks, and weeds to plug spaces between stones and waste weirs They recognise the value of stone bunds in creating deposits of soil They also are sowing across slopes, perhaps as a result of the training and visit programme

In Dhoki-wai village, the government has helped establish contour vegetative barriers of 'Khas' grass in 2 or 3 fields It was observed that one of these which seemed to be in fine condition, the farmer was genuinely enthusiastic Otherwise in this village, farmers have built gully bunds with stone, cotton stalks, and thorns on their own, using family labour as it is available

In Pimpalpur village, located in the lower reaches of the watershed, farmers have been building stone and earthen bunds for the last 30-35 years with no government or NGO involvement They not only build them but keep them in repair for the clear purpose of controlling soil erosion They do not depend on family labour but hire labour at the current rate of Rs 25 per 3 metres of a 30 cm X 30 cm bund The general attitude in this village of gently sloping to flat land is summed up in the answer to the questions "Is it good for soil from someone else's land to deposit behind your bund?" The answer was, "It would be good but it would never be allowed to happen in this village" They reported that erosion occurs even on relatively flat land

Farmers are well aware of where deposited soil comes from and are particularly sad when it completely leaves the field However, deposited soil is considered desirable, especially when it flows from others' fields Soil eroded from a degraded area and deposited was said to become the best from the worst Deposited soil is universally viewed as a superior soil in terms of both fertility and workability In one village, farmers stated that where the yield is one quintal from eroded soil, the yield on deposited soil from the eroded area would be 3-6 quintals

Priority on soil and water conservation investment The issue of farmers' priority on investment in soil conservation measure was meant to provide insight into the validity of an hypothesis that farmers can and do put off expenditures on soil and water conservation 'till next year' since degradation is a slow process and the situation will be only marginally worse next year It was noted that farmers' investment priorities are within agriculture and not in household improvement The investment priorities given in order are bullocks, fertiliser, improved seed, an electric pump, and then at the end land protection The general attitude (excluding Pimpalpur farmers) about land protection was summed up by, "we do what we can with family labour and if more is needed, we cannot do it" Farmers in all villages confirmed that the land degradation was a slow process with not much happening in any one year

The perceptions of farmers concerning land degradation in Mangi-Karanji watershed were labelled as high awareness Not only were they aware of both gully and sheet erosion, even on nearly flat land, but they also were aware of nutrient mining and other kinds of degradation like salt accumulation and soil organism decline (earthworms)

In this dynamic agriculture, farmers clearly see the difference in future opportunity for intensification and income generation between different types of soil degradation Degraded land can usually gain little benefit from new technology (farmers use local varieties on poor land) but new technology used on good land can increase net returns (farmers use hybrid varieties on good land) Government intervention is essential to prevent the process of degradation where farmers are unable to invest on available measures alleviating land degradation

Degradation other than erosion also seems to be well understood by farmers Their cropping system, dominated by cotton and sorghum is a nutrient mining system In all villages, it was noted that although yields were stable over time, these were maintained only by use of increasing levels of mineral fertilisers

Investment priority on land degradation alleviation was always at the end of the list In highly and moderately degraded villages, farmers action to alleviate degradation processes is through family labour They do not invest to prevent or rehabilitate degraded lands In the prosperous village with limited degradation, farmers hire labour and also invest for building conservation bunds

Farmers' actions include building gully bunds with rock, cotton stalks and thorns, some boundary bunds, establishing vegetative bunds, sometimes on the contour, and cultivation across the slope To cope with nutrient mining, carefully developed rotations are used, including intercropping of cotton with pigeonpea

Some of the most significant information obtained by the appraisal identifies relationship between severity of land degradation and several socio-economic characteristics General economic prosperity, position on the subsistence – commercial continuum and education levels are all related to the productivity of the basic land resource To maximise effectiveness, degradation policies and programmes, as well as general rural development efforts, should recognise and respond to the severity of land degradation

[This paper is derived from the ISP 3 Progress Report No 1 on 'Farmers' Perception of Land Degradation Rapid Rural Appraisal in Mangi-Karanji Watershed of Yavatmal District, Maharashtra, India', at the International Crops Research Institute for the Semi Arid Tropics (ICRISAT), Patancheru in August 1995 The authors are grateful to S M Virmani K K Lee T G Rego, N K Awadhwal Anil R Bonde and D C Upare for their help at various stages to conduct this study]

References

Brown, Lester R (1984) 'Conserving Soils' in Lester R Brown et al (eds), *State of the World* W W Norton and Company, New York

Kerr, J M and V Sanghi (1992) *Indigenous Soil and Water Conservation in India's Semi Arid Tropics*, Gatekeepers Series No 34, International Institute of Environment and Development, London

Narayana, V V Dhruva and Ram Babu (1983) 'Estimation of Soil Erosion in India' *Journal of Irrigation and Drainage Engineering*, ASCE, 109(4), pp 419-33